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THE THOMSON-HOUSTON ROAD IN BANGOR, ME.

THE accompanying cuts illustrate the new electric railway which has been put in at Bangor, Me. One of the cuts shows the car on Main Street Hill, opposite the Opera House, a grade of 7 per cent; and the other, the car in West Market Square, the very heart of the city. The road at Bangor is three miles in length, single track, with three turnouts, and contains many sharp curves and grades, the most severe of which is a curve of 35 feet radius, which occurs on a grade of 7 per cent. There is one stretch of the road, about

The power-plant consists of one 80-horse-power Thomson-Houston generator, with the necessary station-fittings, which is driven by a 14 by 13 Armington & Sims engine, running at a speed of 250 revolutions per minute. This is the only tramway which has ever been constructed in Bangor, and it has, from the very start, given the utmost satisfaction, but one schedule trip being missed since the day of starting, May 21. The travel has been very heavy, averaging 1,600 passengers per day, and on one day 3,000 were carried by three cars. The success of the road has been such, that extensions have been asked for in many parts of



THOMSON-HOUSTON ELECTRIC ROAD IN BANGOR, ME.

three-fourths of a mile in length, which has five curves and an average gradient of 5 per cent. No difficulty, however, is experienced here, and the cars climb these grades with a scarcely perceptible diminution of speed. The nature of the overhead work necessitated by these can readily be seen from the accompanying map, on which the situation of the road is indicated by a heavy line.

There are four 16-foot cars, made by the Newburyport Car Manufacturing Company, which are handsomely finished, and equipped with two 15-horse-power Thomson Houston motors. Three cars are in operation from 6 A.M. till 11.30 P.M., the fourth being held in reserve for special occasions.

the city, and it is probable that before long the equipment will be greatly increased.

THE USE OF OIL ABOARD UNITED STATES NAVAL VESSELS.

MANY hundreds of reports have been published on the "Atlantic Pilot Chart," and elsewhere, relative to the great benefits derived by means of the use of oil to prevent heavy seas from breaking on board vessels. By far the greater number of these reports have been received from merchant vessels, very many of which have undoubtedly been saved, with all on board, by the use

few gallons of oil in the manner recommended by the United States Hydrographic Office. The following reports from United States naval vessels show that even aboard men-of-war, with their complete equipment and large crews, the use of oil is regarded as of the greatest value:—

Commander W. C. Wise, U.S.N., commanding the "Junjata," on passage from Hong-Kong to Singapore, used oil on three occasions during a typhoon in the China Sea, Sept. 28 and 29, 1888. "Oil was used, and marked effect shown in lessening amount of water coming on board. . . . A bag containing oil was towed from the weather bow, and decreased the violence of the seas to a marked degree."

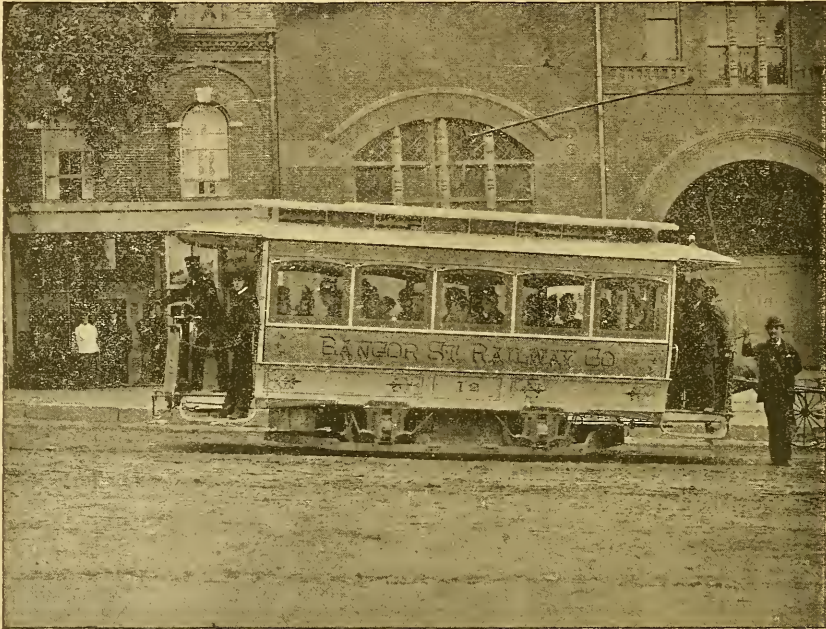
On April 4 and 5, 1889, the "Swatara," Commander John McGowan, U.S.N., was in a hurricane in latitude 41° south, longitude 9° west. On the previous day the wind had veered from west-south-west to north-west, and then to north-north-east. From 9 P.M. to 4 A.M. it blew with a force of 11, and the wind shifted to

from coming on board. Oil was used a part of two days, while hove to.

Finally, the "Yantic," Commander C. H. Rockwell, U.S.N., encountered a terrific hurricane, May 21, in latitude 38° 35' north, longitude 68° 30' west. While on her beam ends, with heavy sea sweeping over her, "oil in large quantities was thrown overboard from the weather bow, and even in that terrible scene its effect was immediately apparent."

A HISTORY OF HABITATIONS.

The French have always exhibited a fondness for the study of comparative architecture, and have made themselves masters of a peculiarly interesting portion of art history in which other peoples have scarcely made more than beginnings. For some years the story of the evolution of the dwelling has been known chiefly through "The Story of a House," by M. Viollet-le-Duc, which has



A 7-PER-CENT GRADE ON THE THOMSON-HOUSTON ROAD IN BANGOR, ME.

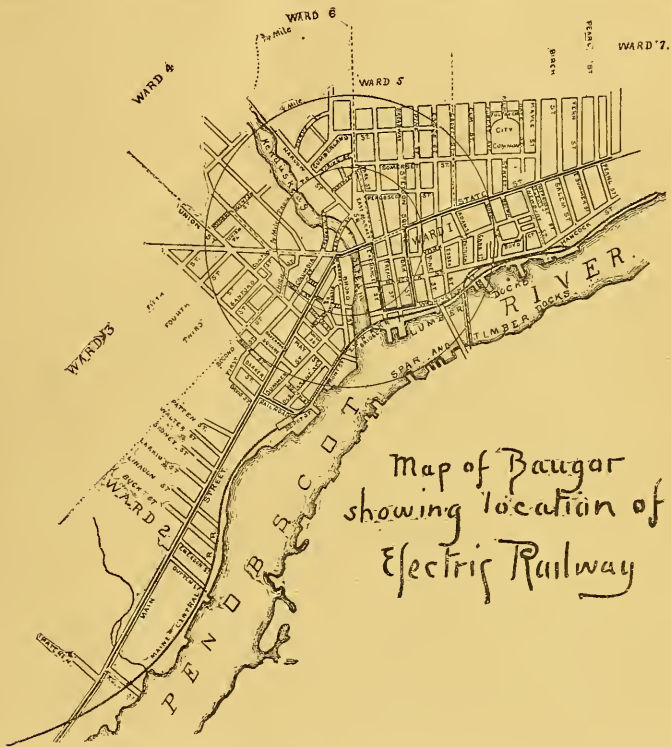
west, kicking up an ugly confused sea. The ship had been hove to on the port tack early in the morning, with oil-bags over at the fore and mizzen chains. Their effect was such that not a drop of water came on board. April 5, scudding with the wind about two points on the starboard quarter and an oil-bag towing at the starboard fore-chains, "the angry-looking crests simply disappeared, leaving one to wonder what had become of them." Again, on the 8th, "Blowing a living gale of wind, force 11, having backed from north-west to north-north-west. Hove to, and put oil-bags over from fore and mizzen chains, with excellent results. The sea was exceedingly heavy, and the ship rolled deeply; and although considerable water came on board, yet not once did a sea break over the rail. The angry, towering crests of the huge waves disappeared by magic."

Commander C. F. Norton, U.S.N., of the "Kearsarge," reports that in the morning of the 6th, 7th, and 8th of April, off Hatteras, they used oil in the same manner, with marked effect, pouring it through the forward water-closet. "The oil was used, which did fairly well; but later they found that gave perfect satisfaction, keeping the water

been the most accessible, if not the only, work of its kind extant. In the Paris Exhibition of 1878, one of the most interesting features was the "Street of Nations," which was lined with typical specimens of architecture of all lands, and was unquestionably the most complete exhibition of comparative architecture that had been made up to that time. The present exhibition, however, has, thanks to the rare skill and energy of M. Charles Garnier and a body of enthusiastic assistants, an exhibition of comparative architecture that is by far the most elaborate yet attempted. A series of thirty-two edifices have been erected on the Quai d'Orsay, representing the evolution of the dwelling, from the earliest form of a rude breakwind and cave, to the completed residence of the Renaissance. It is an unfortunate fact that much of the material for such a display exists only in a fragmentary or much-scattered form. The dwellings of antiquity are known to us chiefly by meagre descriptions, rough, sketchy carvings in the sculptures, and other data that are quite as apt to mislead as to indicate the right direction. Yet M. Garnier has not been content to accept mere hearsay, nor even to adopt the results of the imagination, but, on the contrary, has

availed himself of all possible authorities, and as the result has prepared a series of dwellings, which, if not authentic in all their details, are still sufficiently correct to be accepted as the best obtainable, and which are certainly nearer the originals than has been reached by any previous attempts. In designing these edifices, the idea has been to exhibit the actual dwellings of the masses of the people rather than to represent the palaces of the rich and the powerful; and the rule has also been laid down, to represent the most ancient form, where there has been any great deviation in styles, because the more modern variations are more familiar, and have been more frequently reproduced. Both these limitations, admirable in themselves, have added to the difficulty of the task M. Garnier laid out for himself; for the houses of the rich are more frequently described by ancient writers than those of the poor, and

Gauls, Greeks, and Romans. In 395 A.D. the Roman Empire was divided, and the two parts exhibit distinct features of architectural types. In the West the Roman civilization was overthrown by several invasions, all resulting in distinct architectural types. These were the Huns, the Germans and Franks, and, last in point of date, the Scandinavians. After Europe had passed through the convulsions caused by these inroads, we have the civilizations of the Romanesque period, the middle ages, and the Renaissance. In the East other events were shaping the destinies of humanity. The Roman civilization lasted here some ten centuries; but it soon lost its earlier characteristics, and developed into the Byzantine. This was further developed in the Byzantine architecture of the Slavs and the Russians, while the Mohammedan invasions of the Arabs and the Turks soon destroyed its distinctive character. All



the descriptions of the more ancient forms are necessarily less readily interpreted than those near at hand.

M. Garnier has divided habitations into two great classes, — those of prehistoric time, and those of historic. The former period begins with the appearance of man upon the earth, and comes down to the time when nations, properly so called, were formed, and history begins. The historic period includes two subdivisions: the first relating to those peoples who have contributed to the advancement of civilization; and the second including those who, while leaving characteristic monuments, have stood, as it were, on one side, and not influenced the general growth of culture. The models at Paris are arranged in three great groups under these general heads; but, apart from this classification, there is another, which, while not especially observable in the arrangements of the edifices themselves, is of the highest historical importance. The historic period includes, first, early or primitive civilizations, including the Egyptian, Assyrian, Phœnician, Hebrew, Pelagic, and Etruscan; and, second, the civilizations arising from the Aryan invasions, including the Indians, Persians, Germans,

these developments have been admirably summarized by M. Garnier in the "Guide Historique" of M. Ammann, to the exhibition of dwellings.

The structures begin with a simple breakwind. Then man found that the shelter of the caves was more durable, and finally a rude hut was attempted. Then begins the long series of artificial houses. There is a rude hut supposed to be contemporary with the dolmens. A lake-village, modelled after those of Switzerland, is the most elaborate portion of this group, and corresponds to the age of bronze. The age of iron is represented by a hut modelled after a terra-cotta model found at Lake Albino, near Rome. Then come the dwellings of historical times, beginning with an Egyptian house. This is designed in the style the monuments have familiarized us with. A corridor opens into apartments on either side; and the building, which is two stories high, is surmounted by an open balcony. The dwellings of the Assyrians were built on too great a scale to permit them to be reproduced as a whole, so M. Garnier has contented himself with a portion of one only. Two types are represented, — one a tent taken from a bas-relief pre-

served in the British Museum, and the other a part of a palace. It was not possible to secure an authentic representation of a Phœnician house, although the suggestions and opinions of the most competent critics have been followed. The result is therefore not much more than a high probability, but as such it possesses great interest. The dwelling has a stone base, with the upper part of wood, ornamented with long slender columns, and with a balcony above.

Like the Assyrians, the Hebrews have two kinds of dwellings, — one a tent, modelled after a carving in an Egyptian tomb dating from before the time of Moses; and the other a stone house, with a flat terraced roof. Here, also, there is want of authentic material, and the result cannot be regarded as more than approximate. The Pelagic hut is a simple one of large stones, while the Etruscan residence consists of a stone basement taken from an ancient terracotta model, and an upper portion of wood, with an open-roofed balcony, which is confessedly the personal fancy of the architect. The result, however, may be regarded as near the actual truth as our present knowledge permits.

This completes the first series, and we come to those peoples whose civilization has been affected by the Aryan invasions. First is the Hindoo house, — a tall, narrow affair, built after a bas-relief from the top of Sanchi, though the architect has availed himself of the criticisms of Mr. Fergusson. The Persian house comes next. It is in two parts, — one closed, intended for the women; the other, with a dome of enamelled brick, is the public part, and intended for the master himself and his friends. It is designed after information furnished by M. Dieulafoy. Then comes a German village, — rude wooden cabins, with an elevated structure on poles, which serves as a sort of observatory. Close to this is the Gaul house, — a circular hut of wood, stone, and beaten earth. The former is taken from the bas-reliefs of the column of Trajan, while the latter is taken from a host of authorities that render it probably exact. A Greek house of simple construction comes next. A projection at one side serves to accommodate strangers. The walls have, among other inscriptions, the name of the proprietor, "*Heraclès habite ici; que rien de mauvais n'y entre.*" The Roman house, which comes next, is an exact reproduction of a Pompeian villa. The plan and details of this edifice have been prepared with the greatest care.

A new element in civilization is now introduced by the invasions of the barbarians. The first represented are the Huns, who lived in a wagon, and had no regular dwelling. A Gallic-Roman house of the fifth century follows, and is built of fragments of other buildings, which gives it a very peculiar appearance. The Scandinavian house dates from the fourteenth century, and is of wood, with a granite foundation. It has been designed after the suggestions of the Swedish architect Boberg, who has made a special study of early Scandinavian dwellings. Three other buildings bring us almost to our own times. These are, first, a Romanesque house of the time of the successors of Charlemagne (tenth century); second, one of the middle ages (twelfth century), and contemporary with St. Louis; and the third, a specimen of the civil architecture of the Renaissance, a reproduction of a sixteenth-century house at Orleans.

Four other examples complete the list of the civilizations contributing to the general culture of humanity. These are a Syrian (Byzantine) house of the time of Justinian (sixth century), which is an exact copy of one restored and drawn by the Marquis de Vogüé. It is of stone, as wood was scarce in that part of Syria. A Slavic house, almost a primitive affair, comes next, and is close to the Russian house of the fifteenth century. This latter is in two parts, — one for men, and one for women, — with an external staircase. No material for an authentic dwelling of this period was to be had, but the edifice possesses characteristic features. An Arab house of the eleventh century carries us into an entirely different civilization. The building is not a representation of any standing edifice, but is a combination of authentic elements. Lastly comes a Soudanese dwelling, which, though comparatively modern, is, by reason of its very strangeness, one of the most interesting of the entire collection. This brings us to the third section of the series, those illustrating isolated civilizations. There are houses of China and Japan, huts of the Eskimo and Laplanders, a negro village

from Africa, and an Indian hut from North America. The collection is closed by houses from ancient Mexico and Peru.

BARR FERREE.

NOTABLE DERELICTS IN THE NORTH ATLANTIC.

OF the many wrecks afloat in the North Atlantic Ocean, none has as interesting a history as the Italian bark "Vincenzo Perrotta." Abandoned Sept. 18, 1837, this vessel has been represented graphically on every edition of the "Atlantic Pilot Chart" published since that time. Her wonderful drift began in about latitude 36° north, longitude 54° west; and on April 4, 1839, when last reported, she was about 60 miles north of Watling's Island, in the Bahamas. She had thus made good a distance of about 1,400 miles in a general south-west by west direction in one year six months and sixteen days. She has been reported twenty-seven times in all, and when last seen had mizzenmast and about ten feet of mainmast standing, foremast gone, end of jibboom broken off, and port anchor on bow.

On Nov. 26, 1838, the schooner "Ethel M. Davis" was capsized in a hurricane, in latitude 35° 4' north, longitude 70° 52' west. Her crew was rescued after having been adrift four days. The schooner eventually righted, and began a long voyage, unguided, in the general direction of the Gulf Stream. She was last seen June 8, 1839, in latitude 42° 36' north, longitude 57° 38' west, and at that time had about three feet freeboard in waist, forecabin and poop well above water. Her poop-house is painted white, and shows out well; mainmast gone, bowsprit and ten feet of foremast standing; general drift, about 900 miles north-east by east; time, six months eighteen days; number of times reported, fifteen.

The same hurricane that wrecked the "Ethel M. Davis" also brought disaster to the schooner "David W. Hunt." This vessel was abandoned Nov. 25, 1838, in latitude 34° 30' north, longitude 72° 30' west. She was last reported May 26, 1839, in latitude 45° 30' north, longitude 41° 30' west, at which time she had her bowsprit and jibboom complete, stumps of two masts broken off about fifteen feet from deck; general drift, east-north-east about 2,000 miles; time, six months; number of times reported, twenty-two.

The schooner "Palatka" bids fair to rival the above vessels in point of interest. She was abandoned April 10, 1839, off Hatteras, and was last reported June 4, 1839, in latitude 43° 20' north, longitude 56° 34' west. She was then water-logged and on fire, stern high out of water, no masts standing. Like the "Ethel M. Davis" and "David W. Hunt," she is right in the highway of the great bulk of transatlantic commerce, and a serious menace to navigation. In one month and twenty-five days she has made good a distance of about 1,200 miles, on a general north-east by east course; number of times reported, twenty-one.

The above four derelicts were all timber-laden, and this accounts largely for their great tenacity and buoyancy, at the same time rendering their destruction no easy matter. Commander C. H. Rockwell, U.S.N., of the United States steamship "Yantic," recently engaged in blowing up wrecks, says, "From the experience thus far gained in the work, I am convinced that lumber-laden derelicts are very tenacious, and can only be overcome by repeated blows from explosives of great power. These continued will undoubtedly do the work."

PROGRESS OF ENGINEERING.¹

THE provision of the By-Laws of this society which requires that its president shall deliver, at the annual convention, an address upon the progress of engineering during the preceding year, has been observed by my predecessors in various ways. While some of the former presidents have confined themselves strictly to the constitutional provision, by general reviews of the professional progress and scientific advancement of the period, others have dwelt more in detail upon some specific subjects of particular interest at the time. I trust I may be permitted, in this instance, to give you first a cursory glance of the field at large, and then confine myself more particularly to a review of the progress in that

¹ Address of Max J. Becker, president of the American Society of Civil Engineers, delivered at the annual convention of the society at Seabright, N.J., June 20.

special part of the profession with which the long-continued performance of my official duties has afforded me opportunities to become more familiar.

Electrical Engineering.—Of all the forces of nature, the one which has remained a hidden mystery longer than all the rest, but which of late has distanced all in the rapidity of its development, and which is certainly destined to excel them all in the extended range of its useful application, — electricity, — stands pre-eminent.

In the prosecution of subterranean or subaqueous operations, such as tunnelling, mining, sinking of caissons, the use of electric light is found to be of special benefit. In its incandescent form it is absolutely safe against the dangers from explosive gases, and in caisson work it removes the risks and inconveniences incident to the ready and rapid combustion of inflammable substances under the influence of high atmospheric pressure.

Street-Railways and Rapid Transit.—The rapid growth of our cities gradually forces the inhabitants to seek their homes in the suburbs and surrounding country, more or less distant from the business and manufacturing centres where their employment lies. The desire for economy of time, and the necessity for punctuality and prompt attendance, have led to the introduction of various modes of conveyance, beginning with the street-car tramways propelled by horses, followed more recently by elevated railroads and cable-car lines, and still more lately by the electric railroad; which latter system has, within a few years, developed much more rapidly than any of the preceding methods.

At the close of the past year there were completed and in course of construction, in this country, eighty-five electric railways, comprising about 450 miles of track, and the reports show that during the last year over eighteen millions of passengers have been carried over these lines.

The cheapness of original construction and subsequent maintenance and operation commends their adoption in smaller cities, where the older systems would be out of the question; and the practicability of their application in situations which would exclude cable-lines and horse-traction has led to their introduction in places like my own home, Allegheny City, where an electric railway is now in successful operation, which, in a distance of one mile out of a total length of four miles, ascends, with a speed of fully four miles per hour, a hill over 400 feet high, upon gradients of 12½ per cent, with numerous curves of 40 feet radius, the cars being often loaded with 75 people. Upon the lower portion of this line the electric current is supplied by means of an underground current, and on the upper portion of the line by the ordinary overhead conductors.

But while undoubtedly the electric railway will be generally preferred in the immediate future, it is by no means to be inferred that the cable-lines are to be considered as the motors of the past. On the contrary, their use will not only be continued, but greatly extended, wherever the conditions and circumstances favor their adoption. Among the advantages which they possess, are uniformity of motion, generally satisfactory speed, and the ease with which, in times of heavy travel, the vehicles can be multiplied and combined into convoys; and the facilities which they afford to converging horse-car lines, whose carriages they can attach to their own at the points of junction, saving thereby transfer of the passengers. The machinery used at the power-houses of some of the principal cable-lines is of very superior character, and some of the details employed are models of skill and ingenuity. Noteworthy among these are the engines of the Brooklyn Bridge cable-line, which many of us admired during the excursion at the time of the last annual meeting, and which are very interestingly described in a recent contribution to our "Transactions" by Mr. Gabriel Leverich, one of our members, and at one time secretary of this society.

Elevated railways propelled by steam must necessarily remain confined to larger cities, where the volume of traffic promises a return for the capital invested in their expensive construction, and where the distances to be reached are sufficiently great to make the saving of time, by means of their superior speed, an inducement for patronage.

Water-Works.—The introduction of water-works is now so extensive in this country that there are but very few cities or towns of more than five thousand inhabitants which are not supplied with

one system or another. The beneficial results upon the health of the populations are universally recognized, and the sanitary blessings and the advantages in point of comfort are beyond all calculation. Wherever additions and changes become necessary in the older cities, wise precautions are generally taken, under the advice and direction of professionally skilled experts, to profit by former lessons, and to avoid the errors of the past.

The most extensive enterprises now in progress in connection with water-works extensions are the improvements embracing the new lake tunnels at Chicago and Cleveland, the new Croton Aqueduct in the city of New York, and the aqueduct extension in Washington, D.C. In all these cases the question of greater purity has been carefully considered in connection with the increased supply.

The collection and storing of water-supplies for large cities and manufacturing purposes require, in many cases, the construction of extensive reservoirs, with massive dams for the retaining of the reserve supply. The importance of constructing these dams of proper shape and size, and of suitable material and good workmanship, so as to insure their absolute strength, and give them sufficient resisting capacity against every possible contingency, has been taught by a recent lesson of frightful experience; and while the responsibility for this calamity may not be placed upon the shoulders of the profession, yet it will be well for its members to look upon it and remember it as a warning and an example.

An investigation of the cause of the failure of the South Fork dam is now being made by a committee appointed under a recent resolution of this society, who have just returned from a visit to the scene of the disaster.

Examinations and measurements of the structure and its surroundings, and extensive information obtained from various sources, will enable the committee to submit to the society in due time a comprehensive statement of the conditions and circumstances which have induced and contributed to this most disastrous failure.

Sanitary Engineering.—The extensions and improvements of the water-supplies of our cities naturally lead to the adoption of measures for the disposal of sewage. The respective merits of the different methods employed for this purpose have been very ably presented to the profession from time to time, in occasional contributions to our "Transactions," by several members of this society, who stand pre-eminent in their special calling; so that all that would now seem necessary in an emergency is the exercise of sound and impartial judgment in the adoption of the proper method for each special case.

The system most generally used in this country now, and which will no doubt be preferred for a long time to come, is that of common water-carriage by means of the so-called "combined" plan of discharging all sewage and storm-water together through common outlets into adjacent rivers, lakes, or tidal waters. The objectionable features of this method consist in the pollution of the streams and lakes, from which, in turn, the water-supply may have to be drawn; and the injurious effects caused by the deposit and periodical exposure of offensive matter upon the shores of tidal waters.

In order to overcome, at least partially, these objectionable features, modifications of this method have been tried, consisting in a filtration and chemical purification of the sewage so as to reduce the offensive portions, and to render their final deposit into the streams of the district comparatively harmless. The methods employed for some time at Pullman, Ill., and more recently at Orange, N.J., are samples of this system.

Under the provisions of a law passed by the Legislature of Massachusetts in 1886, the State Board of Health is authorized to investigate, through a commission of experts, the effect of sewage discharge upon the streams and inland waters of the Commonwealth, and to recommend to the courts annually plans in remedy of existing evils. Acting upon the reports of this board, several cities are now making preparations for the disposal of their sewage by various methods of purification and dilution. In connection with some of these systems, the fluid portion of the sewage is utilized as a fertilizer of farm-land.

By the general introduction of natural gas as a domestic fuel in Pittsburgh and other Western cities, a large amount of kitchen-

garbage and house-sweepings, which heretofore were regularly burned with the solid fuel then in use, can no longer be disposed of in that way; and after various unsuccessful attempts to bury them, deposit them in the rivers, and burn them in open air, a number of specially designed furnaces were built for the destruction of these accumulations, to which are now added the offal from slaughter-houses, the leached-out bark from tanneries, and all garbage from the public markets. The heat created by the combustion of these waste substances is successfully utilized for generating steam in boilers attached to the furnaces, which, without the addition of any other fuel, except what is required for ignition, supply the motive power for operating the machinery in adjoining factories; so that these establishments not only improve the sanitary condition of the community by the prompt and radical destruction of vegetable and animal refuse, otherwise liable to decay on our hands, but also furnish a cheap fuel-supply for industrial purposes.

Streets and Highways.—Nearly all the larger cities of this country have now passed the experimental stages of their street-paving experiences, and have by this time entered upon a period of more permanent and substantial improvements in that department of municipal engineering. The days of wooden roadways, the Nicholson, the cedar, and locust blocks, will soon be remembered only as things of the past, like plank roads of earlier date. The various compounds with which, at one time or another, nearly all our city streets have been plastered over and poulticed, have cracked and split, shrunk, melted, and evaporated, and been carried off piecemeal, in course of time, by the persistent adhesion of their ill-flavored mixtures to the boot-heels of the weary pedestrians in hot weather. The abominable cobble-stones, which have jarred our nerves and dislocated our spinal columns in years gone by, are finally relegated to the by-streets and back alleys. Such makeshifts may answer the purpose for a while in new towns of rapid growth, where better materials are not readily attainable, and where first cost is a paramount consideration; but they should never be renewed to the extent that has been the case so often, in spite of the most convincing experience, and contrary to the best counsel of professional advisers. The sums of money wasted in repeating these mistakes would in many instances have gone far towards carrying out much more permanent and substantial improvements.

For streets in the vicinity of freight-stations, or of manufacturing establishments employing heavy teaming, and for streets with steep gradients, pavements should be made of stone blocks of basalt, trap-rock, granite, or hard limestone, laid upon a bed of broken stone ballast, topped off with sand or fine gravel, well rammed, and joints filled with cement grouting or coal-tar; for streets used by lighter traffic or carriages only, a well-laid pavement of pure asphalt upon a bed of stone ballast answers the purpose very well, if prompt attention is given to the maintenance and necessary repairs; for parks and suburban pleasure-drives, a good macadamized road, well drained, and constantly kept in condition, affords a very superior and comfortable highway.

Of late years, pavements of hard burnt fire-clay brick have been extensively laid in many cities and towns of the Middle States, where the supply of this material is very abundant and remarkably cheap. In some towns of West Virginia and eastern Ohio such pavements have been laid for less than a dollar per square yard. They make smooth roadways, are easily kept clean, and last very well under moderately heavy traffic. This pavement is especially well adapted for cities of medium size, which cannot well afford more expensive kinds, and yet require something more substantial and durable than either asphalt or macadam.

But if there is one thing which needs reformation more than any other, it is the condition of our common country roads. If it is true that the highways of a people are a measure of their civilization, then we cannot complain if we are classed as an inferior type of low barbarians. The good nature with which we submit to the imposition of the annual road-tax is only equalled by the sublime resignation with which we accept the result of the effort which swallowed up our money. Our Western members all know what is meant by "working the roads." It means to plough a furrow on each side, and scrape the mud into a ridge in the middle, simply

to be washed down again into the ditches by the first shower of rain. And this performance is repeated year after year, under the provisions of our statutes, and by the consent of a law-abiding but much-suffering people. During the spring and fall, we struggle through the mud manfully as best we can; and when winter comes, and the bottom-literally drops out of the roads, we quietly compose ourselves, and contentedly stay at home.

Some years ago, while out on an exploring expedition for a railroad in southern Ohio, I was compelled to hibernate, so to speak, with my entire party, for nearly a month, in a lonely village among the hills of Wills Creek in Noble County; and, when I made an effort to advise my employers of our situation, I was cheered by the comforting assurance of the postmaster that my letter would certainly go out just as soon as the roads dried up.

A faint ray of hope, however, is just beginning to dawn in some parts of the country, most conspicuously in Ohio, where, under the provisions of a recent law, a number of free turnpikes are being built, of quite a superior character, by special tax levied upon the adjacent property.

The beneficial results of this wise system of improvements are very great, and highly appreciated by the people, and it is sincerely to be hoped that other States will profit by the example.

Canals and Hydraulic Engineering.—The days of ordinary canal navigation in the interior parts of this country may well be considered as numbered with the past. With the exception of the Erie Canal, which still maintains to some extent its character as a waterway of commerce, and excepting some parts of the canals in eastern Pennsylvania, New Jersey, Maryland, Ohio, and Illinois, these primitive transportation lines have either been abandoned entirely, after outliving their short period of usefulness, or they are now merely utilized for carrying bulky products between local points, or for the supply of hydraulic power to manufacturing establishments.

Still more discouraging are the immediate prospects for the various maritime canal projects. The Panama Canal, upon which very large sums of money have been expended, has finally been abandoned, after many unsuccessful efforts of its projectors to raise the funds still required for its completion, and after, as a last resort, modifying the original plans of a sea-level canal to one with locks. But notwithstanding this momentary failure, I most sincerely hope—and I honestly believe—that it is yet reserved for American engineering skill and American enterprise to resurrect and successfully carry forward this great and important project to its ultimate completion.

The Tehuantepec Ship Railway, which, for the purpose on hand, may properly be classed with the maritime canals, has not met thus far with the encouragement which its importance and the unqualified indorsements of eminent professional talent would seem to justify. Probably the sad fate of its Panama rival, which places it for the present out of the range of active competition, may assist in reviving the ship-railway project to which our lamented fellow-member, the late Capt. Eads, devoted his energies during the last years of his useful life.

New interest is being manifested in the old ship-canal project across the Isthmus of Nicaragua, which, in the matter of demonstrable feasibility, undoubtedly has many points in its favor.

Among other ship-canal projects in active progress may be mentioned the Cape Cod Canal, which was commenced in 1880, and which will, when completed, connect the Bay of Cape Cod, by way of Herring River, with the head of Buzzard Bay in Massachusetts.

The magnificent success of the ship-canal at Sault Ste. Marie, not only as an engineering project but also as a commercial enterprise, has surpassed all expectations; and since its completion the traffic upon the northern lakes has been multiplied to such an extent that it has been found necessary to build an additional canal and a new lock of larger dimensions even than the one now in use. The direct impulse given by the completion of this canal to the lake navigation, and the indirect effect upon the general business of that region of country, have stimulated the work on the hydraulic canal at Sault Ste. Marie, from which great results are expected; and they have also hastened the operations in progress for deepening and widening the channels through the shallow parts of Hay Lake,

whereby the route from Lake Huron to Lake Superior will be considerably shortened and generally improved.

A project is now being agitated, contemplating a direct connection between Lake Superior and Lake Michigan across the narrow portion of the peninsula between Marquette and Escanaba, whereby the passage through the Sault Ste. Marie would be entirely avoided, and much distance saved for the traffic between Lakes Superior and Michigan.

In the extension of the river-walls in New York harbor, under the Department of Docks, large concrete blocks are being used, weighing from 60 to 75 tons, and requiring hoisting-machinery of extraordinary size and power to place them in position. Similar blocks are being placed in the walls along the lake-front in Chicago, where they have been found to resist effectually the action of the waves in places where all former methods of protection have failed.

Railroads.—Sixty years ago railroads were unknown in this country. At that time the population of the United States consisted of 12,000,000 people. To-day we operate 160,000 miles of railroad, and our population has increased to 60,000,000 people. In 1830 the aggregate wealth of the United States was less than \$1,000,000,000: at present it is estimated at \$56,000,000,000. Just how much of this phenomenal prosperity may be due to the railroads, it is, of course, impossible to conjecture; but it may be safely assumed that they have very largely contributed to the result. While the population has increased during the last fifty years about 350 per cent, the ratio of increase of the railroad mileage for the same period has been nearly four times that of the population, which would seem to indicate that they have not only supplied a want of the past, but have kept well up with the contemporaneous growth of the country, if they have not, indeed, advanced beyond its actual necessities. The railroad mileage of the United States is now fully one-half that of the total railroad mileage upon this globe, while our population is only about one-twenty fourth part, and our area of territory only about one-twentieth part, of that of the inhabited world.

You have all heard the familiar illustration about girdling the equator a dozen times, more or less, with our railroad-tracks; but it will no doubt please you to know, that, since you heard the statement last, enough additional rail has been laid to give the equator another twist; and I might further supplement the illustration by the assurance that we have now a sufficient supply of materials in the tracks of this country to build a railroad to the moon. Over these 160,000 miles of railroad we carried last year 475,000,000 people, and transported 600,000,000 tons of freight. Upon these lines are engaged 1,000,000 employees. Their equipment consists of 30,000 locomotives, 21,000 passenger-cars, 7,000 baggage-cars, and 1,000,000 freight-cars. The capital invested in their construction and equipment amounts to \$8,000,000,000, and the yearly disbursements for labor and supplies exceed \$600,000,000.

The creation of these vast properties has been accomplished by aggregation rather than by preconceived systematic development. The trunk lines of the present day are to a great extent composed of pieces of road originally built by local enterprises, and absorbed from time to time by lease or purchase, to constitute with other acquisitions, in connection with some specially constructed connecting links, the various systems under the management and control of the leading railroad companies of the country.

The recent revival of the temporarily abandoned Hudson River Tunnel project, and the proposed tunnel under the river at Detroit, are enterprises demanded by the necessity of continuous transportation lines for the through traffic of our railroads.

The numerous accidents which happen at points where public highways cross the railroads at grade, in spite of alarm-bells, watchmen, and safety-gates, have led to the enactment of laws in some of the Eastern States looking towards a gradual abandonment of existing crossings and the absolute prohibition of new ones in the future. During the years 1887 and 1888 there were abolished in Connecticut 93 grade-crossings, at a cost of \$625,000. In Massachusetts a special committee of the Legislature has recently reported upon this subject, recommending that all dividend-paying roads eliminate annually 5 per cent, and all non-dividend-paying roads 2½ per cent, of their grade-crossings at the joint expense of the railroads and communities, and that in future no grade-cross-

ings shall be permitted. It is to be hoped that the beneficial results of these wise measures will induce other States to take this subject under serious consideration.

The most noteworthy engineering feature in connection with the general progress of railroad construction in this country is the building of bridge structures upon a constantly increasing scale. In 1862 I triangulated the positions and laid the foundations for the piers of the channel span of the Ohio River bridge at Steubenville. This was the first iron railroad-bridge over any of the navigable tributaries of the Mississippi River. The length of its channel span was 320 feet, and it was the longest iron truss ever attempted up to that time. It was designed by Mr. J. H. Linville, still a member of this society; and it has carried in safety, and without accident, the traffic of one of the principal Western connecting lines of the Pennsylvania Railroad for twenty-five years, and is now being replaced by Mr. Henry G. Morse, also a member of this society, giving way to a double-track structure. To-day twelve railroad-bridges span the Ohio River between Pittsburgh and Cairo, and two more are in progress of construction. There are fourteen railroad-bridges over the Mississippi, and fifteen over the Missouri. Many of these structures have spans of 500 feet, and one of the projected bridges over the lower Mississippi was designed with a span of 730 feet; but this plan, I understand, has been abandoned, and a cantilever structure adopted in its place.

The erection of these large bridges has become a special business in this country, and the leading contractors engaged in that pursuit have acquired wonderful skill in the performance of this dangerous and difficult work. Few people appreciate the risks and hardships encountered, and the courage and judgment required, in dismantling an old railroad-bridge and erecting a new one in its place, with a deep and rapid river running underneath, a strong wind blowing, and a hundred trains passing daily over the frail, temporary supports, which must carry the traffic during the replacement. The mere erection of entirely new structures, free from the encumbrance of moving traffic, is considered an easy job.

In October last, the contractors engaged in the erection of the bridge at Cairo swung free and clear a 520-foot span in six days, and in November last the same parties erected the trusses of another span of 520 feet length in 44 hours, and more recently they erected a 400-foot span in 31 hours, the wind blowing a gale nearly all the time.

The successful completion during the past year of the Hudson River cantilever bridge at Poughkeepsie reflects great credit upon the builders and engineers in charge; and the equally successful completion and skilfully conducted erection of the Hawkesbury Bridge in New South Wales adds new fame to the same firm of contractors, whose leading partners are all prominent members of this society.

Whether the limit of possibilities in bridge construction will be reached in the execution of Mr. Gustav Lindenthal's design of a railroad suspension-bridge over the Hudson River, with a span of 2,800 feet, resting upon towers 500 feet high, and carrying, in addition to wagon-ways and foot-walks, six railroad-tracks, at a height of 150 feet above water; or whether the projected crossing of the British Channel will require still larger dimensions,—are problems which may perhaps interest at some future day the younger members of this society.

NOTES AND NEWS.

ACCORDING to an ancient superstition, says *Garden and Forest*, the beech is never struck by lightning; and so general has been this belief, that a gentleman recently thought it worth while to write to an English journal that he had been told of a lightning-shattered beech in Ireland. Beliefs of this sort are rarely without some degree of justification in fact, and it would be interesting to know whether in this country the beech has been observed to possess any greater immunity from electrical dangers than trees of other sorts.

—The *Gardeners' Chronicle* says that the ginkgo is proving itself one of the best trees for street-planting in smoky cities, thriving in the most impure atmospheres, and having as yet been attacked

by no insect or fungus disease. In this country, according to *Garden and Forest*, no extensive use has been made of the ginkgo as a street tree except in Washington, where of course it is not subjected to the test of an atmosphere impregnated with smoke. If it is, indeed, able to withstand the most unfavorable conditions, it might be more generally adopted; for it grows rapidly, its shape well adapts it for association with architectural forms, and the peculiar character of its foliage always makes it interesting to the popular eye.

— The true eating banana, or "madura," is said to be unknown in northern countries, the varieties we import being simply those which are used in the land of their growth for cooking-purposes. *Garden and Forest* states that many varieties of the madura are recognized, each of which is distinct in flavor. The smaller are the more delicious; and the smallest of all, the so-called "lady-finger banana," with a skin hardly thicker than paper, is the most highly prized. Green cooking-bananas are peeled, and roasted in the ashes, and eaten with butter; partially ripe ones are boiled for a few minutes with the skin on, and eaten with sirup or honey; and ripe ones are sliced lengthwise, and fried in olive-oil or butter.

— It will be new to some Americans, even though they know that peaches are commonly cultivated under glass in England, to be told that cherries are also grown in this manner. A correspondent of the *Gardeners' Chronicle* recently described the cherry-house at Gunnersbury Park, where many different varieties afford fruit at different times during the season. "When the trees are started into growth," he says, "a temperature of 45° by day, and 40° by night, is maintained. When they are in flower, plenty of air is given, and the bees are encouraged to work among the blossoms as much as possible. Scarcely any fire-heat is employed: indeed, it had been employed only once or twice in order to keep out frost. At the time of flowering, plenty of ventilation is given, top and bottom. As soon as the fruit has set, the house is closed up somewhat, and the temperature kept quite cool until the stoning process is over; then it is kept a little closer, as when the fruit has stoned it ripens quickly. It is a little difficult to thin out the fruit previous to the stoning stage, as it is uncertain which fruit will mature, and which fail. A good watering is given to the trees before they get into flower, and then water is applied with moderation until the fruit has set. Cherries appear to do best, and set their fruit more freely, when somewhat dry at the roots, whether the trees are planted out or in pots, and it appears to be quite certain that all flower more freely when worked on the mahaleb than when on the cherry stock."

— The following interesting report to the United States Hydrographic Office from the American steamer "Indiana," Capt. W. I. Boggs, seems to indicate a normal condition of the Gulf Stream in the regions and during the times stated: "From noon of May 22 (latitude 40° 20' north, longitude 60° 8' west) to noon, May 23 (latitude 40° 46' north, longitude 54° 29' west), experienced a current setting N. 68° E., drift 16.4 knots. The temperature of sea was noted every two hours: maximum temperature, 72°; minimum temperature, 60°; mean temperature, 66°. From noon of May 24 (latitude 41° 15' north, longitude 49° 3' west) to noon, May 25 (latitude 43° 49' north, longitude 43° 47' west), current set N. 51° E., drift 23 knots. The temperature of sea was noted every two hours (and during hours of darkness every half-hour): maximum, 64°; minimum, 54°; mean, 62°; twenty-four observations being taken." It is interesting to note, in this connection, that during the above period, and for fully a week previous, no general storms occurred in the regions referred to. On the contrary, the winds were variable in force and direction, seldom reaching a force of 6 (Beaufort's scale).

— Attention is called to certain changes that have been adopted on the "Atlantic Pilot Chart" for July, which, it is thought, will commend themselves to all who have occasion to use it. The most important of these is the enlargement of the area represented, the eastern limit being now 10° east longitude (instead of 4°, as heretofore). This allows the whole of the North Sea to be shown, more of the Mediterranean than before, and the entire Gulf of Guinea. The system by means of which the prevailing winds are

indicated in each ocean square has also been changed slightly. Instead of representing a north-east wind, for instance, by an arrow pointing away from the centre of the square at the south-west point of the compass, it is now represented by an arrow pointing toward the centre at the north-east point of the compass. This is regarded as more graphic than the old method, the point of each arrow giving, at a glance, the true direction of the wind (the point from which it blows).

— The Brooklyn Academy of Science, a society incorporated Aug. 22, 1888, has opened a free reading-room in their rooms in Warner Institute, Willoughby Avenue and Broadway, in that city. The various scientific journals will be upon the tables, and there is no charge to the public. Donations of papers will be greatly appreciated.

— A boiler may be inspected to-day and found to be safe under a working pressure of one hundred, and be weakened to-night by low water so as to be dangerous to-morrow with fifty pounds pressure. Yet, as the *Age of Steel* says, it may explode a month hence with sixty pounds pressure and plenty of water, but the cause is as certainly low water as if it had exploded when the water was low. There is but one sure remedy, and it is a simple one. Put on a real safeguard, something simple, which has been tried, and proven to be trustworthy.

— According to the *British Medical Journal*, the programme of the Leeds meeting of the British Medical Association in August next "is developing in such manner as to afford the ample promise of a meeting of great scientific as well as social interest, and one which will be worthy of the traditions of this great medical centre."

— The sacred lotus (*Nelumbium speciosum*) has become established in a pond in New Jersey, and proves hardy, although the surface of the water is frozen over during the winter. The history of its planting, by E. D. Sturtevant, is given in *Garden and Forest* for April 10, with a fine photo-engraving of the spot, showing hundreds of open flowers.

— There seems to be every prospect, according to *Engineering*, that the efforts made by the French engineers to entertain the American party of engineers will be very successful. It is intended that an hour and a half or two hours should be spent in Calais to examine the new harbor-works there; and the special train which the Northern Railway of France has so liberally placed at their disposal will make a detour and stop near St. Omer, to give the engineers an opportunity of inspecting the great hydraulic canals. On the day after their arrival in Paris nothing official will be done, but on the following morning a formal reception will be held at the offices of the French Society of Civil Engineers. The party will then breakfast with M. Eiffel on the first story of the tower, and will afterwards ascend to the top in detachments. A part of this day will also be spent in an organized visit to the exhibition. The Ville de Paris has made arrangements for an excursion through the Paris sewers, and further visits to the exhibition and elsewhere will be paid. One of the most interesting of the latter will be the compressed-air installations of the Popp Company. Altogether, though the Paris programme is not yet complete, it is certain to be a very full, hospitable, and attractive one.

— The *Engineering and Mining Journal* says, "It will be remembered that some enterprising associated press agent startled the country a few weeks ago by announcing that the Standard Oil Company had wired from the Media works to Philadelphia for two hundred bull-dogs, which news item the telegraph editors and 'home correspondents' of some of the metropolitan dailies ingeniously enlarged into a small-sized sensation, lasting a day or two, until it was discovered that the 'bull-dogs' wanted were merely harmless lifting-jacks of a particular style. As an example of how so much remarkable literature is floated, observe the following judicial and editorial comment of one of our technical exchanges in its issue of June 22, at which late date it does not seem to have yet 'caught on': 'The Standard Oil Company has, however, introduced a new style of watchman, which we think will be efficient. The company has suffered a good deal by tramps and loafers getting too near its tanks and smoking, and thus setting fire to the gas

generated by the oil, which ignites easily; and it has now given an order to a dog-fancier's association for two hundred bull-dogs, to range in age from six months to a year, the price to be fifteen dollars each. The dogs are to be placed where the company has distributing-stations, and used in the field to guard the large iron tanks that are full of oil. The bull-dog watchman certainly has this merit over the average biped private watchman, that he neither smokes, drinks, nor goes to sleep on watch."

— We learn from *Nature* that the Russian Academy of Sciences offers a prize of \$2,500 for the best inquiry into the nature and effects of the poison which develops in cured fish. The objects of competitors must be: "(1) To determine, by means of exact experiments, the physical and chemical nature of the poison which develops in fish; (2) to study, by experiments on animals, its action upon the heart, the circulation of the blood, the organs of digestion, and the nervous system; (3) to determine the rapidity of its absorption by the digestive organs; and (4) to study and describe the characteristics which may serve to distinguish contaminated fish from such as are not contaminated." The fifth and sixth questions, with which it may be impossible for any one to deal satisfactorily, relate to the means of preserving fish from the development of the poison, and to the question of counter-poisons and the medical treatment of poisoned persons. The competition is open to all. The memoirs must be sent in, either in manuscript or printed, before Jan. 1, 1893, and may be written in any one of the following languages: Russian, Latin, French, English, German. If none of the papers is deemed worthy of the full prize, the accumulated interest upon the above-named sum may be handed over to the author who presents the best solution of some part of the problem.

— Arrangements have been made for a daily exchange of telegraphic weather reports between Washington and Havana during the present hurricane season. Early and reliable information can be obtained at any branch hydrographic office.

— The forecast of weather on the Atlantic for July by the United States Hydrographic Office is that generally fair weather will prevail. Occasional moderate gales, frequently accompanied by electric phenomena, will be felt north of the 40th parallel; and West Indian hurricanes are apt to occur, especially during the latter part of the month. Frequent fogs may be expected over the Grand Banks, along the northern coast of the United States, and in the neighborhood of the British Isles. Icebergs are liable to be encountered in the vicinity of the Grand Banks, between the 46th and 53d meridians, as far south as latitude 42° 30' north. Field-ice should be looked out for to the eastward and southward of Newfoundland and off the coast of Cape Breton Island.

— On July 22 an electric exhibition will open at St. John, N.B., to last ten days. This is in honor of the opening of the Canadian Pacific Railway to St. John.

— The Canadian Pacific Railway, in spite of its northerly latitude, seems to have overcome the snow difficulty. The total detentions during the past winter from this cause were only seven hours, the snowsheds and split and glance fences protecting the line in a very perfect manner, though some very heavy avalanches fell in the Selkirk.

— People may walk until they are fatigued through the almost endless buildings on the Champ de Mars, and yet fail to find any great and striking object by which they would especially remember the exhibition of 1889. The place is filled with evidences of untiring industry and skill on every side, but there is a strange absence of great novelties. We believe, however, that the exhibition will be famous for four distinctive features. — in the first place, for its buildings, especially the Eiffel Tower and the Machinery Hall; in the second place, for its Colonial Exhibition, which for the first time brings vividly to the appreciation of Frenchmen that they are masters of lands beyond the sea; third, it will be remembered for its great collection of war material, the most absorbing subject nowadays, unfortunately, to governments, if not to individuals; and, fourth, it will be remembered, and with good cause by many, for the extraordinary manner in which South American

countries are represented. Several of those nationalities are beginning to put themselves forward as appreciable factors in the politics of the world, and, what is of more interest to the manufacturer, they constitute the richest and largest customers in European and North American markets. Especially this is the case with regard to agricultural machinery of all kinds, and those exhibitors are fortunate who are well represented in this respect.

— Mr. Henry William Bristow, F.R.S., died on Friday, June 14, at the age of seventy-two. In 1842, according to *Nature*, he was appointed a member of the staff of the Geological Survey of the United Kingdom. Mr. Bristow published various works on mineralogy and geology, and was the author of the mineralogical articles in Brande's "Dictionary of Science, Literature, and Art," and of articles on minerals and rocks in Ure's "Dictionary of Arts, Manufactures, and Mines." He became a fellow of the Geological Society in 1843, and of the Royal Society in 1862, and an honorary fellow of King's College, London, in 1863. He received the diploma of the Imperial Geological Institute of Vienna, and from the King of Italy the diploma and insignia of an officer of the Order of SS. Maurice and Lazarus.

— In reference to the destructive volcanic eruption on the Island of Oshima (better known to the Western world as Vries Island), it seems that the first news of it was brought to Yokohama by the master of a passing steamer, who described the mountain Miharaizan as being in fiercely active eruption on the morning of April 13. The eruption was of such a nature that it attracted attention on board the steamer at a great distance. Afterwards it was ascertained that the outbreak was at the western base of the mountain. From this it would appear that a new crater has been formed, as the old crater is at the top of the mountain, though there is a place to the south-west whence smoke is always issuing from the sands. The *Japan Weekly Mail*, from which this information is taken, gives the following historical account of this remarkable volcanic island, Miharaizan, according to the oldest Japanese historical records, was an active volcano so far back as 684 A.D., but the earliest authentic notice of its activity appears to have been taken in 1421, when the sea boiled, and the fish died in shoals. In 1684 an eruption commenced which lasted seven years; and in 1703 there was a great earthquake and tidal wave, and part of the island broke down, and formed the present harbor. In 1777 the mountain was in active eruption, and the island was covered several inches deep with ashes, such phenomena being almost constantly repeated from that date till 1792. It was then quiet till 1837, and more or less in action for the following twenty years. Another lull then took place, when, in 1868, it again broke out, and continued in action four days. The next eruption occurred in 1876, and lasted nearly two months. The most destructive eruptions of Miharaizan were probably those of 1781 and 1789, as during the latter the village of Shimotaka was entirely destroyed, and the people and their houses were completely buried in ashes. There are at present six villages on the island, containing a population of five thousand persons, mostly fishermen.

— Maria Mitchell, the well-known astronomer, until recently professor of astronomy at Vassar, died June 28 at Lynn, Mass. Miss Mitchell was born in Nantucket in 1818, and inherited her love of astronomy from her father, a bank cashier who made a hobby of astronomical investigations. It was one of Miss Mitchell's ambitions to discover a telescopic comet, — an ambition that was satisfied in 1847. For this discovery a medal was presented to her by the King of Denmark, although, doubting the reality of her discovery for a time, Miss Mitchell had delayed publishing it, — a delay which came near losing her the honor, as European astronomers had found the same comet, and made earlier publication. It was through the earnest presentation of her case by Edward Everett that the medal reached this famous woman astronomer.

— Theodore Dwight Woolsey, president of Yale College from 1846 to 1871, died July 1. He was born in New York, Oct. 31, 1801. Besides his Greek text-books, published early in his career, his sermons and essays, President Woolsey wrote the well-known "Treatise on International Law."

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THE SOUTHWARD MOVEMENT OF ICE on the Grand Banks during June was far more decided than for the same month last year and 1886, though scarcely exceeding that of 1887. The probable limit, as forecast on the "Atlantic Pilot Chart" for June, has been well reached in the area lying east of the 50th meridian. Since June 4 there were 16 reports of icebergs south of latitude 45°, and between longitudes 50° and 47½°. Of these, 11 reports fell south of latitude 44°. The southernmost one, a good-sized berg 40 feet high, in latitude 42° 54' north, longitude 49° 54' west, came near proving very serious to one big liner, who slightly struck one of its submerged spurs on a foggy evening, June 11. A few bergs are still coming down across the parallel of 50°, but the season on the southern half of the Grand Banks is drawing to a close, and the probable limit for July has accordingly been moved northward. The fact that the fog belt is so apt to overlap the iceberg region at this season makes it doubly desirable that transatlantic lines, both east and west bound, adopt a set of routes that will skirt rather than cross this dangerous field. Such routes are advocated on the "Pilot Chart," and the slight loss of time incurred by following them gives a factor of safety that must in time be recognized by underwriters. It is to be hoped that the coming international marine conference will give this question their wise consideration.

THE GRAIN PLANT-LOUSE IN OHIO.

ONE of the most notable insect-outbreaks that has occurred in Ohio for many years is now taking place in the grain-fields of that State. The insect is one which has long been known as the grain plant-louse (*Siphonophora granaria*), having originally occurred in Europe, whence it was probably introduced into this country early in its history. It has only occasionally ravaged grain-fields here, and, so far as our present information goes, has seldom been injurious in Ohio.

The insect is now present, however, in destructive numbers over a large portion of Ohio, having already seriously injured the wheat, and is now threatening an equally serious injury to oats and other grains. Last year it was present in many of the northern counties, not becoming sufficiently abundant to attract notice until the oats were nearly ripe.

This insect is closely related to the "green fly" of house-plants, rose-bushes, etc. It is a small, greenish, or in some cases brownish, insect, with or without wings, infesting the leaves and heads of plants of the grass family. It obtains its food by inserting a pointed beak into the leaf or stem, and sucking out the sap. As the wheat gets ripe, it migrates to the more succulent oats, and, when these ripen, will go to various grasses. It brings forth living young; and its rate of multiplication is very great, it being estimated that a single louse in spring may become the ancestor of many millions before autumn.

Fortunately this insect has a great many enemies which prey upon it, and are now doing immense good in decimating its ranks. These are of various kinds, and in some places are being mistaken for foes instead of friends of the farmer. The one which is causing the most apprehension is a peculiar dark-colored, six-footed insect, generally with spots of a brighter color on its back, looking, as one person expressed it, "half worm and half bug," which is very abundant in the infested wheat-fields, crawling about over the heads. These are the young or larvæ of various species of lady-bugs, or lady-beetles, and instead of attacking the wheat, as many farmers believe, is really feeding upon the lice themselves, and destroying them by thousands. Another insect that is doing immense good is a very small four-winged fly that deposits an egg within the louse. This egg hatches into a grub that develops at the expense of the louse, destroying it, and emerging again as a four-winged fly. The dead lice "struck" by these parasites become dull brown in color, and adhere to the leaf or stem upon which they were feeding.

Besides these, various other enemies are attacking the lice; and the indications now are that the outbreak will be so checked by the end of the season, that there will be little danger of a repetition of the attack next year.

The presence of English sparrows in the wheat-fields led some to believe that they were feeding upon the lice; but an examination of stomach contents of a number shot while on wheat, showed that the grain itself was what they were after, no more lice being eaten than was necessary to get the grain.

As yet no practical artificial remedy for the grain plant-louse is known. At the Ohio Agricultural Experiment Station at Columbus they have found that kerosene emulsion will destroy them; but the difficulty of reaching them with this substance, when they occur on the under surface of the leaf, or embedded in the chaff of the head, makes the remedy hardly practical. The injury to the wheat will be manifested by the shrivelling of the grain, due to the extraction of the sap necessary for its perfect development.

THE BRUCE PHOTOGRAPHIC TELESCOPE.

THE Astronomical Observatory of Harvard College has received from Miss C. W. Bruce of New York a gift of fifty thousand dollars, to be applied "to the construction of a photographic telescope having an objective of about twenty-four inches aperture, with a focal length of about eleven feet, and of the character described by the director of the observatory in his circular of November last; also to secure its use under favorable climatic conditions in such a way as in his judgment will best advance astronomical science."

This instrument will differ from other large telescopes in the construction of its object-glass, which will be a compound lens of the form used by photographers, and known as the "portrait lens." The focal length of such a lens is very small compared with its diameter, and much fainter stars can be photographed in consequence. The advantage is even greater in photographing nebulae or other faint surfaces. Moreover, this form of lens will enable each photographic plate to cover an area several times as great as that which is covered by an instrument of the usual form. The time required to photograph the entire sky is reduced in the same proportion. A telescope of the proposed form, having an aperture of eight inches, has been in constant use in Cambridge for the last four years, and is now in Peru photographing the southern stars. It has proved useful for a great variety of researches. Stars have been photographed with it too faint to be visible in the fifteen-inch refractor of the observatory. Its short focal length enables it to photograph as faint stars as any which can be taken with an excellent photographic telescope having an aperture of thirteen inches. The eight-inch telescope will photograph stars about two magnitudes fainter than can be taken with a similar instrument having an aperture of four inches. A corresponding advantage is anticipated from the increase of the aperture to twenty-four inches. Each photograph will be thirteen inches on a side, and will cover a portion of the sky five degrees square, on a scale of one minute to a millimetre. The dimensions will be the same as those of the standard charts of Chacornac and Peters. The entire sky would be depicted upon about two thousand such charts.

It is very important that the best possible location should be found for such an instrument. In Europe and in the eastern portions of the United States, where nine-tenths of the principal observatories of the world are situated, it is cloudy for a large portion of the year. Great advantages are expected from a location, as on some California mountain, where clouds and haze are seldom seen.

This generous gift offers an opportunity for useful work such as seldom occurs. It is expected that the Bruce photographic telescope will exert an important influence upon astronomical science by the large amount of material that it will furnish.

CHARITY AND KNOWLEDGE.¹

THIRTEEN years ago, during the centennial celebrations of Independence Day, the university founded by Johns Hopkins began its work; and now, as we commemorate a completed century of constitutional life, the hospital, gift of the same donor, throws open its doors. These buildings, on which thought, time, and wealth have been freely spent, are now consecrated to the ministry of mercy and the prolongation of life. Science and charity, knowledge and pity, skill and sympathy, are here installed in the service of mankind.

That large-minded citizen of Maryland, "who, by noble gifts for the advancement of learning and the relief of suffering, has won the gratitude of his city and his country," found two words adequate to his great ideas. "University" and "hospital" were his chosen terms, and he linked them together by this significant phrase: "Bear constantly in mind that it is my wish and purpose that the hospital shall ultimately form a part of the medical school of that university for which I have made ample provision by my will." How brief the phrase, how large the purpose!—"apples of gold in pictures of silver."

Like James Henry Roosevelt of New York, "a man upright in his aims, simple in his life, and sublime in his benefaction,"² whose hospital and dispensary give clinical instruction to the College of Physicians and Surgeons; like James Lenox of New York, whose munificence established a public library and gave birth to a hospital,—Johns Hopkins, already honored as a patron of learning, will be henceforward remembered in the annals of charity and

medicine. May we not almost say of him, as Pindar said of Theoron (Olympic II., Cary's version),—

"And I will swear
That city none—though she unroll,
A century past, her radiant scroll—
Hath brought a mortal man to light
Whose hand with larger bounty flows.
The blessings to that man we owe,
Say, who shall hope to count?"

We may form an idea of what this hospital may become by the study of a like institution in London. About a century and a half before Johns Hopkins died, the days of Thomas Guy were ended. Like our benefactor, he had lived unmarried to the age of eighty years, and from humble beginnings had acquired a fortune, with which he provided for the establishment of a hospital. The amount of his gift was more than a million dollars (£238,292). The beneficent influences of Guy's Hospital are now known in every part of the globe. It is doubtless safe to say that every one of us has shared, indirectly, in its benefits. The name of the great surgeon, Sir Astley Cooper, would alone give renown to the hospital to which he was attached,—Sir Astley Cooper, of whom it was said that from the period of his appointment to Guy's, until the moment of his latest breath, he was every thing and all to the suffering and afflicted; his name was a host; but his presence brought confidence and comfort.¹ Addison and Hodgkins, whose names are familiar to the historians of medicine, were physicians in that hospital; so was Richard Bright, whose discoveries have been pronounced the most important contribution to medical science made in the first half of the nineteenth century. The observations and studies made in Guy's Hospital since 1836 fill fifty volumes. Thousands of medical students have been trained within its walls. "Their presence," says a competent observer, "has made the hospital." Hundreds of thousands of patients have received relief from the treatment there afforded. In a single year, five thousand in-door patients have been cared for, and more than thirty thousand out-door patients have sought advice.

But we are planning for a future much longer than a century and a half; for a history as long as that of St. Bartholomew's or St. Thomas's, which now, after many centuries, are more useful than ever.

By a curious coincidence, as I had reached this point in the preparation of my address, I received a volume from Dr. Norman Moore, the warden of St. Bartholomew's Hospital in London, bearing an inscription so welcome and so apposite, that I will read it: "To the library of the newest of hospitals, this account of the progress of medicine in one of the most ancient is given by Norman Moore—with the earnest hope that the Johns Hopkins Hospital may flourish at least as long as the Royal Hospital of St. Bartholomew in Smithfield, and prove no less useful to mankind—on the opening day of the Johns Hopkins Hospital, 1889."

This little book is full of suggestions for us. First, as to the longevity of a hospital. "For more than seven hundred and fifty years the hospital has flourished upon its present site; and its Smithfield gateway, through which passed men of the generation whose fathers saw William the Conqueror enter London, has ever since been open to the sick poor."

Then as to the progress of medical science. Here you may see "how the physician grew from a schoolman into a scientific observer, and how the surgeon, who appeared on the scene in livery and without learning, grew from a handicraftsman to be a man of science."

Next as to the training of illustrious men. Here you will find a record of the names and services of Caius, Bernard, Pott, Abernethy, Lawrence, and Paget; you may learn that Dr. Thomas Young, the originator of the undulatory theory of light, was here a student; and you will come upon the story of one more famous than any person I have named,—the discoverer of the circulation of the blood, the illustrious Harvey.³

¹ Letter of Dr. Roots in the Memoir of Sir A. Cooper.

² Dr. Moore calls attention to the fact that it was a fund given by Dr. Caius to encourage the study of anatomy, which was the immediate means of leading Harvey to his discovery and also to a remark in one of Harvey's lectures that it was a passage of Aristotle which first suggested to him the idea.

³ An address by Daniel C. Gilman, delivered at the opening of the Johns Hopkins Hospital, Baltimore, Md., May 7, 1889.

² This phrase (like that above, referring to Johns Hopkins) is taken from a memorial tablet.

Time may efface the personality of our founder, as it has effaced the personality of Rahere, the founder of St. Bartholomew's; but the beneficence of Johns Hopkins will last for centuries, and gratitude will cherish the memory of his broad views, his great liberality, his wise and beneficent purposes.

The previous speakers have told us of the circumstances which led to the construction of these buildings, and have described their purposes. Let me, from a different point of view, point out some of the benefits which are likely to proceed from this foundation. As I enter upon this theme, I am reminded that in 1789, John Howard, *facile princeps* among modern philanthropists, published in a quarto volume, just before his death, the observations he had made upon the lazarettos of Europe. That was the beginning of reforms in prisons, asylums, refuges, and hospitals. To this work he prefixed these words of Cicero (*De Oratore*, l. 8), a motto so appropriate that I might take it for a text: "*Quid tam porro regium, tam liberale, tam manificum, quam opem ferre supplicibus, excitare adfectos, dare salutem, liberare periculis.*"

First, last, and always, this hospital is to furnish relief to the sick and wounded. Make the best of it, introduce fresh air and sunshine, and provide the utmost comfort; secure wise physicians, engage the best trained nurses; decorate the walls with pictures; bring fruit and flowers, and books and friends, and even the comforting influences of religion, — yet you cannot conceal the direful consciousness that this is the home of suffering.

"From any other ill

(Except it be remorse) can men escape
By work, — the healing of divinely balm
To whomso hath the courage to begin, —
But sickness holds the sick man in a chain
No will can break, or bend to earthly use."¹

The names that have been given to these abodes of the sick are suggestive. "Hospitality" and "hospital" alike suggest the bestowal of kindness to guests. The word "lazaretto," ultimately degraded, pointed at first to the restoration of life. "Misericordia," "La Charité," "La Pitié," "The Home of the Good Samaritan," "The House of Mercy," bring to mind the kindly influences of love and care. St. John, St. Thomas, St. Bartholomew, and St. Luke, above all other apostles, are favorite patronymics. Paracelsus died in the Hospital of St. Sebastian. Bethlehem, Bethany, Bethesda, and Jerusalem recall the scenes where the great Physician was present. The name of Christ has been given to many a foundation. In other places the hospital shares with the temple the name of "Hôtel-Dieu," or "House of God."

By whatever name it may be called, this is a convent where sickness is the abbess. The rule of sympathy for the suffering must govern everybody with a strictness of discipline as rigid as the rule of the Benedictines or the Carthusians. Those who daily walk these cloisters will be the wardens of life and health, however high their station, or however humble their service; and casual visitors will not cross the threshold of the wards without pity for those who are disabled, or without admiration and gratitude for those whose lives are spent in alleviating distress.

This hospital will not only meet the daily calls of humanity, it will stand ready to render extraordinary services in those emergencies which not even the progress of municipal reform and preventive medicine can entirely ward off. A fire, an explosion, an accident on the rails or on the seashore, the fall of a platform or of a building poorly constructed, may at any moment tax the utmost resources of a great establishment. True, we have no fear of leprosy and the plague; we have almost ceased to dread the coming of the cholera; yellow-fever we are hoping to thwart in its approaches to our Northern seaports (vaccination, which was spoken of by Sir James Simpson "as the greatest thought ever broached in practical medicine," is a great prophylactic): but we are not certain that diphtheria and infectious fevers will not continue to be epidemic; nor can we always be sure that the boards of health in the city and State will succeed in protecting us, as well as they can, from the inroads of pestilence. Indeed, it is well to inquire whether Baltimore is now fortified as it should be against the hostile incursions of epidemic disease. In addition to its other func-

tions, this hospital will stand as a reserved force, — a sort of store-house of energy, ready to serve the city if apprehension and disease spread their pall upon it.

Here let me say, in anticipation of the future and in memory of the past, that, in all the records of bravery on land and sea, none are more noble than those of the medical profession. Free from all excitement, free from the hope of reward, free from any commands but those which are divine, they have in times of pestilence gone from bed to bed, firm, fearless, faithful, carrying the offerings of cheer, comfort, and relief, and often of restoration to health and vigor. For them there is no repose in time of danger. The black wings of death hovering over a city do not deter them from duty; and often it may be said of them, as Milton said of Abdiel, "faithful found among the faithless," faithful only they. Read the annals of modern pestilence, of cholera in New York, of fever and famine in Ireland, of yellow-fever in the South. Everywhere it is the same story. The more direful the record, the more unflinching, the more self-forgetful, the more humane, are the efforts of physicians.

While the offices of a hospital are bestowed without money and without price on those who are destitute, those who are able to pay for suitable attendance, and for the domestic comforts to which they are accustomed, may discover that they can here be better treated than in many private houses. The conditions of quiet are more easily secured; suitable diet at unusual hours can be commanded; medical attendance is within call at every moment of the day and night; manifold appliances for relief are more readily obtained. More and more frequently travellers, students, all whose homes are in hotels and boarding-houses, and even many who have good private homes, turn toward good hospitals when they see the need approaching for prolonged and special care. For the wants of such persons, provision has been made in the wards here set apart for paying patients, male and female.

This hospital would be a very narrow institution if it kept to itself its experience. It is the essence of quackery to deal in mysteries and nostrums: it is the glory of medicine that it owns no patents, and conceals no discoveries. On the contrary, the best hospitals of the world consider it one of their first duties, second only to the care of their patients, to record the cases they have treated, the methods they have pursued, the results, whether favorable or unfavorable, which have followed. Scientific studies in pathology and practical medicine must be printed. Special papers, often requiring costly illustrations, must be published upon extraordinary cases, and upon new operations and modes of relief. It is thus that the science of medicine is advanced. Where secrecy reigns, carelessness and ignorance delight to hide: skill loves the light.

It is impossible to have a hospital without its becoming a place for medical education. It is interesting to note that in the physician's oath, attributed to Hippocrates, the duty of imparting knowledge is explicitly enforced. Even the country doctor, as he rides from village to village, takes in his gig an observing pupil, like the squire to a knight-errant. Every great surgeon is watched with the closest attention by the younger physicians who assist him. Every mother is the pupil of the physician whom she calls upon to attend her suffering child. So, of course, a hospital, having upon its staff men of rare qualifications who are in daily consultation with their most skilful brethren, is, from the necessities of the case, a place for instruction. How systematic that instruction will be, depends on circumstances that at the moment need not be presented. All that need now be said is, that hospitals the wide world over are the schools of medicine and surgery.

The training of nurses is another form of hospital activity, recently developed, never hence to be abandoned. To the sisterhoods of the Roman Catholic Church, to the Protestant Deaconesses of Kaiserswerth and the Bethanien at Berlin, and to many guilds in many lands, much credit is due for lessons they have taught the world as to the importance of training nurses. Elizabeth Fry was one of the first Englishwomen to propose such instruction. Florence Nightingale, by her services in the Crimean war and by her subsequent writings, has borne a noble part in this work. So, too, have our own countrywomen. The civil war, full of sad recollections, has some bright stories, and among them none

¹ Ugo Bassi's Sermon in the Hospital, p. 13.

more inspiring than the labors of brave, self-sacrificing, and intelligent women in the hospitals. Who that has read "What we did at Gettysburg," or "Hospital Days," has forgotten their lessons? As a direct result of the war, nurses' schools have grown up in every part of this land. Our hospital has such a department soon to be opened, where nurses will be trained, not only for their merciful offices within these walls, but for household engagements, and for visiting among the poor.

A good hospital may readily become the rallying-place of the medical profession who are resident in the city.

"Through mutual intercourse and mutual aid
Great deeds are done, and great discoveries made;
The wise new wisdom on the wise bestow,
Whilst the lone thinker's thoughts come slight and slow."

One purpose of this central building is to afford opportunities for professional intercourse. Here are rooms set apart for the library that will presently be collected; here the medical journals will be taken in; here are the best appliances and instruments for the treatment of patients; here are rooms for private consultations and for public conferences; here are laboratories for physiological and pathological determinations; and it will not surprise me to hear that within a very short time medical associations are here brought together "for mutual intercourse and mutual aid" at the invitation of Dr. Osler, the physician-in-chief, who this day assumes his great responsibility with the hearty welcome of Baltimoreans, and with the well-earned confidence of the profession throughout the entire land.

Reference must also be made to the lessons that this hospital has already given to the world, before a single patient has been received. The vast amount of thought bestowed upon these buildings, not only in their general arrangements, but in thousands of details which promote their efficiency, has not failed to attract the attention of observers from every part of the globe. The letters which have been received during the last few days from the most distinguished surgeons and physicians abroad, and the presence of this large body of medical men from the distant cities of the United States, are indications of this interest.

Finally, if this hospital becomes the seat of knowledge in all that pertains to the nature of disease, its treatment, its prevention, and its cure, it will of necessity be a constant guide to the people of the city and the State in which it is placed; it will promote the general health of the inhabitants. There is an altar in one of the churches of Messina which bears an inscription to *Æsculapius* and *Hygiea*, the god of medicine and the goddess of health; and their statues are found together on the façade of Guy's Hospital. May they always be associated in Baltimore!

Is all this outlay wise? I might answer an inquirer in the words which Wordsworth employed in speaking of King's Chapel, one of the most costly structures in the University of Cambridge:—

"High Heaven rejects the lore
Of nicely calculated less or more.
Tax not the royal saint with vain expense;
With ill-matched aims, the Architect who planned
This glorious work of fine intelligence."

For in this hospital, as in that church, are

"Thoughts whose very sweetness yieldeth proof
That they were born for immortality."

But I prefer to give a more specific and appropriate reply to those (if any such there be) who say, "I believe in every thing that is practical, in whatever leads to the relief of suffering; but I am afraid of this talk about science. I would rather see a thousand beds for patients than any provision for medical education." Such reflections are to be heard with respect, for they are natural to minds unacquainted with the intimate relations which subsist between the progress of medical knowledge and the progress of medical art. Nevertheless it is true that those who have most carefully studied the conditions by which human life is perpetuated, human sufferings lessened, and human vigor increased, are well aware that every step forward in science leads to many forward steps in practice. May I endeavor to be a mediator between these two divergent views, and bring a few illustrations from the doctor's shop to the attention of those who are practically interested in hospitals,

but who have paid no attention to the steps, so slow, so difficult, so uncertain at first but so sure at last, by which the healing art makes progress.

The late Dr. Austin Flint of New York, in an address prepared near the close of his life, has pointed out with the wisdom of experience the probable future of medicine. It would be presumptuous for me to attempt to do again what he has done so recently and so well. But on this day of promise, in view of all this expenditure, it is fitting that we should bring to mind some inspiring thoughts.

Let us first consider the benefits which have come to mankind from the opportunities which hospitals have afforded for the observation of disease. There is no one among us more competent to speak upon this subject than the pathologist of this hospital, Dr. William H. Welch, who, years in advance of its opening, has been engaged as a professor of the university, in the study of the nature and origin of disease. He has called my attention to these noteworthy points:—

"Those who have contributed the most to the advancement of practical medicine and surgery have accumulated their experience largely in hospital service. By the constant attendance of skilful physicians and of well-trained nurses in hospitals, precise observations can be made, and the phenomena of disease and the influence of treatment determined, under the most favorable conditions.

"Our present knowledge of the natural history of disease, of its diagnosis, prognosis, and treatment, are based to a very large extent upon experience derived from hospitals. Text-books, monographs, and medical journals incorporate this experience, and bring it to the knowledge of the medical profession. This is why intelligent physicians are always eager to secure the advantages of a hospital service."

The benefits which medicine has received from purely scientific investigations may be shown by so many examples, that it is difficult to make a selection among them. Dr. Welch mentions these:—

"Upon the foundation laid by Helmholtz's researches in physiological optics, and his discovery of the ophthalmoscope, the art and science of ophthalmology have developed into the most accurate department of clinical medicine.

"The investigations which received their impulse from Du-Bois Reymond in the difficult subject of animal electricity have rendered electricity available for diagnosis and treatment, and have advanced thereby our knowledge of nervous diseases.

"Of the many ways in which the work of the chemist has aided medicine, may be cited, as one of its most recent contributions, the introduction into modern therapeutics of many useful remedies which are the products of synthetic chemistry. Doubtless this is a field which will be cultivated still further, and it would be rash to attempt to foretell what agents for the cure of disease and relief of suffering are still hidden in the chemist's laboratory.

"By the discovery of the specific germs causing various infectious diseases, surgical practice has been revolutionized. It has become possible to prevent the infection of wounds from the exterior, and thus to guard against a host of traumatic infections which rendered dangerous and futile so many surgical operations. Preventive medicine has taken its place among the exact sciences.

"Accurate knowledge of the causes of disease now forms a sure basis for intelligent therapeutics, and there is every reason to expect that the future will bring to light means to overcome the injurious agents which are now, for the first time, known."

But there is another illustration so marvellous that it may almost be called miraculous. The relations of advancing knowledge to advancing charity are brilliantly displayed by the history of methods for the relief of pain.

To put a stop to suffering is an instinct of human nature, distinguishing man from animals. The most scientific men, and the most practical, are agreed upon this, and have been so agreed for centuries. But Anæsthesia, most welcome of all the angels of mercy, came down from heaven. When the older surgeons in this assembly were students, opium and alcohol were the imperfect anæsthetics most usually employed. Their use was restricted and unsatisfactory, if not dangerous. No one can tell what was suffered in places where gentle sleep now quiets apprehension, and

makes the patient unconscious of his state. To this alleviation we are so wonted, that we accept it as the air we breathe. But if you would learn how man secured this boon, how many efforts of scientific and of practical men were combined before the results were reached, recur to the history of four modern agencies, — nitrous oxide, ether, chloroform, and cocaine, — which are like "the gentle dew from heaven, which blesteth him that gives and him that takes." It is a chapter more wonderful than any romance of the Arabian Nights.

Let any one present who is sceptical in respect to the usefulness of science to the healing art keep this record in his mind. Let him reflect on the apprehensions that have been removed not only from the patient, but from his attendant friends; let him see how much easier, and therefore how much more certain, the task of the surgeon has been made; and, above all, let him think of the hours of pain that have been absolutely annulled: and then let him divide the honors, if he can, which belong to science, from those which belong to philanthropy. Let him balance half a century of scientific relief with the previous practice of many thousand years: then let him tell us which is better.

From the past let us turn to the future. All the signs of the times point to a new era in the history of mankind. All the sciences are leading up to a better understanding of the laws of life, to a true anthropology, and the consequent improvement of the physical, mental, and moral powers of man.

There are four or five directions toward which we may turn an expectant gaze, as in days gone by the merchants watched upon the house-tops for the return of the ships they had sent out to distant ports.

Preventive medicine promises to do more and more for mankind. As the germs of many specific disorders have been discovered, so the means of their destruction have been found out. If legislation and civil administration keep up with science, if knowledge is controlled by virtue and followed by temperance, the community will be freed from many of the foes which in former generations have slain their tens of thousands.

From the chemical laboratory new remedies, as well as simpler forms of old remedies, are to be constantly looked for. The synthetic processes which now receive so much attention have lately made important contributions to the pharmacopœia. It would surprise any one whose attention has not been directed to this point to know how many claimants are awaiting judgment. Scores of substances, till lately unknown, as I have heard my colleague Professor Remsen say, are awaiting the study of competent therapeutists. Nobody can foretell what will come from their new contributions to *materia medica*; but one who watches the processes of discovery must feel certain that secrets hid from the beginning are ere long to be revealed, and that many of the substances already discovered have properties of the most serviceable character.

No one can say what will result from the attention that has been recently given to the study of psychological phenomena by the exact methods of science, but the outlook is hopeful. If we are as far as ever from elucidating the mysterious inter-relationship of the mind and the body, progress has certainly been made in a knowledge of the laws by which they act upon each other. The knowledge that has been required in respect to the functions of the brain and nervous system has already led to the treatment of many disorders, and the relief of many diseases, which a short time ago were beyond the reach of remedy. We are not without hope that in the physiological and psycho-physical laboratories already established here, important contributions will be made to science which will ultimately prove to be of value to medicine, and to the conduct of the body in health and disease.

Medical appliances and surgical instruments are greatly to be improved. A surgeon who has just returned from Europe, after visiting in the interest of this hospital the most celebrated instrument-makers, has informed me that the processes of manufacture even now are behind the devices and requirements of surgical science. The hands of the artisan have not kept up with the brains of the chirologer. It is not possible to buy ready made the instruments required by this hospital.

In the near future we are to look for progress in the applications of electricity and magnetism to the treatment of disease as well as

to its diagnosis. Chemistry, by its synthetic methods, is producing new remedies, which experimental therapeutics proceeds to test, and pharmacy then appropriates. The laws of light, heat, electricity, and magnetism, are found in close relationship to the problems of relief and cure. The laws of temperature and climate have their services to render. Even the influence of barometrical pressure upon surgical operations begins to be noticed. The study of the nervous system is sure at no distant day to make important contributions to the welfare of man. Psychology is waiting for the results. Experimental physiology is doing its part. Pathology, a term as old as Hippocrates, has become a new science within the last few years. The laws of descent have but just begun to assume a scientific form. Preventive medicine is almost a new conception. The morality of personal hygiene is a new department of ethics. Biology, after having met with the same critical reception with which anatomy, astronomy, geology, and chronology were greeted, may yet be honored as leading to the highest and noblest conceptions of humanity. Anthropology, and the knowledge of man in his relations to the universe in which he is placed, may sum up finite knowledge.

So all along the line, in the laboratories of the university and in the wards of the hospital, knowledge is contributing to the welfare of man. The days of the coming man may not always reach the full allotment to which Chevreul has just attained; but perhaps to die at seventy will be to die in youth, and to reach the age of eighty or ninety in health and vigor will be the rule, and not the exception. Nor is length of days our only hope. The disappearance of epidemics; fewer days of confinement in sickness; fewer "minor ailments"; a decrease of infantile mortality; greater powers of resistance to the evils of certain occupations, and comparative immunity from many infirmities which are now common; artificial re-enforcements and replacements of bodily defects; simpler and surer means of diagnosis; the detection of the nature, origin, and history of specific affections; and finally the assurance of euthanasia, — these, as it seems to a layman, are reasonable expectations which the nineteenth century holds out to the twentieth. Can any outlay be too great if humanity is thus benefited?

To the attainment of these noble aims — "the relief of suffering and the advancement of knowledge" — the foundations of Johns Hopkins are forever set apart. On the one hand stands the university, where education in the liberal arts and sciences is provided, and where research is liberally encouraged; on the other hand stands the hospital, where all that art and science can contribute to the relief of sickness and pain is bountifully provided. Is there any thing wanting? Yes, there is still a great want to be supplied, an arch to rest upon these pillars. An institute of medicine and surgery, a college of physicians and surgeons, a medical school the office of which shall be to promote the training of young physicians and the encouragement of medical science, is imperatively needed. Is it too much to say that there is not such an opportunity on the face of the globe for another Peabody or another Hopkins to benefit his fellowmen?

The university needs all it has, and more, to carry on the non-professional courses to which its funds are appropriated. The hospital, with all its readiness to co-operate in the advancement of knowledge, will, after all, remain — as I have said before, and cannot say with too much emphasis — the home of the sick, the feeble, the injured, and the dying. It is the house of mercy, not the hall of philosophy. But in close alliance with both these foundations there is a place for a school of medicine, which may bear its founder's name, and may render services as significant and memorable as those of Salerno and Bologna, at the beginning of the modern era; as those of Leyden and Edinburgh, where the earliest American physicians received their education; or as those of Berlin and Vienna, to which so many students of this decade resort.

This grateful city should no longer delay placing upon one of the squares near the monument of Washington the figure of Johns Hopkins, with such designs as an artist, and an artist only, could devise, to typify the great ideas which underlie his gifts, — "the advancement of knowledge and the relief of suffering." Then might some friend of this hospital place beneath this dome a copy of Thorwaldsen's "Christus Consolator," with the outstretched

hands of mercy, to remind each passer-by — the physician and the nurse, as they pursue their ministry of relief; the student, as he begins his daily task; and the sufferer from injury or disease — that over all this institution rests the perpetual benediction of Christian charity, the constant spirit of "good will to man." Upon one hill of Baltimore rises a temple "whose guardian crest, the silent cross," is an emblem of the Christian faith; upon another a lofty column reminds us of the patriots' hope; upon a third the Hôtel-Dieu is placed, — the house of charity. Significant triad! Here "abideth faith, hope, charity, . . . but the greatest of these is charity."

BOOK-REVIEWS.

Economic Value of Electric Light and Power. By A. R. FOOTE. Cincinnati, Robert Clarke & Co. 16°. \$1.

The author of this little book claims that the spirit moved him, as it were, to write it *pro bono publico*. The book is essentially a collection of papers read before scientific societies, and extracts from magazine articles on the applications of electricity for producing light and in the transmission of power. Mr. Foote is a strong believer in the future of electricity as an agent in furthering human comfort, and we doubt not that many who may be pondering on the question of introducing electricity in their homes or factories will find valuable suggestions within the covers of this book. In an appendix is given a glossary of electrical terms for the benefit of unprofessional readers.

Treatise on Trigonometry. By W. E. JOHNSON. London and New York, Macmillan. 12°. \$2.25.

THIS work is intended for both those who are beginning the subject and hope to continue their mathematical studies, and those

who wish to revive their knowledge of trigonometry and to extend it beyond the limits of the ordinary text-book. The treatise is so written as to make a good introduction to much of the higher mathematics; Chapter IX., on the geometry of the triangle, being sure to help those desirous of entering upon modern geometrical developments, and the final chapter presenting a fair view of the transition from the earlier interpretations of $\sqrt{-1}$ to the quaternions of Hamilton.

AMONG THE PUBLISHERS.

HARPER BROTHERS published last week H. Rider Haggard's story of "old and mysterious Egypt," entitled "Cleopatra: being an Account of the Fall and Vengeance of Harmachis, the Royal Egyptian, as set forth by his own hand." The book is profusely illustrated from drawings by Mr. Greiffenhagen and R. Caton Woodville.

— D. Lothrop Company have issued recently, among many other books, "One Voyage," a story of life at sea from the passenger's point of view, by Capt. Julius A. Palmer; also a pictorial "History of England in Rhyme," and a similar one of the United States. Later they will publish new editions of "Art for Young People" and "Adventures of the Early Discoverers," by Mrs. F. A. Humphrey.

— The J. B. Lippincott Company have in preparation "Elementary Lessons in Heat," by Professor S. E. Tillman, of the United States Military Academy; and a new subscription-book entitled "A Manual of Machine Construction," a practical reference-book for the design, proportions, and method of constructing all kinds of machinery in common use, with all required references for the use of engineers, draughtsmen, and mechanics, by John Richards.

Publications received at Editor's Office,
June 17-29.

- ALDEN'S *Manifold Cyclopaedia of Knowledge and Language*. Vol. XIII. Electricity to Exclaim. New York, J. B. Alden. 12°. 50 cents.
- BLANFORD, H. F. *A Practical Guide to the Climates and Weather of India, Ceylon and Burma and the Storms of Indian Seas*. London and New York, Macmillan. 356 p. 8°. \$3.50.
- DORRIT, SOPHIE. *The Beguines' Book in German*. Boston and London, Ginn. 273 p. 12°. 90 cents.
- GEFF, C. G., and HAIGH, A. E. *A Latin-English Dictionary*. Boston, Ginn. 563 p. 12°. \$1.40.
- LIGHT on the Path, with Notes and Comments by the Author. Written down by M. C. Boston, Theosophical Book Co. 63 p. 16°. 30 cents.
- LOEWY, B. *A Graduated Course of Natural Science*. Part I. London and New York, Macmillan. 151 p. 16°. 25 cents.
- MEADOWCROFT, W. H. *The A B C of Electricity*. New York, Lovell. 103 p. 12°. 50 cents.
- PENNSYLVANIA Geological Survey. *Catalogue of the Geological Museum*. Part III. Harrisburg, Geol. Surv. 260 p. 12°.
- Atlas Northern Anthracite Field. Part III. Harrisburg, Geol. Surv. 8 maps. 1°.
- Atlas to Reports III and IIHH. Harrisburg, Geol. Surv. 56 p. 5 maps. 8°.
- PLATO'S *Protogoras*; with the Commentary of Hermann Sauppe. Tr. by James A. Towle. Boston and London, Ginn. 179 p. 12°. \$1.50.
- SMITHSONIAN INSTITUTION. *Annual Report of the Board of Regents of the, for the Year ending June 30, 1886*. Part I. Washington, Government. 875 p. 8°.
- Two Great Retreats. I. The Retreat of the Ten Thousand. II. Napoleon's Retreat from Moscow. With Introduction and Notes by D. H. M. Boston, Ginn. 318 p. 16°. 60 cents.
- U. S. WAR DEPARTMENT. *Annual Report of the Chief Signal Officer of the Army to the Secretary of War for the Year 1888*. Washington, Government. 418 p. 8°.
- WERNER, A. *Essays upon Heredity and Kindred Biological Problems*. Oxford, Clarendon Pr. 455 p. 8°. (New York, Macmillan.)

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NORTH AMERICAN REVIEW.

JULY, 1889. CONTENTS: DISCIPLINE IN AMERICAN COLLEGES. S. C. Barlett, President Dartmouth; Jas. B. Angell, President University of Michigan; Prof. N. S. Shaler of Harvard; Charles K. Adams, President Cornell; William D. W. Hyde, President Bowdoin; Sir J. W. Dawson, Principal McGill University; Horace Davis, President University of California. An English View of the Civil War.—L. Lord Wolsley. The Telegraph Monopoly. . . . Prof. Richard T. Ely Our Future Navy. . . . Rear Admiral S. B. Luce, U.S.N. The Throne in England. . . . Justin McCarthy, M.P. Our Ignorance of Alaska. . . . Kate Field The Negro Intellectual. . . . William Matthews, LL.D. A Plague of Office Seeking. Gen. Charles B. T. Collin TRIBUTES TO ALLEN THORNDIKE RICE. William Waldorf Astor, Edwards Pierpont, Gen. William H. Sherman, Lloyd Bryce (by cable).

NOTES AND COMMENTS. Foreign Influence on American Fiction. . . . Maurice Thompson American Anagnies. . . . Felix L. Oswald The Future of the Newspaper. . . . Julian Proctor Abolishing Poverty—on Paper. The Rev. J. B. Wasson "Thought-Transference." . . . W. A. Credit Protection for Our Language. . . . N. A. Campbell French Proper Names in English. . . . M. B. Thrasher Fifty cents. All Newsdealers.

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HEAVEN AND HELL, by EMANUEL SWEDENBORG, 416 pages, paper cover. Mailed pre-paid for 14 CENTS by the American Swedenborg Printing and Publishing Society, 20 Cooper Union, New York City.

—The opening article in the *Political Science Quarterly* for June is by Albert Shaw, on "Municipal Government in Great Britain." It is not a history, but an account of the existing system of municipal government, which differs in important respects from that prevailing in the United States. The governing authority in British cities is the Common Council, the members of which are chosen by districts, and which has the appointment of the mayor and other administrative officers. The mayor is always a member of the council, and holds office for only a short time, while the other appointive offices are held for life. Mr. Shaw thinks this system greatly superior to the American, because it centres both power and responsibility in what is really a committee of the citizens, while in America responsibility is practically destroyed by the division of power and the complicated system of checks and balances. He also disapproves giving the mayor of a city such great power as the mayor of New York now wields, and remarks that "the one-man power is on the decline everywhere in this age." The article ought to be read by every American who is interested in municipal affairs. The next paper in the *Quarterly* is by J. H. Dougherty, on the "Constitutions of New York," the first part of which was published in September of last year. It is purely historical, and contains nothing specially new or striking. Another historical paper is that of J. W. Jenks on "The Whiskey Trust." The writer does not inquire into the legality of the trust nor into its economic effects, but merely relates the circumstances of its formation and development; and those wishing for information on these points will find it in this article. Mr. E. P. Cheyney discusses the recent decisions of the courts in "Conspiracy and Boycott Cases," and thinks that they have been too harsh against the labor-unions. He believes the judges have been too much influenced by legal precedent, and have not given sufficient attention to the changed condition of industry and society. Mr. F. W. Whitridge writes on "Rotation in Office," strongly condemning the United States law which provides that all officers appointed by the President and Senate shall hold office for only four years, which he justly holds to be one of the main supports of the spoils system. Besides these essays and a number of book reviews, the *Quarterly* contains a "Record of Political Events" from October to May, which is evidently the continuation of those formerly published in the *New Princeton Review*, which has now been merged with the *Quarterly*.

—Professor W. G. Sumner is to contribute to the *Popular Science Monthly*, as the opening article of the July number, a discussion of the question, "What is civil liberty?" in which he reviews the ideas of liberty that have prevailed, and the relations that rights and duties have borne to each other, in the past, and points out the tendencies that threaten civil liberty in the present. "Christianity and Agnosticism" is the title of a further reply to Professor Huxley, by Rev. Dr. Henry Wace, which will be printed in the July issue. In this paper Dr. Wace undertakes to show that his opponent's latest arguments are evasive and involve numerous fallacies; he also courteously criticises Mrs. Humphry Ward, whom Professor Huxley had cited with approval. What man has done and may do to lessen or increase the abundance of those food-fishes that have the wide ocean for their home, is told in an article on "The Artificial Propagation of Sea-Fishes," which Professor W. K. Brooks will contribute; and the railway problem now before the country will be treated by Mr. Benjamin Reece, under the title "Railway Maladjustments." Mr. Reece maintains that our laws favoring railroad-building have produced an excess of roads, which must be either a loss to the investors or a burden to the public, and that the Interstate Commerce Law is a clumsy expedient which takes little note of the working of economic forces.

—D. C. Heath & Co. will publish, July 20, "An Introduction to the Study of Shakspeare," by Hiram Corson, professor of English literature, Cornell University. It will be an attempt to indicate to the student some lines of Shakspearian study which may serve to introduce him to the study of the plays as plays. The commentaries presented on "Romeo and Juliet," "King John," "Much Ado about Nothing," "Hamlet," "Macbeth," and "Antony and Cleopatra," aim chiefly to present the points of view which are demanded for a proper appreciation of Shakspeare's general attitude

toward things, and his resultant dramatic art. An attempt is made to show the moral spirit with which he worked, as distinguished from a moralizing spirit, which it seems all-important to appreciate. Herein consists the transcendent educating value of the plays. To come into the fullest possible sympathy with this moral proportion, with this harmony and truthfulness, should be the highest aim of Shakspearian culture.

—P. Blakiston, Son, & Co., medical and scientific publishers, booksellers and importers, 1012 Walnut Street, Philadelphia, have just ready "The Cerebral Palsies of Children," a clinical study from the Infirmary for Nervous Diseases, Philadelphia, by William Osler, M.D., F.R.C.P., London; physician-in-chief Johns Hopkins Hospital, Baltimore; late professor of clinical medicine, University of Pennsylvania.

—Messrs. Ginn & Co. of Boston have for some time been publishing a series of classics for children, with the object of introducing the young to a better class of literature than most of them now read. The different volumes of the series comprise stories of various kinds, biographical and historical works, and any others that seem suitable for young readers. The series has proved successful in a mercantile sense, and already comprises more than thirty volumes. The latest issue is entitled "The Two Great Retreats of History," and contains Grote's account of the retreat of the ten thousand Greeks, and an abridgment of Ségur's account of Napoleon's retreat from Moscow. Count Ségur was an officer in the French army and an eye-witness of the scenes he relates, and his story of the great disaster in Russia has long been celebrated. The two works together make an interesting volume, and can hardly fail to hold the attention of all young people that can appreciate historical events.

—The *Magazine of American History* opens its July number—the beginning of its twenty-second volume—with a "Story of the Washington Centennial," illustrated from photographs by amateurs and other artists, executed during the progress of the celebration. It is safe to say that no great public event was ever before seized in all its interesting particulars, and placed before the popular eye, with such felicitous results. The truthful pictures of the scenes are rendered doubly attractive and valuable through the portraits of the distinguished characters in our national life of to-day appearing in them. The view of the assemblage on the steps of the Sub-treasury Building in Wall Street is good, and every reader will be able to recognize in the picture the distinguished men present whose faces are best known. "The Discovery of the Mississippi" is the second paper, an instructive study by Henry Lee Reynolds. "Washington and William the Silent—a Parallel," is an article by M. M. Baldwin. Judge Dykman contributes the second part of his account of "The Last Twelve Days of Major André." Gen. Alfred E. Lee writes a paper, entitled "Some Glimpses of Holland," in which he gives us a general idea of the habits and customs of our Dutch ancestors, and a better knowledge of our Dutch cousins in their homes. There is a sketch of Hon. Robert C. Winthrop, by Daniel Godwin; and a short paper on Col. William S. Smith, the son-in-law of John Adams, by M. D. Raymond. There are other short articles, and the notes furnish fresh and curious data.

—Roberts Brothers published on the 25th, in two handsome octavo volumes, "Rogers and his Contemporaries," by P. W. Clayden, containing hitherto unpublished letters from Lord Byron, Wordsworth, Coleridge, Walter Scott, Everett, Daniel Webster, Prescott, Ticknor, Irving, and Sumner, all of which furnish abundant materials for forming a just estimate of Rogers's place in English literature and social life; "By Leafy Ways," by F. A. Knight, describing wild life in Old England in as interesting a manner as John Burroughs does that of New England, with fine illustrations by E. T. Compton; the second part (July to December) of E. E. Hale's "Sunday-School Stories;" and "Sunday-School Stories for Little Children," by Lucretia P. Hale and Mrs. Bernard Whitman.

—*Medical Classics* for June includes articles on "The Care of the Hands, Finger-Nails, and Nail-Brushes;" "The Doctor in the Kitchen;" "Fruit as a Food;" "Strawberries as Food and Medicine;" "Blond Hair;" "Wakefulness;" "Early Rising;" "Vaca-

tion Victims;" "The Gospel of Rest;" "The Legal Liability of Doctors;" "The Danger of Ignorant and Indiscreet Bathing;" "Bleaching the Hair;" "The Filtering of Drinking-Water;" "Liver-Spots;" "Typhoid-Fever on Long Island;" "Lotions for Freckles, for Red Hands, for keeping the Hands Soft and Smooth;" etc. There is also a very interesting article on "The Policeman as an Autocrat, and Clubbing and its Effects," by Capt. Gunner of the New York police.

—Mr. Gladstone has an article in the *Nineteenth Century* for July, entitled "Plain Speaking on the Irish Union." In it he says, "Sir Richard Webster, in examining William O'Brien before the Parnell Commission, implied that a grave charge would be proved against certain Irishmen if it could be shown that they regarded English power as alien. I should like to have asked Mr. O'Brien whether the Irish, so far as he knew, regarded the Act of Union as possessed of the same moral authority as the laws against theft and murder, or as possessed of moral authority at all. I do not doubt that Mr. O'Brien would have answered that they regarded it as an act of force to which Ireland was under, not a moral, but only

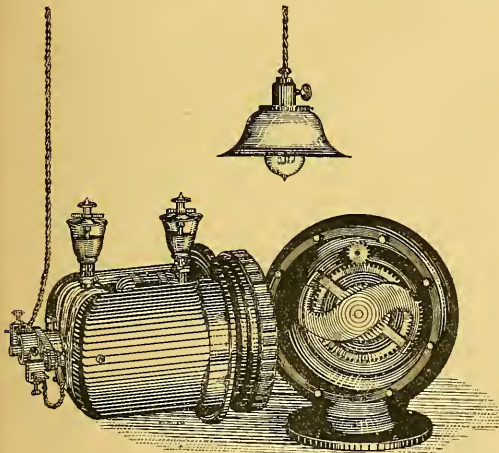
a prudential obligation to conform. There may be immorality in miscalculated resistance even to immoral laws, but such resistance is not in itself immoral. The question is, whether worship of the Act of Union is piety or superstition."

—Mr. George John Romanes, the distinguished author of "Mental Evolution in Man: Origin of Human Faculty," will contribute to *The Open Court* of July 11 (Chicago) an article entitled "The Psychic Life of Micro-Organisms." The public will recall M. Binet's able series of essays in Vol. II. of *The Open Court*, in which the soul-life of these tiny and interesting beings was so carefully discussed. The essays were afterwards published in book form by The Open Court Publishing Company. In a preface written especially for the American edition, M. Binet took issue with Mr. Romanes relative to the stage in animal development at which psychological powers first appear. The criticism has attracted much attention. The eminent English scientist, in turn, now replies to the strictures of the French *savant*. The controversy will be of interest to all. To those who have read M. Binet's monograph the reply of Mr. Romanes will be an appropriate supplement.

INDUSTRIAL NOTES.

A Combined Water-Motor and Dynamo.

A COMPACT combination of a water-motor with an electric generator, now being placed on the market by the Belknap Water Motor Company of Portland, Me., is shown in the accompanying illustration. It is intended for small plants of from ten to fifty or more 16-candle-power lamps. In the engraving the dynamo and



COMBINED WATER-MOTOR AND DYNAMO.

water-wheel are shown detached from the wheel-case and stand or base. The gear-wheel and pinion seen in the wheel-case operate the devices which control the flow of water to the wheel, thus governing the speed of the motor and dynamo. Water under the requisite pressure is admitted at the centre of the case, in the rear, passes through the curved arms shown in the case, whence it impinges upon the curved buckets of the wheel, at the inside, and escapes at the exterior of the wheel, passing away through the base of the motor casing. The wheel is an outward-flow turbine or vortex wheel, mounted on the same shaft as the armature, and may be run at a speed ranging from one thousand to three thousand revolutions a minute, according to the head of water available. Several of these novel electric-light plants are now in operation, and are said to give great satisfaction.

Aside from its use in connection with a dynamo, this motor, the "Little Giant," as it is called, is used for a variety of purposes, having been on the market some eight or ten years. In many towns and cities of the United States and Canada, where water at

a pressure of twenty-five or thirty pounds may be had at a reasonable price, these motors, ranging in size from seven to twelve inches in diameter, are successfully running printing-presses, lathes, saws, jewellers' and dental tools, organs, sewing-machines, and coffee, spice, and drug mills.

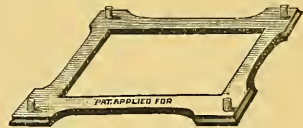
Graduated Glassware and Bohemian Beakers.

James W. Queen & Co., Philadelphia, have recently made arrangements for the manufacture of chemical glassware of fine quality, and call particular attention to the accuracy of their graduated ware, such as burettes, pipettes, volumetric flasks, cylinders, etc. These goods are made abroad, by experienced workmen, of the best German glass.

In order to satisfy themselves still further, as well as their customers, as to the quality of the apparatus, they selected at random a number of each of the articles mentioned above, and sent them to William H. Greene, professor of chemistry in the Philadelphia Central High School, asking him to submit them to a comparison with his "standard instruments," made by Geissler of Bonn. The results of these tests, as shown in a letter from Professor Greene, are highly satisfactory.

A Rubber Mat for Type-Writers.

A useful device, manufactured by the United Rubber Company of Trenton, N.J., is shown in the accompanying illustration. It is a rubber mat, to be placed under a type-writing machine for dead-



ening the clicking noise of the type, which, even in the best of type-writers, sometimes becomes annoying. The mat reduces the noise to a minimum, and is made in various sizes and styles to fit machines of different makes.

Notes on Electric Railways using Thomson-Houston System.

The popularity of electric railways is evidenced by the recent purchase of the Des Moines Broad Gauge Railway, equipped with the Thomson-Houston system, by a wealthy Chicago syndicate; the purchasing price being \$350,000, some three times the original cost of the road. When equipped with horses, this road did not pay operating expenses; but, since its equipment and operation under the Thomson-Houston system, its net earnings will pay 3 per cent dividends upon an investment of nearly \$400,000. The road has never had a repair-shop for its electrical apparatus; and in a recent conversation its president said that they did not know what electrical repairs meant, as they had had none to make. In some respects the Des Moines road has been the most wonderful

in results of any electrically equipped road; it having at its power-station but one 30-horse-power generator, which operates eight cars over grades running as high as 10 per cent without indications of overheating, and frequently tow-cars are used with those equipped with motors. On one branch of the system the necessity of speedy equipment compelled the use of a No. 2 copper wire without feeders, such wire being the only available material; yet, with this small conductor, the cars are run at a rate of six miles per hour up a 10-per-cent grade, three miles distant from the station.

The Omaha and Council Bluffs Railway and Bridge Company are progressing rapidly with the electrical equipment of the recently purchased horse-car lines in Council Bluffs. For the operation of such lines they have purchased ten additional motor-trucks and two generators from the Thomson-Houston Electric Company. In placing this order for additional apparatus, the management of the road state, in a letter to the Thomson-Houston Company, that

they consider their present line equipped with the Thomson-Houston system the most perfect electric railway in the world.

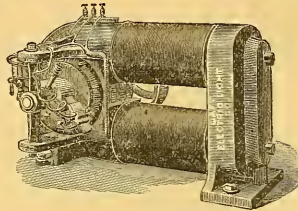
The Omaha Motor Railway Company is nearly ready to begin operations with the Thomson-Houston electric system. The largest power-station which has yet been constructed for electric-railway operation is owned by this company, and the car-equipment ranks second in quantity among electric railways yet constructed, it having twenty-six motor-cars, each of which will be used to tow at least one additional car, and many of the motor-cars will tow two additional cars. The success of the Thomson-Houston system on the Omaha and Council Bluffs line has made the citizens of Omaha jubilant at the immediate prospect of such rapid transit being given them over their entire city. In addition to the equipment ready to be put in, the company intends to add twenty additional motor-cars upon the extensions to its system within a few months.

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The Committee has recently returned and has made a very interesting Report upon the general development of Kansas and Nebraska as well as the business of the Company. The Company will be glad to send this Report to any address.

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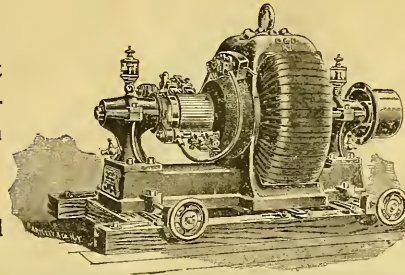
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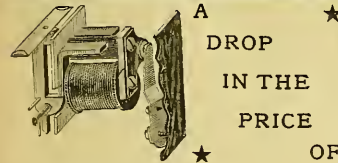
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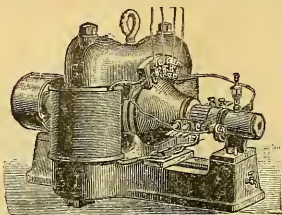
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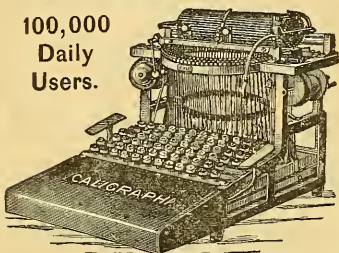
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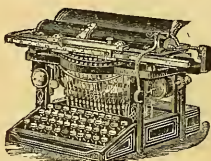
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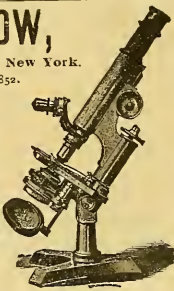
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SEVENTH YEAR.
VOL. XIV. No. 336.

NEW YORK, JULY 12, 1889.

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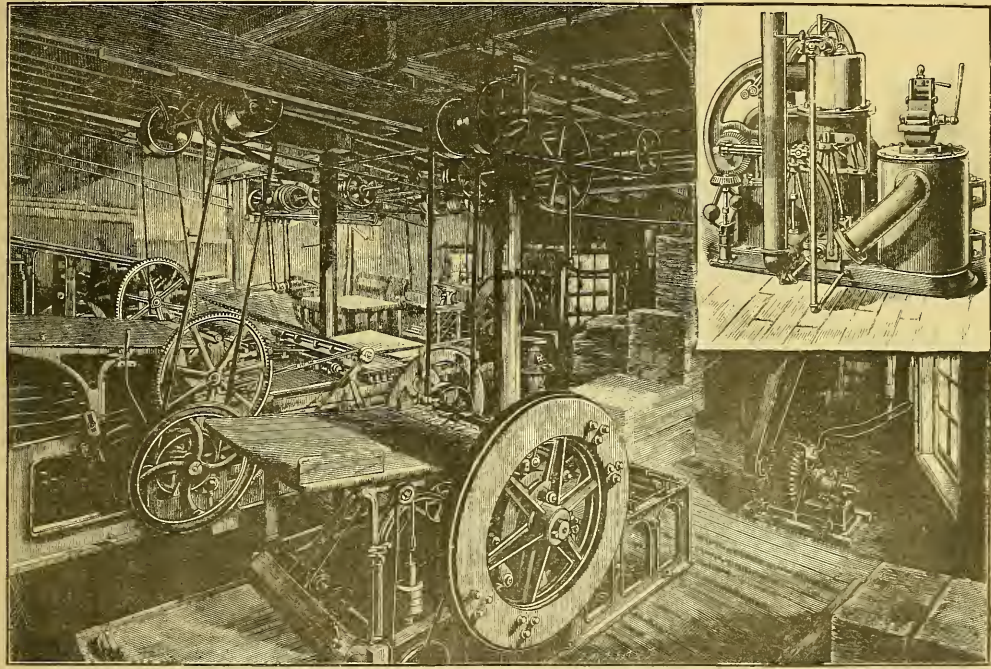
ELECTRIC MOTORS IN PRINTING-OFFICES.

ONE of the many uses found for the electric motor is to furnish power for running printing-presses. There are quite a number of them used for that purpose in this city; and so well and economically do they work, that a rapid development of the electric-motor trade in that direction is now going on, not only in New York, but in all parts of the country.

A recent installation of electric motors in the press-room of a newspaper of wide circulation is worthy of notice. Some weeks

sult, the *Washington Star* of June 29, as well as the subsequent issues, were printed upon electrically driven presses.

The machinery of the press-room shown in the picture on this page, that of a firm of printers in this city, is driven by the little 5-horse-power C. & C. motor shown in the lower right-hand corner, which displaced the large hot-air engine shown in the view above it. The machinery in the office consists of five large and three small printing-presses, a 28-inch paper-cutter, and a pump 2.5 by 8 inches, lifting water forty feet. Where there are many small industries in a limited area, as is the case in all large cities, the



C. & C. ELECTRIC MOTOR OPERATING THE MACHINERY OF A PRINTING-OFFICE.

ago the walls of the *Washington Star's* press-room gave way, ruining the steam-engine, throwing the shafting out of place, and completely disabling the office. The only means of quickly resuming work that could be thought of was to put in an electric motor of sufficient power, thus rendering the presses independent of engine and shafting. The Washington agent of the C. & C. Electric Motor Company of this city, being appealed to, telegraphed at once for a 15-horse-power motor, which was shipped immediately, installed, connected with an electric-light circuit, and started up. As a re-

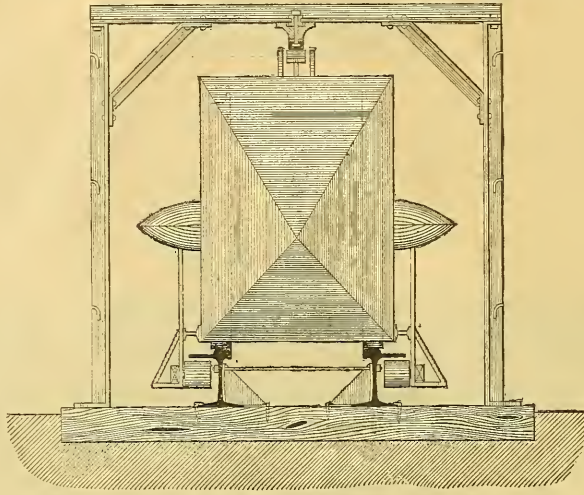
electric motor is peculiarly economical. Instead of a number of steam-plants scattered about in different buildings, one large engine with dynamos can supply electric current to a great number of motors, each using only the power required, and none wasting power when idle. Besides supplanting small steam, gas, and hot-air engines, the electric motor is in many places opening out a new field for itself as a substitute for foot and hand power in several branches of industry, its compactness and cleanliness being strongly in its favor.

THREE MILES A MINUTE.

THE following account is sent us by the company interested, of what is claimed to be a great railway invention for the transportation of mails and light freight. The Weems railway system, incorporated under the name of the Electro-Automatic Transit Company of Baltimore, has patented its multiplicity of electrical and mechanical appliances in the United States and all over the world as a preliminary to putting the system regularly to work wherever required. By this electro-automatic arrangement the morning

in the surface of the ground over which the road passes. The mail and express cars are telescoped in forming a train, the former into the end of the motor-car, and the latter into that of the one preceding it, forming a flexible train of cars, offering an unbroken surface to the air. The rear end of the rear car is pointed in a similar manner to the front of the motor-car, thus preventing any suction as the train rushes on its way. The motor may pull one car or a train of cars.

All trains will be controlled from a generating station, where will be placed an electrical generating plant. Electrical brakes are

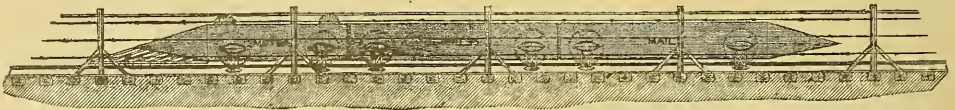


END VIEW OF THE WEEMS ELECTRO-AUTOMATIC RAILWAY.

papers may be delivered for the breakfast-table, and the evening papers before supper-time, at distant points. It will deliver letters almost with the promptitude of the telegraph sending a message. The mails between New York and Omaha will be carried in a night. It will handle perishable light freight from long distances, will deliver with celerity the mails and parcels in cities and suburban towns, and will multiply many times the business of the post-office and express companies. Its advantages are not alone in its speed, but in the economy and frequency with which trains can be despatched. In addition to all these things, it will save interest on remittances at long distances, will bring the people closer together,

to be used, and trains are started, stopped, speed lessened, and backed at will from the station. Special appliances will inform the operator in charge of the generating station of the exact location of the train from the time it leaves or passes any given point until it reaches its destination. It has not yet been determined how far apart the generating stations shall be placed. Possibly 100 miles may not be out of range, as the current can be run for 50 miles each way from the station as a centre without much loss of electricity.

The patents of the company number 143 in the United States and the principal countries of the world, covering the vital details



THE WEEMS ELECTRO-AUTOMATIC RAILWAY.

and will create new enterprises. Doubtless, as in the case of the telegraph, its important uses cannot be anticipated in advance of its going into active operation. Its development will create new fields of usefulness not now thought of. Such, in brief, are what the persons interested in this invention claim for it.

The motor-car is 18 feet long and 2½ feet square at each end. It is pointed in front, the wedge or point being below the longitudinal centre, adjusting it to the air pressure, thus keeping the car down to the track. To reduce atmospheric friction to a minimum, all wheels and electrical appliances are placed within the walls of the cars. The road is to be built on the surface of the ground, with track of 24 inches gauge, and will cost about \$5,000 per mile. In thickly settled districts the road can be elevated, the varied length of the uprights being a cheap mode of covering irregularities

of this novel system. The principles patented involve special form of rail, making it impossible for trains to jump the track at any rate of speed; form of electrical safety rail, carrying the outgoing current and returning the same on the same rail (this rail can be crossed by pedestrians or vehicles with perfect safety); form of conductors and rails combined, with insulation of the same for carrying currents over long distances; means of starting, stopping, backing, and controlling trains from the generating stations; method of regulating the electrical current automatically on trains while in motion, increasing the power in ascending and decreasing the same in descending grades; means whereby trains automatically register themselves at every station as they pass every mile of track; form of journals and boxes for fast speed to avoid heating; reducing the air pressure at high speed to a mini-

mum by pointed cars splitting the air in front, and preventing suction in the rear, while in transit; reducing the cross-section of cars to a minimum, and enclosing the wheels and electrical equipment within the walls of the same to offer as little resistance to the air as possible; telescoping the cars of a train to present to the air an unbroken surface; special switch for rails; keeping the centre of gravity of the whole train below the axles. Patents have also been secured for a passenger system which applies to the conversion of existing steam railroads into electric railroads, which cover the only safe mode of rapid transit for passengers.

A series of experiments have been made at Laurel, Md., to show what the Weems railway system will do. This experimental line is a circuit of exactly two miles. Over this route there are 29 changes of grade, some of them very heavy, even to the extent of 108 feet to the mile. The generating plant there contains all the electrical appliances necessary to the attainment of high speed by a railroad-train. There is also special machinery for experimentation, and the perfecting of all mechanical and electrical inventions tending to advance and improve the system. All tests of speed have been made upon heavy grades and curves combined, too great ever to be required in the construction of a commercial line: therefore the experiments demonstrate the high rate of speed which will be obtained upon lines built for business purposes. At this experiment station 2 miles per minute are made around a heavy curve, or the equivalent of 180 miles an hour, or 3 miles a minute, on a level track. Prior to the inauguration of this system, 20 miles per hour was the fastest time ever made by any kind of electrical railroad travel.

At the experiment station there are no extensive works; and the motor-car, when it comes out from under its shed in obedience to the will of the engineer in the distant plant building where the electric dynamo generates the current, moves deliberately, slowly, and with absence of all sound. This cigar-shaped car, painted a bright red and moving sharp end foremost, at first sight does not seem a wonderful thing as it goes quietly along the track; but later, when the engineer at the dynamo puts on more power, or, as a steam-car man would say, more steam, and the creeping thing on the ground hastens its movement until it fairly flies, and becomes a moving speck of red, spectators feel the progress being made in applied science, and talk of the wonders of electricity, and the great things it will accomplish in the active affairs of life in the near future. All who have witnessed the successful trials at Laurel are impressed with the great stride made in the matter of rapid transit by electricity.

Arrangements are now being made for the building of an extended road between distant cities, and Baltimore will be one of the stopping-points on the line.

The officers of the Electro-Automatic Transit Company of Baltimore City are Dr. Julian J. Chisolm, president; O. J. Smith of New York, vice-president; Alex. Brown, treasurer; William M. Pegram, secretary; David G. Weems, general manager; J. J. Chisolm, Edward B. Bruce, F. F. Gambrell, O. J. Smith, Robertson Taylor, Franklin J. Morton, Alex. Brown, S. E. George, William M. Pegram, Edwin F. Abell, David G. Weems, directors.

Mr. David G. Weems of Baltimore is the inventor of the system. Mr. O. J. Smith, the vice-president, is president of the American Press Association of New York. The officers of the company have made frequent visits to witness the various trials, and with each successful increase of speed made have enlarged their expectations of future results.

WHO ARE THE AMERICAN INDIANS? 1

WHEN Columbus discovered America, he discovered not only a new continent, but a new people,—the American Indians. From one end to the other of its broad expanse the continent was occupied by Indian tribes that had held the land from time immemorial,—so far, at least, as their own traditions aver,—knowing nothing of any country but their own. The commonly presented picture of the Indians as they appeared at the time of the discovery is that of a horde of wandering savages, half or wholly naked, living on roots and herbs, or existing by the capture of wild animals scarcely

¹ Abstract of a lecture delivered in the National Museum, Washington, D.C., March 30, 1889, by H. W. Henshaw.

more savage than themselves, and the chief object of whose existence was to enslave, to torture, and to kill each other. Those who hold such opinions have ever taken a hopeless view of the Indian's present, and a still more hopeless view of his future. Such a picture conveys a totally false impression of the Indian, and of the state of culture to which he had attained at the era of the discovery. Though still living in savagery, he was in the upper confines of that estate, and was fast pressing upon the second stage of progress,—that of barbarism; that is to say, he had progressed far beyond and above the lowest states in which man is known to live, to say nothing of the still lower conditions from which he must have emerged, and had travelled many steps along the long and difficult road to civilization.

Already he had become skilful in the practice of many arts. Though the skins of beasts furnished a large part of his clothing, he had possessed himself of the weaver's art; and from the hair of many animals, from the down of birds, and from the fibres of many plants, he knew how to spin, to weave, and to dye fabrics. Basket-making he had carried to so high a degree of perfection that little further improvement was possible. The potter's art also was his; and, though his methods were crude and laborious, the results achieved, both as regards grace of form and ornamentation, may well excite admiration at the present day.

Copper had been discovered, and was mined and roughly beaten into shape to serve for ornament, and, to some slight extent, for mechanical use. In Mexico and Peru, gold, silver, and copper were worked; and many authors contend that the method of making bronze, an invention fraught with tremendous possibilities, had there been discovered.

In much of South and Central America, Mexico, and the eastern parts of the United States, so important an advance had been made in agriculture that it furnished a very large part of the food-supply, and it should not be forgotten that the chief product of the Indian's tillage, maize or Indian-corn, which to-day furnishes a large part of the world's food, was the gift of the Indian to civilization. A scarcely less important contribution to mankind is the potato, the cultivation of which also originated with the Indians. A third important agricultural product, though less beneficial, is tobacco, the use and cultivation of which had been discovered centuries before the advent of the European.

"Architecture" may seem like a large word to apply to the dwellings of the Indians; nevertheless many of their houses were more substantial and comfortable than is generally supposed, while in the North-west many tribes reared dwellings of hewn planks, sometimes as large as 210 feet long by 30 feet wide, which were capable of accommodating several hundred individuals. More pretentious and durable were the communal houses of mud and stone reared by the pueblo people of Arizona, New Mexico, and Mexico; while farther south, in Central and South America, were edifices of hewn stone, which from their dimensions, the size of some of the blocks contained in them, and the extent and ornate character of the ornamentation, justly excite the wonder and admiration of the traveller and archæologist.

The advantages of a beast of burden had been perceived, and, though the human back furnished by far the greater part of the transportation, yet in North America the dog had been trained into an affective ally, and in the Andes the llama performed a similar office. Insignificant as was the use of the dog as a carrier, its employment cannot well be overestimated as a step in progress, when it is remembered that the plain's tribes that most employed it lived in the midst of the buffalo,—an animal which must have become of prime domestic importance in the never-to-be-enacted future of the Indian.

The need of some method of recording events and communicating ideas had been felt, and had given rise, even among the ruder tribes, to picture-writing, which in Mexico and Central America had been so far developed into ideographs, popularly called hieroglyphics, as to hint strongly at the next stage, the invention of a true phonetic alphabet. Nay, more: the Mexicans and Mayas are believed to have reached a state of true phonetic writing, where characters were made to represent not things, as true ideographic writing, but the names of things and even of abstract ideas; and this is a stage which may be said to be on the very

threshold of one of the proudest achievements of civilization, that of a phonetic alphabet.

Instead of living in an unorganized state, where each man was a law unto himself in all things, the Indians lived under organized forms of government, rude enough indeed when compared with the highly organized system of civilized nations, but marking an essential advance on the conditions attained by savage peoples in other parts of the world. The chieftaincy was transmitted by well-understood laws, or, as in some tribes, was more purely elective. Their social system was very ingenious and complex, and, being based largely upon kinship ties, was singularly well fitted for the state to which they had attained, of which indeed it was simply an expression and outgrowth. In many sections a considerable advance had been made in political confederation, and neighboring tribes combined for defence and to wage war against a common enemy. They had invented many and singularly efficient laws to repress and punish lawlessness against the individual and the social body, and as a consequence they enjoyed almost entire immunity from theft and many other crimes.

The development of religious ideas among our Indians is a curious and instructive study. Though the Great Spirit and the Happy Hunting Ground which missionaries and theologians thought they had discovered among them are now known to have had no existence, the Indians had by no means reached the state of culture in which they were found without developing religions. Their gods or fetiches were innumerable, their priests endowed with immense influence, and their ceremonies of devotion and propitiation were as devout as they were elaborate. The precision of the beliefs of many tribes and the elaborateness of their rituals are simply astonishing. Thus their advance in the domain of religious thought equalled, if it did not surpass, their progress in some other directions.

If by medicine we mean the rational treatment of disease, the Indian can be said to have learned only the rudiments of the healing art. Medicine, in so far as it was a distinct profession, was almost wholly in the hands of the medicine-man or shaman, who filled the twofold office of priest and doctor. Neither the theory nor the practice of the shaman had in it any thing that was rational and very little that was efficacious, except through the influence exercised over the mind of the patient; in other words, except so far as the shaman was a faith-curer. Whatever that is marvellous in the modern cases of faith-cure can be more than matched out of the practice and experience of the shaman, who learned his trade long before the European came to these shores. He who would see the Indian shaman need not seek the wilds of the Far West. He may find his counterpart on Pennsylvania Avenue. The whole medical practice of the Indian shaman was based upon the idea that all disease was the effect of evil disease-spirits that had obtained lodgement in the body, or that it was caused by witchcraft; and, so long as practice was directed to the dislodgement of these spirits, no rational treatment was possible. I am aware that the above idea of Indian medicine is contrary to popular belief, which, to some extent at least, is in harmony with the claims of alleged Indian doctors of white extraction, who claim to have derived their skill and their herbs directly from the hands of Indian experts. Recent and carefully conducted investigations on this subject, however, fully substantiate the above statements. Though roots and herbs were employed in the treatment of nearly all diseases, they were chiefly used as adjuncts to the charms and sorceries of the medicine-man. Often they were not given to the patient at all, but were taken by the medicine-man to heighten his power over the disease-spirits. Often they were applied by being rubbed on the body of the patient, or by being blown in the shape of smoke on the afflicted part.

Among the Indians was found flourishing to a remarkable degree the so-called doctrine of seals or signatures. A few examples of the doctrine derived from the eastern Cherokee by Mr. James Mooney may prove of interest. Doubtless you are all familiar with the cone-flower. The Cherokee call it deer-eye, and from its fancied resemblance to the strong-sighted eye of the deer, and its connection by name (for the Indian believes that there is a potent connection between the name of a thing and the thing itself), it is used as a wash for ailing eyes.

The common purslane (*Portulaca oleracea*) is used as a vermifuge, because the red stalk looks like a worm.

An infusion of the roots of the hoary pea (*Tephrosia virginiana*), called devil's shoe-strings in the South because of their toughness, is used by the Cherokee ball-players as a wash to strengthen their bodies, and by the women as a hair-wash to strengthen it and keep it from falling.

When of you has ever walked in our woods without getting on his clothing the common beggar's lice (*Desmodium*)? How tenaciously they stick, you all know: so do the Cherokee; and because the burrs stick fast, they use a tea made of them to strengthen the memory. The Cherokee at least can dispense with the service of a Loisetie.

You whose ambition it is to be good singers have only to drink a tea of crickets, according to the Cherokee, for does not the cricket possess a fine voice, and doth he not sing merrily?

The tendency of the human mind to speculate and to draw inferences—a tendency common alike to the savage and the civilized man—cannot be held in check forever, however strong the bonds; and just as knowledge and science escaped from priestly thrall through the history of civilized times, so a certain small amount of knowledge of the therapeutical use of drugs was gaining ground among the common folk of the Indians. It was fairly to be called old woman's practice, as it was largely in their hands. It grew out of observation. Infusions of certain herbs produced certain results, acted as emetics or purgatives, and hence these herbs came to be employed with something like an intelligent purpose. Many of the herbs used were absolutely inert; many were harmful, of course, since where there is practically no true diagnosis and no correct knowledge of the effect of drugs there can be no really intelligent selection of remedies; but in the case of certain simple diseases, herbs, the actual cauter, and, above all, the sweating process, were beginning to be recognized by the common folk as serviceable, and to be employed to some extent without recourse to the shaman.

As the child must creep ere it can walk, in such theories and treatment, childish though they may seem, may be discerned the beginnings of the noble science of medicine, which, having largely cast aside the superstitions that hampered its infant steps, now walks erect; and, although of late she seems to have revived the beliefs of her childhood, her handmaiden, science, bids her call the demon disease-spirits ignorance and vicious habits; the diseases themselves, bacilli or germs. The Indian believed that the white man carried the spirit of small-pox in bottles, and let it loose among them. Modern science actually does bottle the small-pox germs, and germinate them at will. So the Indian theory of disease reappears in a new form.

Such in briefest outline are some of the achievements of the Indian as he was found by civilized man. Whatever value may be placed upon them, whatever rank may be assigned them in the scale of human efforts, they were at least his own; and some of them compare favorably with the record of our Aryan ancestors before they split up into the numerous nations which have done so much to civilize the world. Many, I am aware, hold that the Indian had progressed as far towards civilization as his capacities admitted. Others have held, and possibly some now hold, that he was already on the decline: they see in his crude ideas and rude inventions only the degradation of a higher estate; in other words, instead of a savage preparing to enter civilization through the necessary halfway state of barbarism, he is held a half-civilized man lapsing into savagery. Such views, it is needless to say, find no favor in the mind of the evolutionist. To him the achievements of the Indian are only the mile-stones which have marked the progress of every civilized nation, in its march from what it was to what it is; to him the chief value and significance of his studies of the mental state of the Indian, as expressed in his mythology, his medicine, his social and political organization, or in his more concrete arts, is the fact that in them he reads the records of his own past. If there be any truth whatever in the theory of evolution as applied to human progress, only one inference can be drawn from the history of the Indian race as it appears in historical pages, and in the no less eloquent records interpreted by archæologists. This inference is, that, starting in its career later than some other races, or being less favored by circumstances or conditions of environment, or pos-

sibly being less endowed, the Indian, despite all, had progressed an immense distance towards civilization; that the race contained all the capabilities for a further advance and for achieving a civilization of its own, differing, it may be, markedly from our own, as other civilizations differ, but still containing within itself all the essentials of that wonderfully complex thing called civilization. Such, at least, is the lesson evolution teaches.

Hardly had the new land been discovered when the question arose, Who are the Indians, and where did they come from? Naturally enough, the Indian had his own answers to these questions. It may almost be said, as many tribes, so many origins. A large number of tribes claim to have originated in the localities where they were first found by Europeans, where they emerged from the ground or came from the recesses of some neighboring mountain. Somewhat more poetical is the idea of the Aht of Vancouver Island, who allege that animals were first created at Cape Flattery, and from the union of these with a star that fell from the skies resulted the first men, their ancestors. Puerile these answers certainly are, yet who will maintain that they are more so than the theories of origin held by the Greeks and other classical peoples?

Who, then, are the American aborigines? For Columbus and his followers there was but one answer to the question. As he had reached the eastern shores of India, the people must be Indians, and his error is perpetuated to-day in the name. Later, when the newly discovered country was found to be not an old, but a new continent, the question of the origin and consanguinity of the Indians was renewed. So strongly tinged with religious thought was the philosophy of the day, that biblical sources were naturally first appealed to, to solve the knotty problem. As mankind was supposed to have originated in Asia, and as all but the ten lost tribes were accounted for, they were rationally appealed to for the origin of the Indian. Perhaps the best exponent of the belief in the Jewish origin of the Indians was Adair, who published his celebrated essay in 1775.

There is a theory of origin to suit the tastes of all. If you have a special bias or predilection, you have only to choose for yourself. If there be any among you who decline to find the ancestors of our Indians among the Jews, Phœnicians, Scandinavians, Irish, Welsh, Carthaginians, Egyptians, or Tatars, then you still have a choice among the Hindu, Malay, Polynesian, Chinese, or Japanese, or, indeed, among almost any other of the children of men.

Preposterous as may seem many of the theories above alluded to, nearly all of them rest upon a certain basis of fact and comparison. Many, at least, of the similarities of thought, custom, methods, arts, religions, and myths from which the theories are deduced indeed exist, though false analogies permeate them all. The thread of fact which sustains the theories is, moreover, far too slender to bear the weight put upon it. Erroneous hypotheses like the above have, however, been productive of great good in pointing out and emphasizing some of the most useful lessons which the student of anthropology of the present day must learn and ever keep in mind. Of these, perhaps the most important is that the human mind is everywhere practically the same; that in a similar state of culture, man, in groping his way along, will ever seek the same or similar means to a desired end; that, granting the same conditions of environment, man acts upon them, and is acted upon by them, in the same way the world over; hence in large part arise those similarities of customs, beliefs, religions, and arts, which have been appealed to as evidences of genetic connection or of common origin, when in fact they are evidences of nothing but of a common humanity.

Likewise up to the present time the attempts to classify mankind by his physical characters have produced discordant results, and little dependence is to be placed upon the results themselves or upon the theories arising therefrom which relate to the more profound question of the origin of races. In turning to the test of language, if doubt and uncertainty were left behind, and harmony and agreement took the place of discordant views, we might count ourselves fortunate indeed. Yet, though still in its infancy as regards future possibilities, and while it needs and welcomes the aid of all the other sciences to solve the complex questions which come properly within its domain, it is unquestionably our best guide in prob-

lems relating to the origin and relationship of the races of mankind.

The evolution theory sees evidences of growth and development in every language spoken by man. Comparing the languages of highly civilized peoples with those of lower culture, it finds in the latter evidences of the successive stages through which all languages have necessarily passed in their upward growth. It notes the fact that among lower peoples languages are less and less highly organized, and that among them signs are much more freely used than among the higher; that the sign-language is capable of a development among savage peoples and mutes so wonderful as to be the medium of all classes of ideas; and, noting these, it is prepared to believe, though it has not yet proved, that there was a time in the dawn of the human race when organized vocal speech was unknown, and when the fingers, the facial expression, and the postures of the body, were the chief if not the sole means possessed by man to communicate to his fellows his simple wants and ideas.

Before proceeding further, let us glance briefly at some of the methods employed by linguistic students in their efforts to unlock the mysteries of linguistic relationship. How the comparative study of language is to be carried on, linguistic students are well agreed. Since language is made up of words, each word being the sign of a thought, the science of linguistics is largely the study of words; in other words, it is the tracing word genealogies by means of their etymology. By stripping words of the accretions they have received in the process of time, they may be resolved into roots; and by the comparison of these roots the philologist obtains proof of relationship, and classifies languages into linguistic families.

It may be well at this point to define clearly what linguists mean by a linguistic family. A linguistic family is a group of languages which have sprung from a common parent language. The first requisite of a linguistic family, therefore, is that the languages composing it shall be related genetically; the second, that they shall not be related to the languages of any other family. Each family thus consists of a group of languages wholly disconnected from all other families. The chief danger to the student in dealing with such material is to mistake apparent for real resemblances, and to be led to present false word analogies as evidences of true genetic relationship.

That linguistic science is competent to deal with problems of great magnitude and intricacy, and that there are students who are capable of applying its varied resources, best appears in the grand achievements which concern the group of languages known as the Aryan or Indo-European family, in which our own English tongue takes a prominent if not the first place. It is almost wholly as the result of linguistic studies that the component members of the large and important Aryan family are now recognized, and the history of its earlier members reconstructed to a remarkable degree. The family contains eight groups of distinct languages. Among many others, the family includes as offspring from one source Sanscrit, Hindu, Romany or Gypsy, Persian, Armenian, Welsh, Cornish, Irish, Scotch, Latin, Italian, French, Spanish, Portuguese, Albanian, Greek, Bulgarian, Russian, Servian, Polish, German, English, Dutch, Swedish, Danish, Norwegian, and many others. Though one of the largest, and, by reason of its history and the prominent part it has played in the civilization of the world, the most important, the Aryan family is only one of many linguistic families, each one of which is made up in the same way of a greater or less number of related languages. Such are the Bushman and Hottentot of Africa, the Semitic of Asia and Africa, the Chinese, Australian, and many others. The related languages which make up linguistic families vary indefinitely in the amount of likeness they bear to each other. They are often so much unlike, that those who speak them cannot understand each other; as, for instance, English, German, and French. Though these languages are mutually unintelligible, yet they contain many words of nearly identical form, while other members of the Aryan family have in process of time become so unlike affiliated tongues that it requires the most critical study to detect their relationship. As languages are the principal divisions of a linguistic family, so dialects are the subordinate divisions of a language. Family, lan-

guages, and dialects are to linguistic science what family, genera, and species are to biology.

There is an important question which may be considered at this point: To what extent is linguistic relationship to be interpreted as blood relationship; in other words, how far does linguistic classification answer for race classification? In cosmopolitan America, where nearly all speak English, and yet a very large proportion are of foreign parentage, it is obvious that a pure linguistic classification of individuals would largely misinterpret the facts of parentage and race. Nevertheless, taken in connection with readily ascertained facts, it will not mislead even in such an extreme case, and usually a language classification of a tribe or people actually does express race relationship.

To return to the Aryan family. Not only are we able by means of language to class together as related members of one great family the above-mentioned languages, which apparently are so diverse in the sound and form of their words, but by means of word analysis we can reconstruct the past history of the peoples who spoke them, and can get a glimpse even of the mode of life, customs, arts, and religious beliefs of our remote Aryan ancestry. The process by which this is done is sufficiently simple, although, like many other simple processes, its application is not so easy. When we find in the greater number of the languages of a linguistic family the same fully formed word with the same meaning, we are justified in believing that it existed before the separation of the family, and that the thing it signifies was already known to the parent body. Applying the rule to the case of the Aryan family, we learn, that, contrary to earlier theories, our forefathers came from a cold region, since eastern and western Aryan tongues contain names for the birch and pine, and these are the only two tree names common to both branches. The same process continued shows us that the family relations were defined much as they are with us to-day, and that marriages were monogamous. The old Aryans held the land in common, and redistributed it from time to time among the members of the clan. The houses were built of wood, and were entered by means of a door. The communities were settled in villages with a recognized chief or head, and the villages were connected by roads over which travelled peddlers carrying their wares for sale. All were free men. They worshipped natural objects and natural phenomena, more particularly the sun. They believed in the evil spirits of night and darkness. They were a pastoral people, and cattle and sheep formed their chief wealth. They also had goats, pigs, dogs, geese, and bees. They had domesticated the horse, though they did not ride, but employed him, like the ox, for drawing carts. They still used stone implements, though gold and silver and bronze were known. Charms were chiefly relied upon to cure disease. Future events were divined from the flight of birds. These are a few of the facts among many which linguistic science has revealed to us pertaining to the life and achievements of our Aryan ancestry before the historic period. Surely no contemptible record this for a new science.

Let us now turn our attention to the Indian languages of this country, and see what progress has been made in the attempt to classify them. It may be premised that no part of the known world affords a better opportunity for the study of the nature of language and its processes of growth than America. The Indian languages are by no means the most primitive at present spoken by man; and it may surprise some of my hearers to be told that in respect of some of their characteristics they compare favorably with Greek and other classic tongues, though the classic languages as a whole belong to a much higher stage of development. Instead of being mere jargons of words, disconnected with each other and capable of expressing only the simplest ideas, as I find many intelligent people believe, they are in some directions singularly highly developed; and not only are they capable of serving as the vehicle of every thought possible to their possessors, but their vocabularies are extensive, possess many synonyms, and furnish the means of discriminating the nicest shades of meaning.

As a body they are still in that stage of development in which the various processes of language-making may be studied with comparative ease. Just as the various natural processes by which mountains are levelled and the earth's surface carved out and re-

modelled are more apparent, and more readily studied by the geologist, in the still primitive West, so Indian languages offer to the scrutiny of the linguistic student a similar unfinished condition highly favorable for analysis and study.

For the past fifteen years Major Powell and his assistants of the Bureau of Ethnology, with the aid of many collaborators in various parts of the country, have been accumulating vocabularies by means of which to classify Indian languages. The present provisional results of the study of the large amount of material accumulated show that in the territory north of Mexico there were at the time of the discovery fifty-eight distinct Indian linguistic families, containing some 300 or more languages and dialects.

So far as Language is a competent witness, she has exhausted all the evidence thus far accumulated when she has grouped the Indians in fifty-eight families. Back of this point she may not now go, except as a theorist and in pure speculation. So far as she is entitled to speak authoritatively, these fifty-eight families are separate entities, which never had any connection with each other. But she recognizes her own limitations too well to dare to state positively that this is the interpretation that must be placed upon the results she has attained. When facts from which to draw deductions fail, men may and do resort to theories. Let us glance at the two broad hypotheses which have been based upon the development theory of language. The first is in effect that all the present languages of the earth are not so unlike that they may not have been developed from a single original parent language. By this view the original language is supposed to have changed and developed into all the various forms of speech that are now spoken or that have ever been spoken. According to this view, the families of languages as at present classified have no other significance than as groups of related tongues, the once existing connection of which with other tongues cannot now be proved, because through the process of change the connecting links have been lost.

The second hypothesis assumes that there must have been at least as many original languages as there are now existing families: it assumes, in other words, that the families of speech are fundamentally distinct, and therefore cannot have had a common origin. The first theory postulates that from original unity of language has come infinite diversity; the second, that the tendency has ever been from original diversity towards unity.

Widely different as are these two theories of the origin of linguistic families, they agree in one essential particular: they both remove the origin so far back in time as to make it practically impossible to prove the truth or falsity of either theory. Both of these hypotheses have able advocates; but for a variety of reasons, which time will not permit me to give, the second is deemed the more plausible. At all events, it best explains many difficulties.

There is abundance of archæologic evidence showing that man has resided on this continent for a very long period; and the character of the remains prove that the farther back in time we go, the ruder being he was. Linguistic testimony is to the same effect; and there is no *a priori* reason why man may not have lived upon this continent ages before he learned to talk, — no reason, for that matter, why America may not have peopled the earth, if the earth was peopled from a single centre, or why, if there have been several centres of origin for mankind, the Indians, as they themselves believe, may not have originated here where they were found.

Obviously the fifty-eight families are as likely to have originated here as anywhere else; for remember that every country has linguistic families of its own to account for. Is there, then, any possible theory which will meet the case? There is certainly one that is possible, if not probable. It is the theory, that, whether born from the soil or an emigrant from other lands, our Indians spread over the entire continent before they acquired organized language, and that from not one but from fifty-eight centres sprung up the germs of speech which have resulted in the different families of language. This theory accords with the idea that there may have been but one origin of man, and that in any event all the Indians from the Arctic to Patagonia are of one race. It does not forbid the supposition that the Indian was an emigrant from other shores, though it permits the thought that the American Indian may have originated on American soil.

Though this theory seems more probable than the other, which assumes that the languages of our Indians were brought here from foreign shores, it must be frankly admitted that Linguistic Science is not now, and possibly never will be, competent to decide between them. If she is unable to decide fully as to the origin of the Indian's language, how can she be expected to solve the infinitely more complex problem which concerns the ultimate origin of the peoples who spoke them? She certainly has no solution for this problem now. When she considers the number of linguistic families, and the vast length of time it must have taken to develop their languages and dialects, she finds herself confronted by a problem beyond her present powers. And yet the case is not hopeless. Linguistic Science is still in her infancy, and her future may contain possibilities far exceeding the dream of the most sanguine.

When interrogated as to the origin of the Indian, all that she can now say is, that whether the Indian originated on this continent, where he was found, or elsewhere, it was in bygone ages, — ages so far removed from our own time that the interval is to be reckoned, not by the years of chronology, but by the epochs of geologic time. With such problems she affirms that at present she cannot deal.

I have presented the subject to you to-day, not to answer it, but to aid you in comprehending the tremendous difficulties that enshroud the problem. Much time and ingenuity have been expended in the past in attempting to force an answer to a question which cannot even yet be answered. The question, however, that really concerns the ethnologist of to-day is not *who* are the American Indians, but *what* are they, and what have they accomplished in working out the problems of life, which, ever since his birth, man has grappled with.

In reading the history of mankind, we are too apt to be blinded by the achievements of our own Aryan race. As the old Greeks classed as barbarians all who did not speak their own tongue, so we are prone to think that most of the good that has come to humanity has come through and by means of our race. In truth, there are valuable lessons to be learned from races less high in civilization than our own. Though many and diverse are the roads that lead man to the higher life, they all pursue about the same course, and time only is required to unite them into one broad stream of progress.

Many are the lessons taught by anthropology; but the grandest of them all is the lesson of the unity of mankind, — the unity of a common nature and a common destiny, if not of a common origin.

NOTES AND NEWS.

WE hear that the Russification of the German educational establishments in the Baltic provinces goes on apace. The University of Dorpat, in particular, is suffering in this respect. Recently the Czar specially sanctioned the Russianizing of the faculty of law within the next few years, and now it is intended to transfer the theological faculty from that seat of learning and enlightenment to Moscow or St. Petersburg, in order to deprive it entirely of its German-Protestant character. German culture evidently seems a dangerous element in the eyes of the Russian Government.

— *Nature* states that Herr Victor Apfelbeck, the entomologist, will shortly start, in behalf of the Bosnian Government, on a journey of research in Herzegovina. Last year he discovered in southern Bosnia five new species of eyeless cave beetles, and his investigations excited much interest among entomologists.

— The largest tree in Great Britain, and one of the most famous, is the Cowthorpe oak in Yorkshire, which is believed to be some fifteen hundred years old. When Evelyn wrote his "Silva," in the seventeenth century, its circumference at the ground was seventy-eight feet; but later, earth was banked up around it, which covered some considerable projections, and reduced its girth. As told in *Garden and Forest*, at the beginning of the last century its branches overshadowed an area of half an acre of ground. The top or leading branch fell at some unrecorded date, curiously slipping down into the hollow trunk, where it remained. In the last century one of the main branches which was blown down proved to be ninety feet in length, and yielded five tons of timber. When

carefully measured by Dr. Jessop in 1829, the girth of the tree at the ground was sixty feet, and at a yard above, forty-five feet; the chief remaining limb was fifty feet long and its circumference eight feet, and the height of the tree was forty-five feet. It was then hollow to the top. For many years saplings raised from this tree were sold in pots by the villagers for as much as a guinea apiece. It is now a venerable ruin, but most picturesque in its decay. It stands in a green paddock, carefully protected from injury, with its ancient limbs supported by props. An idea of its size may be gathered from the statement that at least forty persons can stand within its cavity, and that its circumference is greater than that of the Eddystone Lighthouse, which was confessedly designed on the model of an oak.

— Does the cuckoo ever hatch its own eggs? Herr Adolf Müller answers this question in the affirmative, and has given in the *Gartenlaube* a full account of a case which he himself claims to have observed. A translation of this account has appeared in the *Ibis*, and is reproduced in the new number of the *Zoologist*. The latter periodical prints also a translation of an article in which Herr Adolf Walter disputes the statements of Dr. Müller, who, he thinks, must have made a mistake. The same subject is dealt with in the June number of the *Selborne Magazine* by Mr. C. Roberts, who quotes from "Zoonomia" an interesting passage, in which Dr. Erasmus Darwin expresses his belief that the cuckoo sometimes makes a nest and hatches its own young. In this passage Dr. Darwin gives an extract from a letter of the Rev. Mr. Wilmot of Morley, near Derby, describing an instance brought to Mr. Wilmot's notice in July, 1792, by one of his laborers, and afterwards closely watched by Mr. Wilmot himself. Mr. Wilmot was confident that the bird was a cuckoo.

— There is a note by Dr. Charles Waldstein in the London *Athenaeum* of June 8 which will no doubt attract much attention. Dr. Waldstein states that recently, while in Constantinople, he was shown photographs by Hamdy Bey of the sarcophagi discovered some time since at Sidon; and he is of opinion that the discovery is one of the most important made in this century, and, moreover, that excepting the Elgin marbles, and the Hermes of Praxiteles at Olympia, "no works of ancient Greek art have been found of greater artistic interest and merit." One of the sarcophagi contains a portrait of Alexander. Hamdy Bey does not positively assert that this is the tomb of Alexander, but Dr. Waldstein thinks he will be justified in pointing to the possibility of such being the case.

— At the New York meeting of the American Institute of Mining Engineers, February, 1889, Mr. John C. Smock of Albany, N.Y., read a paper on "The Iron-Mining Industry of New York for the Past Decade," from which it appears that the total production of the iron-mines of the State in 1888 was 1,207,000 tons. This sum includes all the returns received from the mining companies and carefully made estimates for three mines unreported. According to the "Ninth Census," New York produced 14 per cent of the iron ore mined in the country. Ten years later, the State produced 1,262,127 tons, or 15.4 per cent, and ranked third in the list of States. In 1886 the production of all the iron-mines in the country, as estimated by James M. Swank, general manager of the American Iron and Steel Association, was 10,000,000 tons. In 1887, according to the same authority, it amounted to 11,300,000 tons. New York mines produced in the former year about 900,000 tons, and 1,100,000 nearly in the latter year, or 10 per cent of the whole. In 1888 the same average proportion was maintained, but the rank changed to fourth, falling behind Michigan, Pennsylvania, and Wisconsin. According to the last report of the American Iron and Steel Association, the total for the United States in 1888 was 12,050,000 gross tons. The fluctuation in the totals for the State during the decade have not been so great as might be inferred from the sharp fluctuations in the prices for pig-iron; and the steadiness in the figures for 1886, 1887, and 1888 is remarkable proof of the enduring capacity of the mines of the State. The variation from year to year is not as great as it is in the magnetic iron-ore districts of New Jersey. The production of the iron-mines in New Jersey in 1880 was 745,000 tons. In 1885 it had fallen to 330,000 tons, and in 1887 had risen to 547,000.

Another notable fact brought out in this comparison is the diminished number of mines producing these totals. At the commencement of the decade there were about 100 mines at work: last year, only 50 were producing ore.

— A recent issue of the French *Journal Officiel* contains the report of the consultative committee for sea-fisheries in France, on the subject of poisoning through the eating of mussels. The committee, in the first place, recognize that the oysters which cause poisoning are those which have become stale, or have been kept in water rendered foul by decomposed organic matter, and question whether the same may not be the case with regard to mussels. Various explanations of mussel-poisoning were made to the committee. By some it was attributed to a parasite crab (*Pinnotheres pisum*). This explanation, however, was unsatisfactory, for in the United States this *Pinnotheres* is sought after as food. By others the presence of the poison was attributed to the spawn of star-fish, and also to copper absorbed from wrecks. Both these suggestions were, however, disproved. The theory of Orfila, also, that the poisonous action of the mussels in the stomach is the result of imagination, does not find acceptance at the hands of the committee. An authority on the subject has found that the mussels lose their poisonous property if cooked for a period of ten minutes with carbonate of soda. The committee conclude that the poisonous nature of the mussels is due to the presence in them, especially in the liver, of a volatile organic alkaloid (*mytilotoxine de Brieger*), developed under the influence of a particular microbe which is only found in mussels living in stagnant and polluted waters. Finally, they advocate the removal of all restrictions on mussels in artificial beds, and recommend the sale at all times, at fish-markets, of mussels coming from such beds, which are usually situated in favorable localities, — a sale which is at present prohibited in France during May and June.

— There is being exerted at this time an effort for the establishment in the University of Pennsylvania of a department of pedagogics. The university being without the necessary funds for this work, two of this year's graduating class, as we learn from *The Philadelphia Telegraph*, have undertaken the raising of ten thousand dollars, which will provide for a three-years' salary for a pedagogic professor, and found a library; and at the expiration of three years it is believed that the department will be self-sustaining. A short time ago Superintendent MacAlister of the Board of Education addressed a letter to Dr. William Pepper, provost of the university, in which he set forth the manifest urgency and value of such a department. He said, "Until within a few years American students were compelled to go abroad for the purpose of pursuing their studies in this branch, and large numbers still find it advantageous to avail themselves of opportunities which are but scantily provided in this country. The German universities have long maintained chairs of pedagogy. In the year 1876 a chair of education was organized in the University of Edinburgh, and has since been occupied by a distinguished scholar, Professor Laurie, who has exerted great influence over the education of Scotland. Some years ago, lectures on education were given for the first time in the Universities of Oxford and Cambridge, and in both of these schools lectures are now read regularly by men eminent as teachers. The first chair of pedagogy in the United States was organized in 1879, in the University of Michigan, and this was followed by the establishment of professorships in the Universities of Wisconsin, Iowa, Cornell, and other less important schools. The only serious attempt thus far made to furnish opportunity for the study of pedagogy in the older States was the work done by Professor G. Stanley Hall before his retirement from Johns Hopkins; and it is understood that this department will be recognized in the new Clarke University in Massachusetts, of which Dr. Hall has been appointed president. It is only a question of time when all the great schools in the Eastern and Middle States will be moving in this direction." Professor MacAlister remarks, that, if the great function of a university is to teach and supply the world with teachers, it cannot be said to fully perform its office if it does not provide adequate professional preparations for the teacher's work beyond the studies of the academic curriculum. He holds that in a department of pedagogy the instruction should consist of the following courses: his-

tory of education, psychology and its relation to education, the science and art of teaching, organization and administration of school systems, school hygiene. He adds, "With the provisions already existing in the university, the organization of such a department could be easily secured, and the financial responsibility incurred would be very slight. A chair of the history and science of education would be sufficient to begin with. The chair of psychology, recently organized, the chair of philosophy, the chair of political economy, the chair of hygiene, could be made available in furnishing the additional courses required. The general course in pedagogy would probably not extend beyond one year, but special courses could be formed for those desirous of more extended study. To give the department academic dignity, and make it really valuable, a degree should be granted. The degree of Ph.D. is suggested, which might be given on examination in the courses in pedagogy, with such additional electives — say, three or four — in language, literature, science, or history as might be prescribed. In this way the department of pedagogy would become affiliated with the general instruction of the university, and would also fall into place among the university courses created during the present academic year."

— No other ancient works of the United States have become so widely known, or have excited so much interest, as those of Ohio. This is due in part to their remarkable character, but in a much greater degree to the "Ancient Monuments of the Mississippi Valley," by Messrs. Squier and Davis, in which these monuments are described and figured. The constantly recurring question, "Who constructed these works?" has brought before the public a number of widely different theories, though the one which has been most generally accepted is that they originated with a people long since extinct or driven from the country, who had attained a culture status much in advance of that reached by the aborigines inhabiting the country at the time of its discovery by Europeans. The opinion advanced in a paper by Cyrus Thomas, on "The Problem of the Ohio Mounds," published by the Bureau of Ethnology, in support of which evidence is presented, is that the ancient works of the State are due to Indians of several different tribes, and that some, at least, of the typical works, were built by the ancestors of the modern Cherokees. The discussion is limited chiefly to the latter proposition, as the limits of the paper do not permit a full presentation of all the data which might be brought forward in support of the theory, and the line of argument is substantially as follows: First, A brief statement of the reasons for believing that the Indians were the authors of all the ancient monuments of the Mississippi valley and Gulf States: consequently the Ohio mounds must have been built by Indians. Second, Evidence that the Cherokees were mound-builders after reaching their historic seats in East Tennessee and western North Carolina. This and the preceding positions are strengthened by the introduction of evidence showing that the Shawnees were the authors of a certain type of stone graves, and of mounds and other works connected therewith. Third, A tracing of the Cherokees, by the mound testimony and by tradition, back to Ohio. Fourth, Reasons for believing that the Cherokees were the Tallegwi of tradition, and the authors of some of the typical works of Ohio.

— The *Glasgow Herald* states that last year, while some workmen were engaged in drainage operations at Lochavullin for the purpose of forming a public park, they discovered what was believed to be an old "crannog," or lake-dwelling; and several experts who visited it were of opinion that it was a very good specimen of an ancient lake-dwelling. Arrangements were made by the town council for its being properly investigated and preserved as far as possible, but the weather has rendered operations impracticable till within the last few days. Workmen are now engaged in excavating round the place; and recently it was visited by Mr. Cochran-Patrick, under-secretary for Scotland, and other gentlemen interested. Among the articles turned up by the workmen during the examination were a stone bullet, such as would have been used in the slings of the period to which the dwelling is supposed to have belonged, and portions of the wattle used in the construction of the dwelling. Professor Hedley of St. Andrews took some photographs of the place.

— The last international medical congress, which met in Washington in 1887, unanimously selected Berlin as the next place of meeting in 1890. Professors Virchow, Von Bergmann, and Waldeyer, to whom was confided the preliminary direction of the next congress, have already taken active steps to make it a success. All the medical faculties and other medical bodies in Germany have been invited to nominate delegates to confer together on the subject this year, at the time of the Heidelberg meeting of the German Scientific Association in September. It is proposed that the congress of 1890 should commence its proceedings on Aug. 6, 1890.

— Dr. Oliver P. Jenkins, professor of biology in DePauw University, accompanied by Oscar Vaught and G. C. Price, two of his students, sailed June 29 from San Francisco for the Hawaiian Islands, on a scientific fishing expedition. They go under the authority and with an appropriation of the university for that purpose. They will return the middle of September. They hope to find a valuable field.

— Krüss and Schmidt's statement that both nickel and cobalt contain a small percentage of a hitherto unknown element, gnomium, amounting in the case of one specimen of nickel to as much as 2 per cent (*Ber. der deut. chem. Gesellsch.*, xxii, 11; *Nature*, xxxix, p. 325), has not been permitted to pass unchallenged, and quite recently two papers have appeared which tend to show that the supposed new element is non-existent. At the time when they were led to recognize the presence of this common impurity, says *Nature*, Krüss and Schmidt were engaged in repeating Winkler's old determination of the atomic weights of nickel and cobalt, in which the ratio Au : Ni or Au : Co was arrived at from the amount of gold precipitated by these metals from neutral solutions of gold chloride. Winkler, in the mean time, has repeated this work with carefully purified materials (*Ber. der deut. chem. Gesellsch.*, xxii, 890), and has not only failed to obtain any evidence of the existence of gnomium, but, moreover, calls in question the purity of the metallic specimens employed by Krüss and Schmidt. A communication from Dr. Fleitmann to the *Chemiker Zeitung* (xiii, 757) lends considerable support to this view. Adopting the method patented by Krüss and Schmidt for separating this common impurity from nickel and cobalt by extracting the hydroxides of these metals with sodium hydroxide, Fleitmann has examined a number of specimens of commercially pure nickel and cobalt, and, so far from obtaining 2 per cent of gnomium oxide, has failed to isolate from 50 grams of material a weighable amount of any impurity which would serve to justify the view that a hitherto unknown element was associated with these metals. Fleitmann points out that when the hydroxides of commercially pure nickel and cobalt are treated with large quantities of sodium hydroxide, impurities go into solution which vary in composition and amount with the source and degree of purity of the metals. These impurities consist of small quantities of the oxides of lead, zinc, arsenic, manganese, molybdenum, silicon, aluminium, cerium, chromium, etc., together with an amount of nickel or cobalt oxide not exceeding $\frac{1}{100}$ of one per cent of the hydroxide extracted, and, when separated from the alkaline solution by the addition of an acid and subsequent precipitation with ammonium carbonate, give rise to a highly complex mixture of oxides and acids which can only be separated and identified with considerable difficulty. It is not improbable, therefore, that Krüss and Schmidt have been dealing with some of the constituents of this mixture, and that, on further examination, gnomium oxide will prove to be a mixture of the oxides of elements already known.

— At the ladies' conversazione of the London Royal Society, June 19, there were exhibited by Mr. Percy E. Newberry, by kind permission of the director of the Royal Gardens, Kew, a series of ancient funeral wreaths and plant-remains, discovered last year by Mr. W. M. Flinders Petrie, in the cemetery of Hawara, Egypt. As described in *Nature*, these consisted of wreaths of Egyptian and Greek manufacture, which were all made in the first century B.C., and were found in wooden coffins, either resting on the heads or surrounding the bodies of the mummies. Among them the following are of special interest:— (1) A very perfect wreath

composed of the flower-heads of a species of immortelle (*Gnaphalium luteoalbum*, L.), called by the ancients "helichrysos," and much used by them in making garlands. Helichrysos wreaths are mentioned by Pliny (*Hist. Nat.*, xxi, 96) as having been used in Egypt in Ptolemaic times, also by Theophrastus, Athenæus, Cratinus, etc. (2) Portion of a curious garland made of cones of papyrus pith, lychnis and rose flowers, rose petals, and scarlet berries of the woody nightshade. These latter are mentioned by Pliny as having been employed in garland-making by the Egyptians. (3) Portion of a wreath of Greek manufacture made of flowers of the *Polyanthus narcissus* (*N. Tazetta*, L.). Wreaths made of this flower, the "clustered narcissus" of the ancients, are often mentioned by early Greek poets. (4) Portion of a wreath made of the flowers of a species of rose (*Rosa sancta*, Richards). (5) A perfect wreath composed of rose-petals threaded by a needle on to strips of twine. "Recently," writes Pliny in his history of garlands, "the rose chaplet has been adopted, and luxury has now arisen to such a pitch that rose garlands are held in no esteem at all if they do not consist entirely of petals sewn together with the needle" (*Hist. Nat.*, xxi, 8). There are also exhibited (6) a portion of a wreath composed of twigs of sweet marjoram (*Origanum majorana*, L.), lychnis flowers, coils of papyrus pith, and pieces of copper tinsel; (7) a portion of a wreath composed of chrysanthemum flowers and leaves, purple cornflowers, and petals of the flower of a species of *Hibiscus*; (8) a portion of a wreath made of flowers of *Matthiola liberator*, L., flowers of the polyanthus, narcissus, and *Hibiscus* petals; (9) portions of two necklaces made of flowers of the date palm threaded on strips of twine; and (10) a fragment of a necklace made of fruits of the date palm. Among the plant-remains are peach-stones, dates, and date-stones, walnut-shells, currants, pomegranates, plums, figs, chick peas, common garden beans and peas, lentils, wheat, barley, and oats. These are probably the remains of the ancient funeral feasts which were held in the Hawara cemetery by the relatives of the deceased people who were buried there. The whole collection (of which the series exhibited is only the third part) is fully described by Mr. Percy E. Newberry in Mr. Flinders Petrie's "Hawara, Biahmu, and Arsinoë."

— *Nature* announces the death of Signor G. Cacciatore, director of the Palermo Observatory. He died on June 16, in his seventy-sixth year.

— In response to demand, a new edition of Professor A. Gray's small work on "Absolute Measurements in Electricity and Magnetism" will be issued immediately by Messrs. Macmillan & Co. The whole work has been very carefully revised, and several alterations and additions made, which it is hoped will bring it into accordance with the present state of practical electricity, and render it still more useful to students and electrical engineers. The preparation of the second volume of the same author's larger treatise on the same subject is being pushed on at the same time as quickly as possible.

— Years ago, when Mr. Charles Wickes was engaged in the preparation of his work on "Spires and Towers of Mediæval English Churches," he had the good fortune and good sense to consult certain members of the architectural profession, who earnestly besought him to print, before the completion and issue of the more elaborate colored drawings, an uncolored edition of his work for the special use of architects. This work Messrs. Ticknor & Co. have reprinted, and are about to issue, not in its original form of three volumes, but the entire work in a single volume. A certain portion of these plates have already been republished in the imperial edition of the *American Architect*; but even subscribers to that edition will probably be glad to find a place for the work in its enlarged and completed form, as the plates which have been printed in the imperial edition of the *American Architect* are scattered through the issues of that journal during a period of nearly two years, and therefore are not readily accessible. Moreover, the present edition contains in full the valuable notes and criticisms of the original, making forty pages of text and notes, not less valuable than the plates. The work is now in press, and will be ready for sale in the course of a few weeks.

SCIENCE:

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

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A MOVEMENT IS ON FOOT to celebrate the four-hundredth anniversary of the discovery of America by a world's exhibition to be held in this city. The time before 1892 is considered short for the satisfactory organization of such a vast undertaking; but, as the suggestion meets with general approval, it is likely to be carried forward to success. As to the location to be chosen, considerable discussion has begun, many opposing a proposal that the buildings should be erected in Central Park. This opposition argues, and as it appears justly, that the use of the park for such a purpose would interfere with its legitimate use as a pleasure-ground for at least a year, and that the injuries inflicted on the grounds could not be effaced in ten years. Some spot farther up on the island is more likely to be chosen,—a spot which, with the means of rapid transit which already exist, and which could be added to without much outlay, would be of easy access. We look forward to a rapid and satisfactory development of the plans for the exhibition; although, of course, as Americans do not seek any but a home market for their goods, the main stimulus of such a fair is not so strong as with Europeans.

ON JULY 9 the President appointed Professor T. C. Mendenhall superintendent of the Coast and Geodetic Survey. Professor Mendenhall was born in Ohio in 1841. From 1873 to 1878 he was professor of physics at the Ohio State University at Columbus. In

1878 he went to Japan, where he organized a physical department in the University at Tokio, as well as a weather bureau for the country. On his return to this country, in 1881, he again assumed the chair at Columbus, and in 1882 started the Ohio Weather Bureau. In 1884, Professor Mendenhall was called to Washington to take charge of an electrical branch of the Signal Office, and during his stay in the government employ also busied himself in developing a system of earthquake observations in the United States. Since 1886 he has been president of the Rose Polytechnic School at Terre Haute, Ind. In the new work Professor Mendenhall has undertaken, his many friends will wish him all success.

The last Congress legislated Mr. F. M. Thorn, the late superintendent of the Coast Survey, out of office at the close of the fiscal year. It provided, in an appropriation bill, that he should be appointed by the President, "by and with the advice and consent of the Senate." The proposed change of the law was submitted to Mr. Thorn by the Senate sub-committee on appropriations, and his opinion was requested as to the advisability of its enactment. He replied that he regarded as entirely unobjectionable the requirement that the superintendent should be appointed "by and with the advice and consent of the Senate," and that he had no personal interest in it whatever. His resignation was written on March 6, but was withheld at the suggestion of Senator Allison until April, when it was sent to the President. On June 22 Mr. Thorn directed the attention of the President and Secretary Windom to the law requiring the appointment of a superintendent to be made at the beginning of the fiscal year. He has not since discharged any of the duties of the office. Although Mr. Thorn was not a scientific man, like all of his predecessors, yet it is believed, that, as a result of his excellent executive ability, the forces of the office have been so employed during the past four years as to greatly increase their efficiency.

MASTER AND WORKMEN.

THE greatest interest attaching to the Petit-Bourg Works, for the manufacture of light railway material, twenty miles from Paris, is to be found in the relations that exist between the master and workmen. As described in *Engineering*, a system of almost military discipline prevails everywhere. With the exception of a small number of hands, all work is paid for by the piece, and every thing that fails to pass a rigid inspection is condemned at the expense of the men. The hours of the work are long,—fourteen hours a day,—and Sunday is only observed as a holiday after two o'clock. Yet the men are contented and prosperous, and are the first to stifle and exclude the spirit of discord which too often prevails in the factories of adjoining communes. Workmen are always eager to obtain service at Petit-Bourg, and, once there, are loth to quit it. The secret lies in the fact that the men like to be governed, and that their material welfare is always carefully studied. Comfortably fitted up dwellings are provided for the unmarried men, in which they can rent a well-furnished bedroom for 1½ pence a day, or for 2½ pence if two live together. Then a clean and attractive restaurant is close at hand, where well-cooked meals are furnished at prices just sufficient to pay expenses. Married men are not allowed to use this restaurant, but they can purchase and take home with them their meals at a somewhat lower price, so that all the expense and trouble of cooking is saved them. In this restaurant a separate room is provided for the use of the foremen, the scale of charges being the same; and a general shop is attached, where every thing can be purchased at the lowest possible rate. For those men who wish to save the expense and trouble of going to the restaurant at meal-times, a range of ovens is provided within the works, and placed under the charge of a superannuated employee, whose duty it is to receive the food brought by the men, and have it comfortably prepared when the breakfast or dinner hour comes. The men are paid monthly, and are allowed to open credits to fixed amounts with the restaurant and shop, the balance due to them being paid at each settlement. Pay-day is celebrated

by the works being closed for three days, during which time the men have absolute license to get drunk if they feel so disposed, the fact being that about one per cent avail themselves of this privilege. Drunkenness at another time is followed by dismissal. The married workmen are provided with comfortable cottages surrounded by gardens, and with rents varying from six to twelve francs a month, according to their size and location. A bonus is secured to them on each addition to their family, in the shape of a monthly reduction in their rent; and long service also secures a further reduction. By this arrangement the cottages gradually fall into the absolute ownership of the workmen, and a most powerful inducement for steadiness and content is thus secured. The single men are also allowed to have a plot of garden if they desire it, and this is found to be a great attraction in taking and keeping service under M. Decauville. The result of this wise administration is seen in the fact that the Petit-Bourg colony possess savings to the extent of 200,000 francs, which are not invested in savings banks, but in the works themselves, where it receives a guaranteed interest at six per cent. Workmen are insured against all accidents by M. Decauville, who encourages and assists the several benefit societies, which are mainly supported by the workmen themselves. But the glory of Petit-Bourg is its theatre, — a substantial and really elegant building, 100 feet long and 39 feet wide, capable of seating about 500 persons. This theatre is nicely fitted up, and has a capacious stage, with appointments that would do credit to many a provincial town. Here about four performances are given a year, not by third-rate actors representing sensational drama, but, when it is determined that a performance shall take place, subscriptions are raised among the employers, the foremen, and the men, a committee is formed to negotiate with some good Paris company, and every thing is arranged admirably. It may be mentioned, in passing, that the "Maitre des Forges" is a never-failing favorite. But, besides theatrical performances, the theatre at Petit-Bourg serves other purposes: it is the gathering-place on all political occasions, at which, needless to say, M. Decauville presides in his capacity as Monsieur le Maire; it is the scene of numerous concerts given by the Petit-Bourg band, formed exclusively of Decauville workmen; the corps of Sapeurs-Pompiers, also from the works, hold their meetings and celebrations here; and in the theatre M. le Maire distributes prizes gained in the schools which he controls.

Altogether the Petit-Bourg colony leads a happy and prosperous, though a laborious life; and if M. Decauville can succeed in the future, as he has done in the past, in saving the district where he and his family have ruled for so many generations from the contagion of discontent and communism, Petit-Bourg will continue in its prosperity, and its hard-working population will remain contented.

THE TRANSMISSION OF ENERGY BY COMPRESSED AIR.

WE have not before us any data to show the actual development of the Compagnie Parisienne de l'Air Comprimé, but a statement of the number of installations in active work towards the close of last year will serve to give an idea of the number and variety of industries which have availed themselves of this means of obtaining motive power. Since then, the number of subscribers has largely increased, and one section of the great public lighting scheme of Paris has been carried out by the company. At that date there were, says *Engineering*, seven central stations fed from the installation at St. Fargeau for the distribution of electric light. They represented a total force of 750 horse-power given off by the air-motors; and of these, six were of 100 horse-power each. Four theatres, fourteen cafés and restaurants, two hotels, the same number of newspaper-offices and of clubs, and sixteen private houses were electrically lighted by the same means. Sewing-machines were driven in thirteen different establishments, ice was produced in four, and the air formed the motive power for driving machine-tools in thirty-four different shops. Sixteen printing-offices availed themselves of the same means, and in thirty-five other establishments it was also employed. Among the various applications there were a number of sanitary establishments that were on the

list of subscribers; in six instances it was employed for raising wines and spirits; it was also used for working lifts, shearing metals, and cutting stuffs, for ventilation and for driving mills, and to a large extent for wood-working machinery. At the end of last year, over 1,200 horse-power was distributed daily through the mains. Of this, 478 horse-power found employment among 276 subscribers for various industrial purposes, and 803 horse-power was absorbed in supplying 6,220 incandescent lamps and 145 arc lamps. Since that date, the demands of subscribers have gone on increasing until the reserve of engine-power at St. Fargeau was of necessity absorbed to supply the existing demands, and it became necessary to extend the main station. At the end of last year the situation of the company appears to have been as follows: the subscribers who had made themselves liable for periods of from five to ten years brought in a revenue from various industries of \$12,000; for lighting, of \$92,000; and for the pneumatic clocks, of \$19,400. Besides these, there were a number of subscribers who paid by the records of their counters. Of these, \$14,600 was paid for miscellaneous industries, and \$32,000 for electric lighting. At that time, also, several important installations were in progress which have since been finished. Among others was the Bourse de Commerce, who spent \$20,000 on an installation; refrigerating companies paying \$20,000 a year, and the Eden Theatre \$24,000 a year; there were also a number of miscellaneous applications, amounting to \$16,000 a year. These sums together brought the total revenues of the company to about \$170,000 a year, the expenses being \$152,000 for that part of the installation which was in full operation. This sum included interest on loans at 6 per cent, and interest on capital at 5 per cent. At the beginning of the year the works were not running at any thing like their full capacity, so that a large amount of capital on which interest was being paid was earning nothing. The financial condition became more favorable a short time later, when a large number of other installations were completed. It is said that this year the company will be in a position to pay regular dividends of 10 per cent upon its share capital; and, if all that is claimed for the system be substantiated, there appears to be no reason why such a rate of interest cannot be maintained or even exceeded.

Engineering does not hold itself in any way responsible for the figures given. They were furnished by the company, whose good faith is evident, because they court investigation, and are even now making arrangements for a series of trials to be conducted by wholly independent experts. Naturally the most interesting feature of the system is that by which the efficiency of the compressed air is claimed to be doubled by the application of heat and of a certain proportion of water. Apart from the inconvenience resulting on the extreme cold produced at the exhaust, for large motors at least, the permanent success or failure of the system depends upon the high degree of efficiency that can be obtained. For small motors this question is comparatively of little importance, because, even with an efficiency of 30 per cent, the balance of advantages would rest with the compressed air as compared with power produced by other mechanical means or by manual labor. The great electric-lighting installation which the company has just completed between the Rue Royale and the Opera will afford, after a few months, absolute data as to the relative economy of the system, and a means of comparison between it and the other installations of the other electric companies. Under every aspect, this great industry for the transmission of power, of which the station at St. Fargeau is the centre, is a most interesting one; and it may be predicted with certainty, that, if the reports of independent engineers confirm the statements by the company, applications on an equally large scale will soon be at work in other cities besides Paris. In a great many instances the advantage of being able to promote ventilation and to obtain a supply of pure air in the workshop is an advantage of great importance, and is one that is shared by no other medium of energy after it has done its work. Unlike the waste products from the gas-engine, or exhaust steam, or the discharged water from a hydraulic motor, the expanded air, after having done its work in the cylinder, can be turned directly into the apartment where the engine is at work. There are so many other purposes to which the system may find an application, that its field of usefulness appears to be a very wide one indeed. For

refrigerating purposes it is already in successful use in Paris, and to a modified degree it may well serve to reduce the temperature of houses in hot climates. The production of intense heat for metallurgical purposes, and the aërication of water, are also two other practical uses of which the ultimate list will probably be a long one.

HEALTH MATTERS.

The Mortality in the City of New York for 1888.

A PRELIMINARY report in relation to the mortality of the city for the year 1888 has just been presented to the board of health by Dr. Roger S. Tracy, the assistant sanitary superintendent; and the deductions made in it, as we find them summed up in the *Boston Medical and Surgical Journal*, are somewhat remarkable. The sanitary police took a census of the tenement-house population during the year, which includes all the houses that are more or less constantly under the supervision of the board of health, but not the better class of apartment-houses. The entire population included in this census was 1,093,701 persons, among whom there were 24,842 deaths, while the total number of deaths in the city was 40,175. The highest death-rate, 26.60 per thousand of the population, is in the district south of 14th Street and west of Broadway; the next highest, 23.52, is in the district west of Fifth Avenue and between 14th and 59th Streets, in which are situated a large proportion of the residences of the wealthiest citizens; and the third highest in the district east of Broadway and south of 14th Street, the most densely populated part of the city, and containing almost exclusively a tenement-house population.

The general tenement death-rate was 22.71, while the general death-rate of the city in 1888 was 26.33; and this fact would seem to indicate that the population of the city has been underestimated, and the quoted death-rate too high, or that all the deaths belonging in tenement-houses had not been credited to them, or else that the death-rate is actually lower for the tenement-house population than for the rest of the city, which would certainly seem most extraordinary. It might be that deaths that should have been credited to the tenement-houses have not been so credited; but of the total number of deaths in institutions, 7,774, the former place of residence of the individuals was ascertained in 3,444, and these deaths have all been credited to the houses in which they had lived. In all the districts the death-rate of persons five years of age and over, as a rule, decreases as the number of tenants increases; while the death-rate of children under five years of age increases up to a certain point, diminishing when there are more than eighty tenants to a house. The general death-rate is highest in houses containing from sixty to eighty tenants; and this is caused by the higher death-rate among the children, which reaches in these houses 114.04 per 1,000 living.

The results of the investigations are summed up by Dr. Tracy as follows: "The death-rate in tenement-houses is less than the general death-rate of the city. The death-rate in the large tenement-houses is less than in the smaller ones. While diarrhoeal diseases and diphtheria show a greater death-rate in the larger houses, phthisis and pneumonia show comparatively little difference; that difference, however, being in favor of the larger houses. The greatest general death-rate among persons over five years of age, the next to the highest death-rate from diarrhoeal diseases and pneumonia, and markedly the highest from phthisis, are in the district south of 14th Street and west of Broadway. The excessive mortality in this part of the city is probably connected with the great number of old houses and the dampness of the soil. These results are much at variance with what was expected. It seems to be sufficiently established that people do not live under such extremely bad sanitary conditions in the tenements as they have been supposed to."

Contagious Consumption.

The following report on consumption as a contagious disease was approved July 9 by the Health Department of New York City:—

"Pulmonary tuberculosis (consumption) is directly communicated from one person to another. The germ of the disease exists in the expectoration of persons afflicted with it. The following extract

from the report of the pathologists of the Health Department explains the means by which the disease may be transmitted:—

"Tuberculosis is commonly produced in the lungs (which are the organs most frequently affected) by breathing air in which living germs are suspended as dust. The material which is coughed up, sometimes in large quantities, by persons suffering from consumption, contains these germs often in enormous numbers. . . . This material when expectorated frequently lodges in places where it dries, as on the street, floors, carpets, handkerchiefs, etc. After drying in one way or another, it is very apt to become pulverized, and float in the air as dust."

"By observing the following rules, the danger of catching the disease will be reduced to a minimum:—

"1. Do not permit persons suspected to have consumption to spit on the floor or on cloths, unless the latter be immediately burned. The spittle of persons suspected to have consumption should be caught in earthen or glass dishes containing the following solution: corrosive sublimate, one part; water, one thousand parts.

"2. Do not sleep in a room occupied by a person suspected of having consumption. The living rooms of a consumptive patient should have as little furniture as practicable. Hangings should be especially avoided. The use of carpets, rugs, etc., ought always to be avoided.

"3. Do not fail to wash thoroughly the eating utensils of a person suspected of having consumption as soon after eating as possible, using boiling water for the purpose.

"4. Do not mingle the unwashed clothing of consumptive patients with similar clothing of other persons.

"5. Do not fail to catch the bowel discharges of consumptive patients with diarrhoea in a vessel containing, corrosive sublimate, one part; water, one thousand parts.

"6. Do not fail to consult the family physician regarding the social relations of persons suffering from suspected consumption.

"7. Do not permit mothers suspected of having consumption to nurse their offspring.

"8. Household pets (animals or birds) are quite susceptible to tuberculosis: therefore do not expose them to persons afflicted with consumption; also do not keep, but destroy at once, all household pets suspected of having consumption, otherwise they may give it to human beings.

"9. Do not fail to thoroughly cleanse the floors, walls, and ceilings of the living and sleeping rooms of persons suffering from consumption at least once in two weeks."

Ten thousand copies of the report were ordered to be printed for distribution.

PREVENTING TUBERCULOSIS BY MILITARY ORDERS.—The German war minister has decided, says *The Medical Record*, that the chest of every soldier shall be examined once a month. If the chest does not reach a certain breadth, and does not develop with drill and athletic exercises, the soldier will be disqualified, and regarded as being predisposed to phthisis, and, moreover, likely to infect his comrades.

PASTEUR'S METHOD.—In his brief report for the year ending May 1, 1889, the director of the Pasteur Institute, Paris, announces the treatment of 1,673 subjects, of whom 6 were seized with rabies during, and 4 within a fortnight after, the process. But 3 only succumbed after the treatment had been completely carried out, making 1 death in 554, or, including all the cases, 1 in 128.

PROFESSORSHIPS OF HYGIENE.—The University of Kiel, as we learn from *The Medical News*, has inaugurated a professorship of hygiene, and Dr. Bernard Fischer has been appointed to the chair. There now remain only two Prussian universities—those of Bonn and Königsburg—without such chairs. Dr. Fischer was one of Professor Robert Koch's pupils, and accompanied him on that memorable journey into Egypt and India which resulted in the discovery by Koch of the bacillus of Asiatic cholera. Another companion on that voyage was Dr. Gaffky, now professor of hygiene at Giessen. Other pupils of Koch occupy the same department of instruction in other universities, as Dr. Gärtner in Jena, Dr. Löffler in Greifswald, Dr. Hüppe in Wiesbaden, Dr.

Becker in Leipzig, Dr. Fränkel in Berlin, and Dr. Frank in Naples. These are all members of the younger generation of instructors, and are adepts in the laboratory methods of Koch. Dr. Fischer's original work has been exerted in two directions chiefly,—one in the application of bromine to disinfection, another in the study of the phosphorescence of the sea.

ELECTRICAL NEWS.

NEW FORM OF GAS-BATTERY.—This battery, invented by Mr. Ludwig Mond and Dr. Carl Langer, is an improvement on the gas-battery invented by Grove fifty years ago, which produces electricity from hydrogen and oxygen gas by the intervention of platinum. The distinguishing feature of the new battery, which has been designed to obtain large currents of electricity by means of these gases, is, according to *Nature*, that the electrolyte is not employed as a mobile liquid, but in a quasi-solid form, and it is therefore named "dry gas battery." Each element of the battery consists of a porous diaphragm of a non-conducting material,—for instance, plaster-of-Paris,—which is impregnated with dilute sulphuric acid. Both sides of this diaphragm are covered with very fine platinum-leaf, perforated with very numerous small holes, and over this with a thin film of platinum black. Both these coatings are in contact with frameworks of lead and antimony, insulated one from the other, which conduct the electricity to the poles of each element. A number of these elements are placed side by side, or one above the other, with non-conducting frames intervening, so as to form chambers through which hydrogen-gas is passed along one side of the element, and air along the other. One element, with a total effective surface of 774 square centimetres (120 square inches), which is covered by 1 gram of platinum black and .35 of a gram of platinum-leaf, shows an electro-motive force of very nearly 1 volt when open, and produces a current of 2 amperes and .7 of a volt, or 1.4 watts, when the outer resistance is properly adjusted. This current is equal to nearly 50 per cent of the total energy obtainable from the hydrogen absorbed in the battery. The electro-motive force decreases, however, slowly, in consequence of the transport of the sulphuric acid from one side of the diaphragm to the other. In order to counteract this disturbing influence, the gases are from time to time interchanged. The battery works equally well with gases containing 30 to 40 per cent of hydrogen, such as can be obtained by the action of steam, or steam and air, on coal or coke, if the gases have been sufficiently purified from carbonic oxide and hydrocarbons. The water produced in the battery by the combination of hydrogen and oxygen is carried off by the unconsumed nitrogen, and an excess of air carried through it for this purpose.

BOOK—REVIEWS.

Education in the United States: its History from the Earliest Settlements. (International Education Series.) By RICHARD G. BOONE. New York, Appleton. 12°. \$1.50.

THIS book belongs to a class that are becoming rather common in this country, books presenting a large amount of useful information in an unattractive style. The time has been when a good literary style was considered indispensable in an historical work; but in our time, and especially in this country, we are treated to volume after volume on historical themes in which style is utterly lacking. That this should be so is somewhat surprising; for a work that has no charm of style is certain to have a much smaller circle of readers than one that has that attraction, and writers usually desire as many readers as possible. In Mr. Boone's book we are sorry to find this literary defect; for the work has a good deal of merit of other kinds, conveying as it does a large amount of information for the most part well arranged. It has evidently been prepared by careful and conscientious study of the original authorities, and will be useful at least to all educators and as a work of reference to all intelligent readers. It opens with an account of the steps taken by the early colonists to establish schools and colleges, and shows how, at the very outset of our national history, the sentiments of North and South differed on this subject

of education. Massachusetts and Connecticut led the way in founding schools for the whole people, and it was not until comparatively recent times that their ideas and practice became generally prevalent. How the public-school system grew up and over-spread the country, Mr. Boone relates at considerable length; and he does not fail to show how much the schools have been improved by the increase of State control. Then follows a chapter on recent progress in the colleges, showing the changes in the curriculum, the introduction of the elective system, and other matters of interest. Professional and technological schools are also treated of, and there is a chapter on the education of the deaf and dumb and other unfortunates, and of criminals. The author does not confine himself, however, to the schools alone, but gives the history of other educational agencies, such as libraries, museums, and learned societies. The founding of the Smithsonian Institution, the grants of land for educational purposes, and other acts of the general government bearing on education, are related; and the book closes with an interesting chapter on the advance that has been made in the education of women. Thus it contains a valuable mass of information, which, so far as we know, was not accessible before in a convenient form.

A Theoretical and Practical Treatise on the Strength of Beams and Girders. By ROBERT H. COUSINS. New York, Spohn, 12°. 55.

SINCE the time of Galileo, the subject of which this volume treats has received much attention at the hands of the ablest mathematicians of all countries. Many attempts have been made during the present century to solve experimentally the problems involved, only to result in the adoption, by many experimenters, of empirical rules for the strength of beams and girders, rather than scientifically deduced formulas; the reason for this, as given by one authority, being that "no theory of the rupture of a simple beam has yet been proposed which fully satisfies the critical experimenter." The theory advanced in this treatise, and the formulas resulting from that theory, deduce the strength of beams and girders from the direct crushing and tensile strength of the material composing them, leaving out of the problem altogether the co-efficient known as the modulus of rupture. The theory and the formulas deduced from it are in accord with correct mechanical and mathematical principles, and the author believes that they will fully satisfy the results obtained by the experimenter. Works of this character derive special importance from the constantly increasing use of iron and steel for building and engineering purposes.

The Beginners' Book in German. By SOPHIE DORIOT. Boston, Ginn. 12°. 90 cents.

THIS little book is the result of the need felt by the author and others, in teaching German, of suitable books to put into the hands of beginners. It consists of two parts. Part I. is a series of lessons, each of which is introduced with a picture, followed by corresponding verses from the child-literature of Germany. These pictures, which illustrate the text following, were all drawn expressly for the purpose, and are brimming with the spirit of fun and humor which they have so faithfully caught from the child-lore. A conversation upon the subject, with the study of words and phrases, completes each lesson. In this way advantage is taken of the children's tastes and inclinations, and even of the mischievous element which enters so largely into the child-nature. The second part contains graded selections for reading.

The typography and make-up are in every way excellent. The book, as a whole, forms a very attractive volume, and we have no doubt that it will prove, as the author has intended, a great relief to teachers and a source of pleasure to pupils.

The A B C of Electricity. By WILLIAM H. MEADOWCROFT. New York, F. W. Lovell. 12°. 50 cents.

CONDENSATION of matter and simplicity of language are the points most noticeable in this little volume. A brief general outline of the rudiments of electrical science, or at least of those departments of it which have now become almost a part of every-day life, is given in language devoid of those technicalities which are

so puzzling and discouraging to the general public, though necessary to the student and the electrician. The author does not put it forward as a scientific work, of which there is no lack, intending it only as a sort of guide-book on the road to electrical science, which will probably give to many the information they may desire, without requiring too great a research into works which treat more extensively and deeply of the subject. The book bears the indorsement of Thomas A. Edison.

AMONG THE PUBLISHERS.

AMONG the timely articles in the July number of *The New Review*, which Longmans, Green, & Co. expect to have ready about the 12th, are "The Eiffel Tower," by M. Eiffel himself; "The Shah of Persia," by Lord Castletown; and "The Eight Hours Bill," by Mr. Charles Bradlaugh. There will also be an anonymous article on "The Talkers of London." Matthew Arnold's literary executor, Lord Coleridge, has written a paper on the lamented poet and critic, which will appear in the July number of *The New Review*.

— The July number of *Blackwood's* will contain a story by Mr. Oscar Wilde on the subject of Shakspeare's sonnets. Mr. Wilde will put forward an entirely new theory as to the identity of the mysterious "Mr. W. H." of the famous preface.

— John Wiley & Sons have just ready a work on "Steam-Engine Design," for the use of mechanical engineers, students, and draughtsmen, by Professor J. M. Witham.

— Ticknor & Co. announce "The Moral Idea: a Historic Study," by Julia Wedgwood, — a work which is said to be the outcome of twenty years of study, and which is described as "a history of human aspiration after a moral ideal that changes continually in the evolution of time and thought, the highest truth discovered by one age being often found by a revolt against the errors circling round the belief that was the life of a former age."

— D. Appleton & Co. have ready "Days Out of Doors," by Charles C. Abbott, a companion volume to his "A Naturalist's Rambles about Home;" "The Garden's Story," by George H. Ellwanger, relating the pleasures and trials of an amateur gardener, illustrated with head and tail pieces by Rhead; and "The History of a Slave," by H. M. Johnston, author of the "Kilimanjaro Expedition."

— In the July issues of the leading English reviews, Mr. Gladstone contributes to the *Nineteenth Century* an article entitled "Plain Speaking on the Irish Union." Mr. Gosse writes on "Edward FitzGerald," the translator of Omar Khayyūm, in the *Fortnightly*; and Walter Besant describes the first society of British authors (1843) in the *Contemporary Review*. This last-named periodical will contain, in addition to other notable articles, a paper on "Jewels and Dress," by Mrs. Haweis; and one on "Thomas Hardy," by J. M. Barrie.

— Messrs. Belford, Clarke, & Co. send us two of their lately published novels, — "The Prophet's Mantle," by Fabian Bland; and "Treon, or The Mormon's Daughter," by Alva M. Kerr. The former is much better than many recent novels, being not only unexceptionable in both a moral and a literary sense, but really an entertaining story. The leading character is a Russian nihilist, but the scene is mostly laid in London. The incidents are mostly of an ordinary kind, only a few being unusually exciting; yet the interest is unflagging from beginning to end. A good deal is said by the various characters on the subjects of socialism, capitalism, tyranny, and the urgent need of social re-organization, and the author seems to be more or less in sympathy with socialistic views, but with some doubts about their practicability. The other novel is inferior to "The Prophet's Mantle," but has nevertheless an interest of its own. The hero of the tale is an eastern man, who goes on business to Utah, and there falls in love with a Mormon's daughter. A Mormon bishop, however, who already had several wives, was bent on adding that same girl to the list; and hence arose a host of trouble for the young lovers, out of which, of course, they at last emerged triumphant. The book contains a great deal about the Mormon doctrines and practices — most readers will

think too much for the interest of the story; and the author is evidently a determined hater of the whole Mormon system. Almost every novel nowadays endeavors, as these do, to deal with some moral or social question, either by showing in a vivid light some evil that requires a remedy or by rousing a public sentiment in favor of reform. This tendency, if properly directed, is certainly to be welcomed; for it makes the story not only more useful and improving, but also to men of intelligence more interesting.

— Messrs. Ginn & Co. announce for early publication "Pages Choies des Mémoires du Duc de Saint-Simon," edited for use in colleges and advanced classes, and for private readers, by Alphonse N. Van Daell, Ph.C., LL.D., recently director of modern languages in the Boston High and Latin Schools, and now professor of French in the Massachusetts Institute of Technology. The "Mémoires of Saint-Simon," which are of great importance for both the literary and the historical study of the seventeenth century in France, are accessible to but few students, partly on account of their bulk. The editor does not know of any American edition, although it is very desirable to have Saint-Simon's prose studied in an advanced course. The notes will be in French; and the introduction will consist of two selections, — one from Taine, the other from Rambaud. The same firm also announce for publication in August, Dumas' "Les Trois Mousquetaires," edited by Professor F. C. Sumichrast of Harvard University, for use in schools and colleges and for private readers. Alexandre Dumas was one of the brightest and most entertaining of writers; but his works, with the exception of "La Tulipe Noire," have not been available for college or school work on account of their length and the frequent occurrence of objectionable passages. These two objections are removed in this edition of Dumas' masterpiece, "Les Trois Mousquetaires." The story itself is kept intact, and the brilliant description of court, camp, and city life preserved; but the "padding" has been omitted, and its place supplied by brief summaries. Every objectionable page has been carefully excised, and this with the greater readiness that the actual story is not thereby affected. The book will form a volume of about two hundred pages of reading-matter, and, being fully annotated, will prove an edition serviceable to student and teacher alike.

— The *Forum* for July contains eleven articles on a great variety of subjects and of varying excellence. The most important is the opening one, by Bishop Henry C. Potter, on "The Scholar in American Life." The writer justly thinks that the American people are greatly in need of a much higher grade of scholarship than now prevails among them; and in this essay he endeavors to show this need, and also to point out the conditions on which alone it can be supplied. By scholarship Bishop Potter does not mean the mere possession of knowledge: on the contrary, he speaks slightly of those who merely retail other men's ideas. It is the original thinker, the teacher of new truths, whom he designates as the scholar, and whose work he regards as so important. At present such men are rare in this country, and those of the highest class are not found here at all; and Bishop Potter doubts if we shall have them in any considerable numbers until our universities provide, either by fellowships or by lectureships, for their support. The whole paper is well considered, and ought to be read and pondered by all who have the interests of American civilization at heart. Mr. W. S. Lilly continues his series of papers on what he deems the moral looseness of the present age, treating this time of "The Ethics of Journalism." He contrasts the ideal of the journalist's profession with the reality, and it cannot be denied that the charges he brings against the common run of journalists have a solid basis of fact. Professor G. J. Romanes replies briefly to Mr. Mivart's criticism of the Darwinian theory, but without saying anything that is new. Dr. Austin Flint has a paper on "Late Theories concerning Fever," in which he considers especially the mode of treating that disease. He remarks that the increase of temperature is the really dangerous element in the case, and, while he speaks somewhat hesitatingly about the use of drugs for reducing the temperature, recommends in strong terms the application of cool baths. M. Honoré Beaugrand writes of "The Attitude of the French Canadians" on the questions of commercial union and annexation to the United States. He replies to Professor Goldwin

Smith's strictures on the French people of Canada; and while he admits that they are less successful in accumulating wealth than men of the Anglo-Saxon race, and that they are too much under the influence of the priests, he maintains that they are, on the whole, as good citizens as any others. On the question of annexation, he thinks the French are tending toward a decision in its favor, largely because so many of them have already settled in New England, and so have become familiar with life in the States. Mrs. J. C. Croly writes on "Domestic Service," expressing the opinion that mistresses usually expect too much of their servants,—as much as could be expected of trained experts; and, furthermore, that the servant-girl is too often not treated, as she should be, like any hired laborer, but rather as a dependent. To these causes Mrs. Croly attributes many of the troubles that ladies have with their servants. The other papers in the *Forum* deal with familiar subjects, and call for no special remark.

— It cannot be said that in these days there is any lack of high-class reviews, but their cost is prohibitive to the great mass of the people. A high standard of excellence, and a cultivated literary taste, are no longer confined to the few; while a keen anxiety to become acquainted with the ideas of the foremost men of the day on the many vital problems now before the world is developing among a class unable to purchase the periodicals in which alone these subjects are handled. The object of *The New Review* (Longmans, Green, & Co., London and New York) is to place a critical periodical of the first order within the reach of all; and the preliminary list of writers is a sufficient proof that it will not yield to any in the eminence of its contributors. The public will be brought into direct contact with the most representative men of the age. Politics, science, and art will be treated by writers of acknowledged repute; and literature, both critical and creative, sober and fanciful, will be associated with names which have long carried their own commendation. Brevity as well as cheapness will be one of the distinguishing features of the new enterprise. The second number, to be published early in July, will contain, "The Shah," by the Right Hon. Lord Castletown; "Matthew Arnold," by the lord chief justice of England; "The Eiffel Tower," by M. Eiffel; "The Eight Hours Bill," by Charles Bradlaugh, M.P.; "The Higher Policy for Africa," by Sir G. Baden-Powell, M.P.; "The Talkers of London;" "Greyfriars," by St. George Mivart,

F.R.S.; "The Dying Drama," by William Archer; "Three Types of Womanhood," by the Countess of Cork.

— A natural-history serial, "Among the Florida Keys," by Charles Frederick Holder, describing the strange adventures and observations of a party of boys during a vacation trip in Florida, begins in the July number of *St. Nicholas*, and will continue for four months.

LETTERS TO THE EDITOR.

*Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.
The editor will be glad to publish any queries consonant with the character of the journal.

Queries.

45. IS THE HUMAN VOICE GROWING, OR DECAYING? — In his article on speech and song, in the *Contemporary Review*, Sir Morell Mackenzie writes, "Before leaving the subject of the speaking voice, a word or two may be said on what is more a matter of curious speculation than of practical interest. Is the human voice growing in power and beauty, or is it tending to decay? Certain physiologists assure us that the retina has acquired the power of distinguishing colors by degrees, and that the process will probably continue, so that our descendants will by and by evolve the power of seeing colors now quite unknown to us. On the other hand, it is undeniable that civilization, so far from increasing the keenness of our sight, threatens to make spectacles universally necessary. There can be no doubt that the voice has developed greatly since our 'half-human ancestors' wooed each other in the primeval forests, and it is conceivable that it may in time to come acquire the power of producing musical effects at present undreamt of. It is also probable enough, that, as the voice gains in sweetness, it may lose in power, the latter quality being more required in barbarous than in highly civilized conditions. On the other hand, we are taller and of larger chest-girth than our predecessors even of a not very remote date: it is reasonable, therefore, to suppose that the average lungs and larynx are bigger nowadays, and the air-blast from the lungs stronger. This would appear to justify us in believing that the voice is stronger than it was even two or three centuries ago. There are, however, no facts that I know of to prove it." Cannot some of the readers of *Science* throw light on this? X.

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INDUSTRIAL NOTES.

The Popularity of Electric Cars.

It is extremely interesting to note that a few evenings ago a mass meeting of citizens was held in Cleveland, O., to urge the extension of the electric-railway system in that city. When the East Cleveland Street Railway Company, about a year since, proposed to install an electric line of cars on Euclid Avenue and several other principal streets in that city, there was a general protest by the residents along the proposed route who had never seen any lines in electrical operation, and others, against the erection of poles and overhead lines. Objections to railway pole lines in cities where there have been no electric cars are natural, in view of the kinds of pole lines which are often installed by telegraph and telephone companies; but, as the intention of the East Cleveland Street Railway Company was to install iron poles, the objections were finally overruled, and the line was equipped with the overhead system, using iron poles, and operating sixteen Sprague electric cars. The route extended over some of the handsomest residential streets and principal business thoroughfares, and used the regular Sprague overhead system, with the small No. 6 silicon bronze trolley wire as a working conductor, carrying the main portion of the current on an insulated main wire at the side of the street. The success of the road has been marked from its very start. The residents have been given a method of transit more convenient and more rapid than they had ever before enjoyed, without any disfigurement of the streets by hideous elevated-railroad structures. The system rose rapidly in popularity with residents and property-owners as its advantages became recognized, and real estate along the route of the electric railway increased greatly in value, in a number of cases bringing double or triple its former price. With this change there was a very noticeable change in the tone of the Cleveland press, which rapidly changed from a spirit of opposition to the electrical method of rapid transit to a spirit of friendliness and approbation. The railway company have already increased their equipment, adding eight more to their original order of sixteen cars from the Sprague Company.

The meeting held the other evening was largely attended, and was for the purpose of urging the railway company to still further extension of their line, and to simplify their facilities of rapid transit. The meeting in Doan's Armory on Euclid Avenue, Cleveland, was presided over by Mr. W. E. Sherwood. After the announcement of the purposes of the meeting, which was received with great enthusiasm, a committee, consisting of Judge E. M. Heisly, Gen. Edward S. Meyer, and Mr. George H. Foster, were appointed to draw up a resolution.

The resolution which was presented by these gentlemen, and which was unanimously adopted, read as follows: "*Resolved*, That it is the sense of this meeting that the public convenience of the city of Cleveland requires and demands that the electric-motor system shall be extended to the Public Square, and, if necessary to that end for the East Cleveland Railroad, that it lay its tracks on Euclid Avenue from Case Avenue to the Public Square, if consent can be obtained; and the gentlemen present pledge themselves to do all in their power to obtain that consent for the company."

This action of the citizens of Cleveland is simply another example of the popularity of the electric system of street-car propulsion in every city where it has been adopted.

Electric Rapid Transit in Cleveland.

Among the cities which are rapidly coming to the front as leading in rapid-transit facilities by the application of electricity, there is none, perhaps, where the advantages of electric power for street-cars are more thoroughly recognized than in the city of Cleveland, O. Though it is only about nine months since the first electric cars were put into operation upon the streets of that city, the Cleveland public have become enthusiastic over this method of transit, and the number of electric cars in that city is rapidly extending.

Last week a new extension to the East Cleveland Electric Railway was opened in Cleveland on Prospect Street and Euclid Avenue, and the first car ran over the line with the president and

secretary of the road, and electricians in charge, as freight. It is the intention of the East Cleveland Company to operate sixty motor-cars on this line with two minutes and a half headway, and all horses will be removed from the line as soon as the motor-cars are equipped with the Sprague motors which have been ordered.

It is said that the experiment will be tried of running these cars at the rate of about eleven miles an hour through the city; and it is not thought that the city council will object to this, since it is a well-known fact that electric cars operated at this speed are much safer to the general public than horse-cars run at only six miles an hour, as the electric cars can be stopped very much more quickly than cars propelled by animal power.

It is an interesting fact, in connection with this road, to note the popularity of the electric cars with the passengers and property-owners along the line. In Cleveland, at a public meeting recently, which was presided over by some of the most prominent citizens, resolutions were passed commenting on the successful operation of the Sprague electric road; and the East Cleveland Company was requested to extend the motor-line in several directions, in order to improve the transit facilities. These resolutions were adopted unanimously by the large number of citizens who were present.

The equipment of the East Cleveland Company includes, besides a number of the old type of Sprague motors, a number of cars equipped with the new style of motors, and the additions to the equipment will be all of this class of motor. Cleveland deserves a prominent place among the leading "electrical cities" on this continent.

A Pioneer Electric Line Re-organized.

One of the first electric street-railways in this country, the Washington Street, Asylum, and Park Railway of Binghamton, N.Y., has recently had its entire equipment changed, in order to meet the latest and most approved ideas of electric-railway science. The first equipment was installed about two years ago, and the changes which are being made illustrate the advances which have been accomplished in electric-railway science, and they show the difference between the ideas which were prevalent two years ago and those illustrated in the motor appliances of to-day.

The motor cab, which occupied the front of the car under the old style of electric railway, will be entirely dispensed with, and the motors will be placed underneath the cars, as in all the modern electric railways. The overhead overrunning trolley, and the method of carrying all the current over the track on a single conductor, have been abandoned for the latest Sprague methods in this case. The motive power also will be under the more complete control of the driver, and all degrees of speed in both directions are obtainable by movements of a single switch, so that the car can be propelled either backwards or forwards with equal ease and rapidity.

The cable-lines, which formerly it was found necessary to operate at either end of the road on account of the heavy grades at these points, will be things of the past, as the Sprague motors will be of sufficient power to propel the cars up these grades; and the trip from one end of the line to the other will be made without change.

It is interesting to note the increase of efficiency of the motors, as indicated by the statement which is made, that the management of the railway company has completed a contract for power at nearly one-half less than the amount called for by the previous contract.

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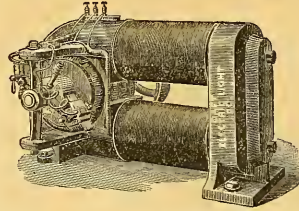
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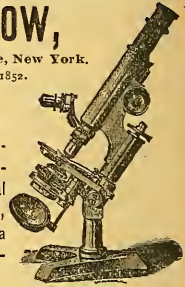
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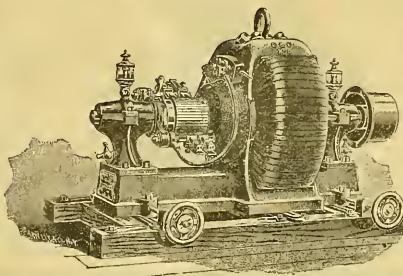
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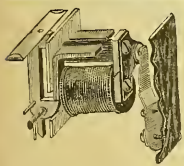
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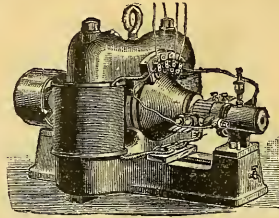
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SEVENTH YEAR.
VOL. XIV. No. 337.

NEW YORK, JULY 19, 1889.

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THE SPRAGUE ELECTRIC-RAILWAY MOTOR.

We publish in this issue views of the Sprague improved electric motor for street-railway work. This motor represents the experience of several years in the electric street-railway business, and it is intended to meet all the exigencies in this kind of work. In its manufacture, every detail of mechanical and electrical construction is carefully attended to, and the most recent improvements which experience could suggest have been adopted to meet the necessities of street-car service.

Only one intermediate shaft is used between the armature pinion and the main gear, and the entire reduction is about 12 to 1. All

The armatures are of the type which has been proved to be water-proof, and incapable of injury by moisture. In a recent test upon one of these armatures, made at the Sprague factory at Schenectady, and described in this paper a short time ago, one of these armatures was placed successively in a tub of fresh water and allowed to remain there for twenty-four hours, and in a tub of salt water and allowed to remain there for the same time. After each of these baths, the armature was placed in position in the motor, and the machine was worked to one-third above its normal load, as measured by a dynamometer, for several hours without developing any trouble whatever. These tests proved most conclusively that these machines can be relied upon under all condi-

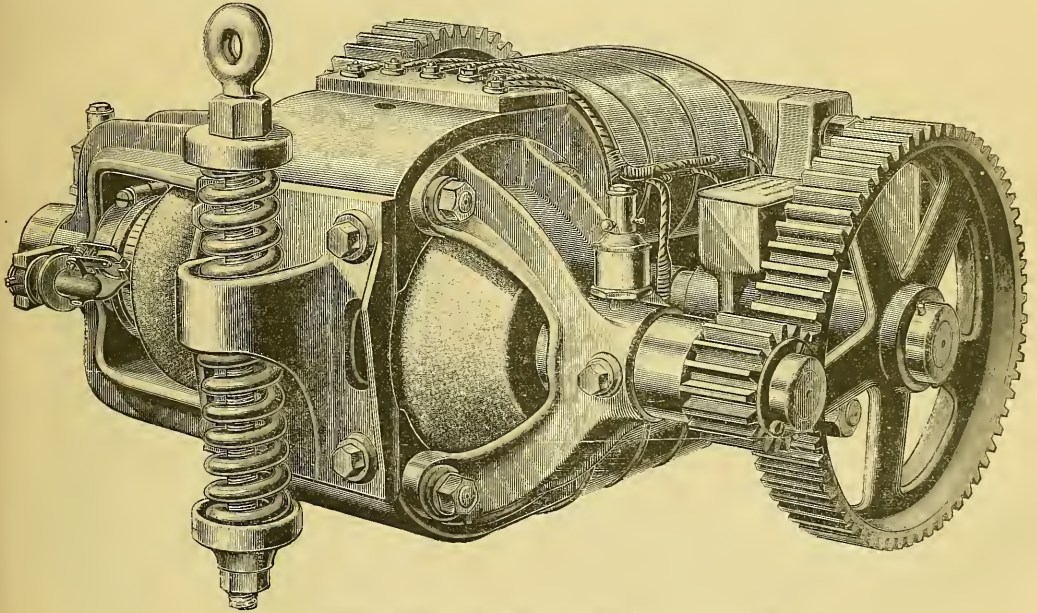


FIG. 1.—NEW SPRAGUE ELECTRIC-RAILWAY MOTOR.

the gears and every part of the motor are made extremely strong and durable, as can be seen in the case of the gears in the engraving, where the general appearance of durability and strength is everywhere marked.

The main gears are of the split-gear pattern, so that in case of necessity they can be easily removed from the shaft without dismounting the machine. The pinion and all the bearings are also constructed so that they can be easily removed if necessary.

Great attention has been paid in this motor to obtain a machine which will require a minimum amount of care, under the unfavorable conditions which motors for street-railway work very often meet in actual practice. For this reason, all the bearings are made completely dust-proof and very durable.

tions of weather, and that they cannot be harmed by moisture or by water splashing upon them from the road-bed.

Another important improvement which has been adopted in this machine is that the field-magnet coils are completely incased in covers, as shown in the engravings, which fully protect the wire from all outside damage. These casings are hermetically closed, so that it is impossible for moisture to affect the coils in any way.

The style of brushes used upon these motors is of a new type, which has been shown to give excellent results in this kind of work.

The Sprague method of flexibly suspending the motors, and of controlling the speed of the motor without the use of any wasteful resistances, is also in use with these motors upon all the roads installed by the Sprague Electric Railway and Motor Company.

A great deal of attention has been paid in the design of this motor, while great care has been taken in regard to durability and strength, to reducing the weight to a minimum. For this purpose, and with this object in view, cast iron has been dispensed

GIRDLING TREES TO IMPROVE FRUITFULNESS.

IN many sections where the soil is moist and rich, fruit-trees grow largely to wood and foliage, and fail to produce fruit until they reach considerable age and size. To discover some means of

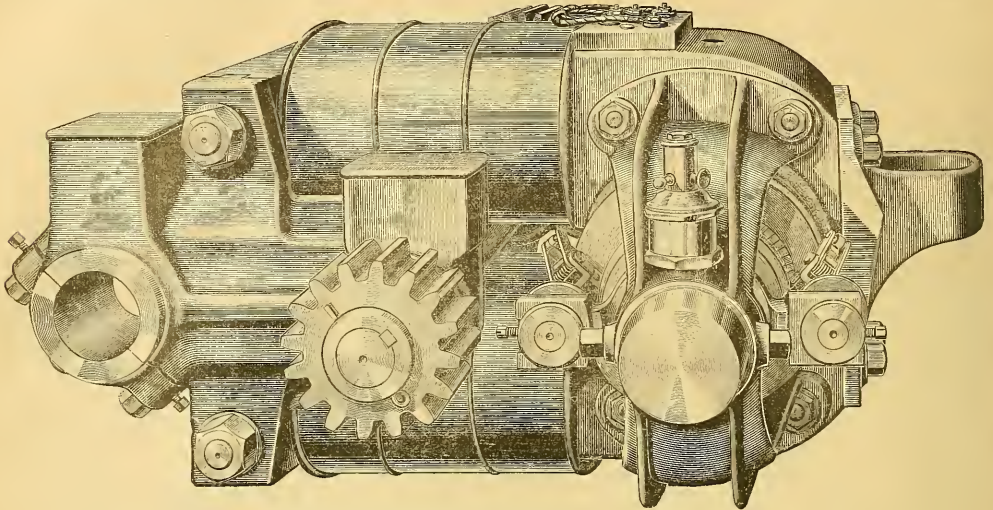


FIG. 2.—NEW SPRAGUE ELECTRIC-RAILWAY MOTOR.

with in the cores and yoke of the field-magnets, and wrought iron substituted.

These motors are already in operation at Wichita (Kan.), Marlborough (Mass.), Cleveland (O.), Cincinnati (O.), Erie (Penn.), At-

hastening the fruiting of such trees, the following experiments were made at the Hatch Experiment Station of the Massachusetts Agricultural College. A row of crabapple-trees of about the same size and condition of growth were selected, and treated as follows: 1st,

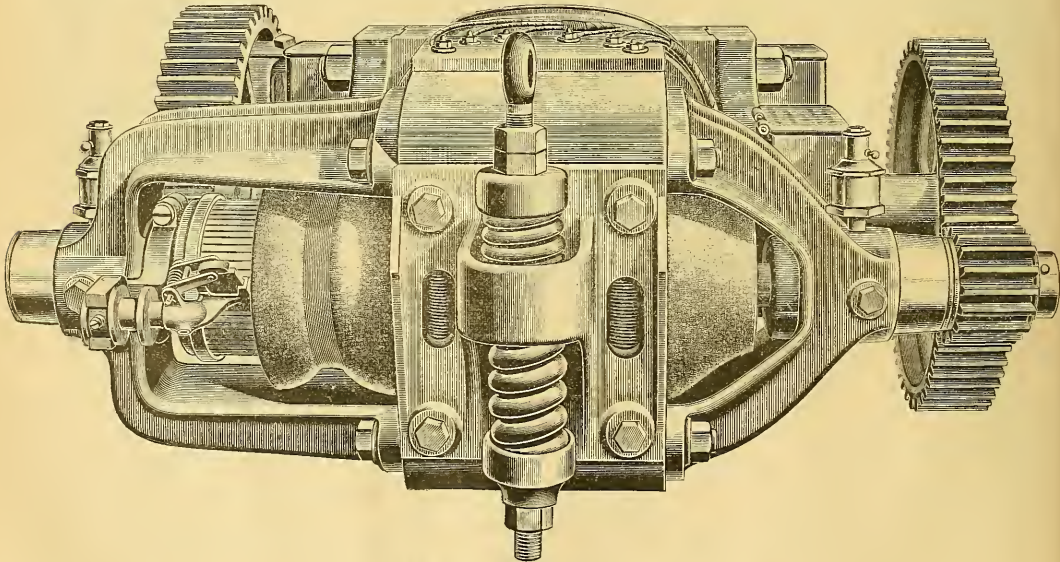


FIG. 3.—NEW SPRAGUE ELECTRIC-RAILWAY MOTOR.

lantic City (N.J.), and at one or two other places where they have been installed. They have been shown to give very good results, and in the future this type of motor will be used in all of the Sprague electric-railway installations.

Three trees were girdled by cutting out a ring of bark $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{3}{4}$ inch wide at the ground, July 12, 21, and 29; 2d, Three trees were girdled just below the main branches with the three widths of girdle as in 1st, July 12, 21, and 29; 3d, The same as above was

made on one or more main branches with the three widths of girdle, July 12, 21, and 29.

The results were as follows: 1st, All the girdles made near the ground healed over readily and completely; 2d, Those on the main trunk healed less completely, but sufficiently to insure a good growth of tree and the covering of the injured part in another year; 3d, The girdles made in the branches healed less completely than the last, and in two instances the new growth failed to meet, and consequently the branch died soon after starting growth in the spring; 4th, All showed a marked increase in fruitfulness over those not girdled; 5th, Little difference was observed in the effect of the girdling made at different times or in the various widths of the ring of bark taken out.

No definite conclusion can be made at this time as to the effect of this treatment upon the permanent health of the tree. Observations for many years alone can determine the point.

Reasoning from analogy and from the known laws of plant-growth, this treatment can be advised only upon trees that are planted too closely, and a part of which must be removed after a time, to allow the full development of others, or those in very rich, moist soil which are long coming into bearing.

Cutting rings of bark from the canes of the grape-vine to hasten the time of ripening has been practised more or less for many years to prepare large specimens for exhibition, but only for the few years past has it been practised to hasten the crop for market.

In a series of experiments made in the college vineyard in 1877 and 1878, and recorded in the "Report of the Board of Agriculture of Massachusetts" for 1878 and 1879, it was found that removing a ring of bark early in July, a quarter of an inch wide, resulted in hastening the time of ripening from one to two weeks.

It was also concluded, from very careful tests made at the time, that the increased size and early maturity were not at the expense of the quality, and that as far as could be determined at that time, and which further observations have confirmed, the vines are not materially injured by the girdling.

Girdling has been practised in the college vineyard more or less every year since, with favorable results. The canes that are to be cut away at the fall pruning only have been girdled, to avoid any possibility of injury to vine or root from stopping the downward flow of sap by the girdle.

Some seasons the results of this practice have been more marked than in others, but generally the increased price obtained for the early fruit has much more than paid expenses of the work; and in seasons of early frost, to which many sections of New England are liable, it has made the difference between total failure and fair profit.

To save expense in the work, for the past two years the girdling has been done by twisting a wire very firmly about the canes the last of June, above the point where the cane is to be cut away at the fall pruning.

About No. 20 wire has been found best, and results obtained have been more satisfactory when the wires were put on the last of June or early in July, and twisted very firmly about the cane.

While there is no proof that the vines are in any way injured (notwithstanding that very careful observations have been made for many years), it is not advisable to girdle the entire vine, but to treat only those canes to be cut away at the fall pruning, and leave about one-half of the vine to grow to a natural condition.

LIFE INSURANCE.¹

I HAVE sometimes been a guest at public dinners when I have felt much more at home and at ease than I do now. The last time I was in this room, a few days ago, it was at a meeting of civil engineers, and I had a reasonable confidence that I had as much practice in public speaking, at any rate, as they had. But now, gentlemen, my experience with gentlemen connected with life-insurance companies is that they can talk a great deal more persuasively than I can.

My business and your business, gentlemen, are connected in a great variety of ways.

¹ A speech at the dinner of the Boston Life Underwriters' Union, April 9, by President C. W. Eliot of Harvard.

In the first place, I do not suppose there is any class of men who are more suitable persons to insure their lives than college teachers. They are almost universally poor, and they universally desire to educate their children and bring up their families well. They have a small, fixed income, and it is an income likely to last as long as their working power lasts. And then, again, they know that they generally live pretty long, to a time when their earning power is impaired; and against that time they make provision by endowment insurance. So I have happened to know a good deal about life insurance as seen from the point of view of a college man. For such reasons as I have given you, I am insured myself in three strong companies.

Again: a good many young men are absolutely without resources, but desperately bent on winning an education. Such a young man induces some friend to lend him a thousand or two thousand dollars, and take security in an insurance upon his life. That young man is presumably ambitious, and has a worthy ambition, and, if he has the necessary physique, he is likely to succeed; and to enable a few such young men to succeed in each decade is a great object.

I will mention still another service which I wish life-insurance companies could render. There may be — there are obviously — serious difficulties in the way; but perhaps here is an opening for new business. As your president has stated, it is the development, comfort, and protection of families that insurance chiefly provides for. Now, I have observed that the permanence of families in good station — the continued usefulness of families from generation to generation — can only be preserved in this country by education. Nothing else will answer: no inheritance of money will answer. You can read in the triennial and quinquennial catalogues how families live and die: some families continue to hold leading places in the community, and other families, which once held such places, disappear. The cause, almost uniformly, for their disappearance, is the ceasing of the higher education at some stage in the history of that family. Men who know these things, therefore (and college men are very apt to have their attention drawn to them), desire some means of securing education to their children. If nothing more, many of them would be greatly relieved to be sure that every one of their sons could get four or five hundred dollars a year for the years between eighteen and twenty-four, for instance. And it seems to me that this provision is not beyond the reach of life insurance; namely, that a father, when his boys are three or four years old, could be enabled to be sure that his boys, as they grow up, should have successively the three hundred or four hundred or five hundred dollars a year necessary to make sure of their education. It is a limited kind of endowment which is sought for, — an endowment which, in my judgment, would go very far to secure the stability and effectiveness in the community of families that have once reached a high state of education and cultivation.

I congratulate you, gentlemen, upon the sphere of your activity. I do not know of any business which has to do more exclusively with the best side of human life; and that is a very great pleasure and satisfaction in any man's life, that he has to do with human nature at its best. It seems to me, from what I have heard of the nature of life insurance and the kind of men with whom the agents of life-insurance companies are brought into contact, that my friend President Capen will be likely to tell you later that all life-insurance agents are Universalists. They must feel, I think, that at least all the men that they know who insure their lives are going to be saved.

It is a great privilege also, gentlemen, that your business in life is, after all, the promotion, as the president has said, of the security and happiness of family. I believe that the normal domestic joys are the chief sources of human happiness; and that, as the president has said, on the family rest all the larger human organizations. Therefore, when you work for the security and cultivation and safety of the family, you work for all that is most precious in human society.

THE sixth annual convention of the Association of Official Agricultural Chemists will be held at the Department of Agriculture, Washington, commencing Sept. 10, 1889, at 10 A.M.

THE PRIMITIVE HOME OF THE ARYANS.¹

IN my address to the anthropological section of the British Association in 1887, I stated, that, in common with many other anthropologists and comparative philologists I had come to the conclusion that the primitive home of the Aryans was to be sought in north-eastern Europe. The announcement excited a flutter in the newspapers, many of whose readers had probably never heard of the Aryans before, while others of them had the vaguest possible idea of what was meant by the name.

Unfortunately it is a name which, unless carefully defined, is likely to mislead or confuse. It was first introduced by Professor Max Müller, and applied by him in a purely linguistic sense. The "discovery" of Sanscrit and the researches of the pioneers of comparative philology had shown that a great family of speech existed, comprising Sanscrit and Persian, Greek and Latin, Teutonic and Slav, all of them sister-languages descended from a common parent, of which, however, no literary monuments survived. In place of the defective or cumbersome titles of "Indo-German," "Indo-European," and the like, which had been suggested for, Professor Max Müller proposed to call it "Aryan,"—a title derived from the Sanscrit *Arya*, interpreted "noble" in later Sanscrit, but used as a national name in the hymns of the Rig-Veda.

It is much to be regretted that the name has not been generally adopted. Such is the case, however, and it is to-day like a soul seeking a body in which to find a habitation. But the name is an excellent one, though the philologists of Germany, who govern us in such matters, have refused to accept it in the sense proposed by its author; and we are therefore at liberty to discover for it a new abode, and to give it a new scientific meaning.

In the enthusiasm kindled by the sight of the fresh world that was opening out before them, the first disciples of the science of comparative philology believed that they had found the key to all the secrets of man's origin and earlier history. The parent-speech of the Indo-European languages was entitled the *Ursprache*, or "Primeval Language;" and its analysis, it was imagined, would disclose the elements of articulate speech, and the process whereby they had developed into the manifold languages of the present world. But this was not enough. The students of language went even further. They claimed not only the domain of philology as their own, but the domain of ethnology as well. Language was confounded with race; and the relationship of tribe with tribe, of nation with nation, was determined by the languages they spoke. If the origin of a people was required, the question was summarily decided by tracing the origin of its language. English is, on the whole, a Teutonic language, and therefore the whole English people must have a Teutonic ancestry. The dark-skinned Bengali speaks languages akin to our own; therefore the blood which runs in his veins must be derived from the same source as that which runs in ours.

The dreams of universal conquest indulged in by a young science soon pass away as facts accumulate and the limit of its powers is more and more strictly determined. The *Ursprache* has become a language of comparatively late date in the history of linguistic development, which differed from Sanscrit or Greek only in its fuller inflexional character. The light its analysis was believed to cast on the origin of speech has proved to be the light of a will-o'-the-wisp, leading astray and perverting the energies of those who might have done more profitable work. The mechanism of primitive language often lies more clearly revealed in a modern Bushman's dialect or the grammar of Eskimo than in that much-vaunted *Ursprache* from which such great things were once expected by the philosophy of human speech.

Ethnology has avenged the invasion of its territory by linguistic science, and has in turn claimed a province which is not its own. It is no longer the comparative philologist, but the ethnologist, who now and again uses philological terms in an ethnological sense, or settles racial affinities by an appeal to language. The philologist first talked about an "Indo-European race." Such an expression could now be heard only from the lips of a youthful ethnologist.

¹ From The Contemporary Review.

As soon as the discovery was made that the Indo-European languages were derived from a common mother, scholars began to ask where that common mother-tongue was spoken. But it was agreed on all hands that this must have been somewhere in Asia. Theology and history alike had taught that mankind came from the East, and from the East accordingly the *Ursprache* must have come too. Hitherto Hebrew had been generally regarded as the original language of humanity. Now that the Indo-European *Ursprache* had deprived Hebrew of its place of honor, it was natural, if not inevitable, that, like Hebrew, it should be accounted of Asiatic origin. Moreover, it was the discovery of Sanscrit that had led to the discovery of the *Ursprache*. Had it not been for Sanscrit, with its copious grammar, its early literature, and the light which it threw on the forms of Greek and Latin speech, comparative philology might never have been born. Sanscrit was the magician's wand which had called the new science into existence, and without the help of Sanscrit the philologist would not have advanced beyond the speculations and guesses of classical scholars. What wonder, then, if the language which had thus been a key to the mysteries of Greek and Latin, and which seemed to embody older forms of speech than they, should have been assumed to stand nearer to the *Ursprache* than the cognate languages of Europe? The assumption was aided by the extravagant age assigned to the monuments of Sanscrit literature. The poems of Homer might be old; but the hymns of the Veda, it was alleged, mounted back to a primeval antiquity, while the Institutes of Manu represented the oldest code of laws existing in the world.

There was yet another reason which contributed to the belief that Sanscrit was the first-born of the Indo-European family. The founders of comparative philology had been preceded in their analytic work by the ancient grammarians of India. It was from Pāṇini and his predecessors that the followers of Bopp inherited their doctrine of roots and suffixes and their analysis of Indo-European words. The language of the Veda had been analyzed two thousand years ago as no other single language had ever been analyzed before or since. Its very sounds had been carefully probed and distinguished, and an alphabet of extraordinary completeness had been devised to represent them. It appeared as if the elements out of which the Sanscrit vocabulary and grammar had grown had been laid bare in a way that was possible in no other language; and in studying Sanscrit, accordingly, the scholars of Europe seemed to feel themselves near to the very beginnings of speech.

But it was soon perceived that if the primitive home of the Indo-European languages were Asia, they themselves ought to exhibit evidences of the fact. There are certain objects and certain phenomena which are peculiar to Asia, or, at all events, are not to be found in Europe; and words expressive of these ought to be met with in the scattered branches of the Indo-European family. If the parent language had been spoken in India, the climate in which they were born must have left its mark upon the face of its offspring.

But here a grave difficulty presented itself. Men have short memories, and the name of an object which ceases to come before the senses is either forgotten or transferred to something else. The tiger may have been known to the speakers of the parent-language, but the words that denoted it would have dropped out of the vocabulary of the derived languages which were spoken in Europe. The same word which signifies an oak in Greek, signifies a beech in Latin. We cannot expect to find the European languages employing words with meanings which recall objects met with only in Asia.

How, then, are we to force the closed lips of our Indo-European languages, and compel them to reveal the secret of their birth-place? Attempts have been made to answer this question in two different ways.

On the one hand, it has been assumed that the absence in a particular language, or group of languages, of a term which seems to have been possessed by the parent-speech, is evidence that the object denoted by it was unknown to the speakers. But the assumption is contradicted by experience. Because the Latin *equus* has been replaced by *caballus* in the modern Romanic languages, we cannot conclude that the horse was unknown in western Europe after the fall of the Roman Empire. The native Basque word for

a "knife" (*haistoa*) has been found by Prince L.-L. Bonaparte in a single obscure village; elsewhere it has been replaced by terms borrowed from French or Spanish: yet we cannot suppose that the Basques were unacquainted with instruments for cutting until they had been furnished with them by their French and Spanish neighbors. Greek and Latin have different words for "fire": we cannot argue from this that the knowledge of fire was ever lost among any of the speakers of the Indo-European tongues. In short, we cannot infer from the absence of a word in any particular language that the word never existed in it: on the contrary, when a language is known to us only in its literary form, it is safe to say that it must have employed many words besides those contained in its dictionary.

A good illustration of the impossibility of arriving at any certain results as long as we confine our attention to words which appear in one but not in another of two cognate languages, is afforded by the Indo-European words which denote a sheet of water. There is no word of which it can be positively said that it is found alike in the Asiatic and the European branches of the family. Lake, ocean, even river and stream, go by different names. A doubt hangs over the word for "sea": it is possible, but only possible, that the Sanscrit *páthas* is the same word as the Greek *πόντος*, the etymology of which is not yet settled. Nevertheless, we know that the speakers of the parent-language must have been acquainted, if not with the sea, at all events with large rivers. *Náus* ("a ship") is the common heritage of Sanscrit and Greek, and must thus go back to the days when the speakers of the dialects which afterwards developed into Sanscrit and Greek still lived side by side. It survives, like a fossil in the rocks, to assure us that they were a water-faring people, and that the want of a common Indo-European word for "lake" or "river" is no proof that such a word may not have once existed.

The example I have just given illustrates the second way in which the attempt has been made to solve the riddle of the Indo-European birthplace. It is the only way in which the attempt can succeed. Where precisely the same word, with the same meaning, exists in both the Asiatic and the European members of the Indo-European family, — always supposing, of course, that it has not been borrowed by either of them, — we may conclude that it also existed in the parent-speech. When we find the Sanscrit *as'was* and the Latin *equus*, the exact phonetic equivalents of one another, both alike signifying "horse," we are justified in believing that the horse was known in the country from which both languages derived their ancestry. Though the argument from a negative proves little or nothing, the argument from agreement proves a great deal.

The comparative philologist has by means of it succeeded in sketching in outline the state of culture possessed by the speakers of the parent-language, and the objects which were known to them. They inhabited a cold country. Their seasons were three in number, perhaps four, and not two, as would have been the case had they lived south of the temperate zone. They were nomad herdsmen, dwelling in hovels, similar, it may be, to the low, round huts of sticks and straw built by the Kabyles on the mountain-slopes of Algeria. Such hovels could be erected in a few hours, and left again as the cattle moved into higher ground with the approach of spring, or descended into the valleys when the winter advanced. The art of grinding corn seems to have been unknown, and crushed spelt was eaten instead of bread. A rude sort of agriculture was, however, already practised; and the skins worn by the community, with which to protect themselves against the rigors of the climate, were sewn together by means of needles of bone. It is even possible that the art of spinning had already been invented, though the art of weaving does not appear to have advanced beyond that of plaiting reeds and withies. The community still lived in the stone age. Their tools and weapons were made of stone or bone; and, if they made use of gold or meteoric iron, it was of the unwrought pieces picked up from the ground, and employed as ornaments. Of the working of metals, they were entirely ignorant. As among savage tribes generally, the various degrees of relationship were minutely distinguished and named, even the wife of a husband's brother receiving a special title; but they could count at least as far as a hundred. They believed in a multitude of ghosts and

goblins, making offerings to the dead, and seeing in the bright sky a potent deity. The birch, the pine, and the withy were known to them; so also were the bear and wolf, the hare, the mouse, and the snake, as well as the goose and raven, the quail and the owl. Cattle, sheep, goats, and swine were all kept. The dog had been domesticated, and in all probability also the horse. Last, but not least, boats were navigated by means of oars, the boats themselves being possibly the hollowed trunks of trees.

This account of the primitive community is necessarily imperfect. There must have been many words, like that for "river," which were once possessed by the parent-speech, but afterwards lost in either the eastern or western branches of the family. Such words the comparative philologist has now no means of discovering: he must accordingly pass them over along with the objects or ideas which they represent. The picture he can give us of the speakers of the primeval Indo-European language can only be approximately complete. Moreover, it is always open to correction. Some of the words we now believe to have been part of the original stock carried away by the derived dialects of Asia and Europe may hereafter turn out to have been borrowed by one of these dialects from another, and not to have been a heritage common to both. It is often very difficult to decide whether we are dealing with borrowed words or not. If a word has been borrowed by a language before the phonetic changes had set in which have given the language its peculiar complexion, or while they were in the course of progress, it will undergo the same alteration as native words containing the same sounds. The phonetic changes which have marked off the High German dialects from their sister-tongues do not seem to go back beyond the fall of the Roman Empire, and words borrowed from Latin before that date will accordingly have submitted to the same phonetic changes as words of native origin. Indeed, when once a word is borrowed by one language from another, and has passed into common use, it soon becomes naturalized, and is assimilated in form and pronunciation to the words among which it has come to dwell. A curious example of this is to be found in certain Latin words which made their way into the Gaelic dialects in the fourth or fifth century. We often find a Gaelic *c* corresponding to a Welsh *þ*, both being derived from a labialized guttural or *qu*, and the habit was accordingly formed of regarding a *c* as the natural and necessary representative of a foreign *þ*. When, therefore, words like the Latin *pascha* and *purpura* were introduced by Christianity into the Gaelic branch of the Celtic family, they assumed the form of *caisg* and *corcur*.

It is clear that such borrowings can only take place where the speakers of two different languages have been brought into contact with one another. Before the age of commercial intercourse between Europe and India we cannot suppose that European words could have been borrowed by Sanscrit or Persian, or Sanscrit and Persian words by the European languages. But the case is quite otherwise, if, instead of comparing together the vocabularies of the eastern and western members of the Indo-European stock, we wish to compare only western with western, or eastern with eastern. There our difficulties begin, and we must look to history, or botany, or zoölogy for aid. From a purely philological point of view, the English *hemp*, the Old High German *hanf*, the Old Norse *hanþr*, and the Latin *cannabis*, might all be derived from a common source, and point to the fact that hemp was known to the first speakers of the Indo-European languages in north-western Europe. But the botanists tell us that this could not have been the case. Hemp is a product of the East, which did not originally grow in Germany, and consequently both the plant itself and the name by which it was called must have come from abroad. So, again, the lion bears a similar name in Greek and Latin, in German, in Slavonic, and in Celtic. But the only part of Europe in which the lion existed at a time when the speakers of an Indo-European language could have become acquainted with it were the mountains of Thrace, and it must accordingly have been from Greek that its name spread to the other cognate languages of the West.

It has been needful to enter into these details before we can approach the question, "What was the original home of the parent Indo-European language?" They have been too often ignored or forgotten by those who have set themselves to answer the question,

and to this cause must be ascribed the larger part of the misunderstandings and false conclusions to which the inquiry has given birth.

Until a few years ago I shared the old belief that the parent-speech had its home in Asia, probably on the slopes of the Hindu Kush. The fact that the languages of Europe and Asia alike possessed the same words for "winter" and "ice" and "snow," and that the only two trees whose names were preserved by both — the "birch" and the "pine" — were inhabitants of a cold region, proved that this home did not lie in the tropics. But the uplands of the Hindu Kush, or the barren steppes in the neighborhood of the Caspian Sea, or even the valleys of Siberia, would answer to the requirements presented by such words. Taken by themselves, they were fully compatible with the view that the first speakers of the Indo-European tongues were an Asiatic people.

But when I came to ask myself what were the grounds for holding this view, I could find none that seemed to me satisfactory. There is much justice in Dr. Latham's remark that it is unreasonable to derive the majority of the Indo-European languages from a continent to which only two members of the group are known to belong, unless there is an imperative necessity for doing so. These languages have grown out of dialects once existing within the parent-speech itself, and it certainly appears more probable that two of such dialects or languages should have made their way into a new world, across the bleak plains of Tartary, than that seven or eight should have done so. The argument, it is true, is not a strong one, but it raises at the outset a presumption in favor of Europe. Before the dialects had developed into languages, their speakers could not have lived far apart. There is, in fact, evidence of this in the case of Sanscrit and Persian; and a more widely spread primitive community is implied by the numerous languages of Europe than by the two languages of Asia. A widely spread community, however, is less likely to wander far from its original seat than a community of less extent, more especially when it is a community of herdsmen, and the tract to be traversed is long and barren.

Apart from the general prejudice in favor of an Asiatic origin, due to old theological teaching and the effect of the discovery of Sanscrit, I can find only two arguments which have been supposed to be of sufficient weight to determine the choice of Asia rather than of Europe as the cradle of Indo-European speech. The first of these arguments is linguistic; the second is historical, or rather quasi-historical. On the one hand, it has been laid down by eminent philologists that the less one of the derived languages has deflected from the parent-speech, the more likely it is to be geographically nearer to its earliest home. The faithfulness of the record is a test of geographical proximity. As Sanscrit was held to be the most primitive of the Indo-European languages, to reflect most clearly the features of the parent-speech, the conclusion was drawn that that parent-speech had been spoken at no great distance from the country in which the hymns of the Rig-Veda were first composed. The conclusion was supported by the second argument drawn from the sacred books of Parsaism. In the Vendidad the migrations of the Iranians were traced back through the successive creations of Ormazd to Airyanem Vaéjô, "the Aryan Power," which Lassen localized near the sources of the Oxus and Jaxartes. But Bréal and De Harlez have shown that the legends of the Vendidad, in their present form, are late and untrustworthy, — later, in fact, than the Christian era;¹ and even if we could attach any historical value to them, they would tell us only from whence the Iranians believed their own ancestors to have come, and would throw no light on the cradle of the Indo-European languages as a whole. The first argument is one which I think no student of language would any longer employ. As Professor Max Müller has said, it would suffice to prove that the Scandinavians emigrated from Iceland. But to those who would still urge it, I must repeat what I have said elsewhere. Although in many respects Sanscrit has preserved more faithfully than the European languages the forms of primitive Indo-European grammar, in many other respects the converse is the case. In the latest researches

into the history of Indo-European grammar, Greek holds the place once occupied by Sanscrit. The belief that Sanscrit was the elder sister of the family led to the assumption that the three short vowels *ä*, *ê*, and *ö* have all originated from an earlier *ä*. I was, I believe, the first to protest against this assumption in 1874, and to give reasons for thinking that the single monotonous *ä* of Sanscrit resulted from the coalescence of three distinct vowels. The analogy of other languages goes to show that the tendency of time is to reduce the number of vocalic sounds possessed by a language, not the contrary. In place of the numerous vowels possessed by ancient Greek, modern Greek can now show only five, and cultivated English is rapidly merging its vowel sounds into the so-called "neutral" *ə*. Since my protest the matter has been worked out by Italian, German, and French scholars; and we now know that it is the vocalic system of the European languages rather than of Sanscrit which most faithfully represents the oldest form of Indo-European speech. The result of the discovery, for discovery it must be called, has been a complete revolution in the study of Indo-European etymology, and still more of Indo-European grammar; and whereas ten years ago it was Sanscrit which was invoked to explain Greek, it is to Greek that the "new school" now turns to explain Sanscrit. The comparative philologist necessarily cannot do without the help of both. The greater the number of languages he has to compare, the sounder will be his inductions; but the primacy which was once supposed to reside in Asia has been taken from her. It is Greek, and not Sanscrit, which has taught us what was the primitive vowel of the reduplicated syllable of the perfect and the augment of the aorist, and has thus narrowed the discussion into the origin of both.

Until quite recently, however, the advocates of the Asiatic home of the Indo-European languages found a support in the position of the Armenian language. Armenian stands midway, as it were, between Persia and Europe, and it was imagined to have very close relations with the old language of Persia. But we now know that its Persian affinities are illusory, and that it must really be grouped with the languages of Europe. What is more, the decipherment of the cuneiform inscriptions of Van has cast a strong light on the date of its introduction into Armenia. These inscriptions are the records of kings whose capital was at Van, and who marched their armies in all directions during the ninth, eighth, and seventh centuries before our era. The latest date that can as yet be assigned to any of them is B.C. 640. At this time there were still no speakers of an Indo-European language in Armenia. The language of the inscriptions has no connection with those of the Indo-European family, and the personal and local names occurring in the countries immediately surrounding the dominions of the Vannic kings, and so abundantly mentioned in their texts, are of the same linguistic character as the Vannic names themselves.

The evidence of classical writers fully bears out the conclusions to be derived from the decipherment of the Vannic inscriptions. Herodotos (vii. 73) tells us that the Armenians were colonists from Phrygia, the Phrygians themselves having been a Thracian tribe which had migrated into Asia. The same testimony was borne by Eudoxos,¹ who further averred that the Armenian and Phrygian languages resembled one another. The tradition must have been recent in the time of Herodotos, and we shall probably not go far wrong if we assign the occupation of Armenia by the Phrygian tribes to the age of upheaval in western Asia which was ushered in by the fall of the Assyrian Empire. Professor Fick has shown that the scanty fragments of the Phrygian language that have survived to us belong to the European branch of the Indo-European family, and thus find their place by the side of Armenian.

Instead, therefore, of forming a bridge between Orient and Occident, Armenian represents the furthestmost flow of Indo-European speech from West to East. And this flow belongs to a relatively late period. Apart from Armenian, we can discover no traces of Indo-European occupation between Media and the Halys until the days when Iranian Ossetes settled in the Caucasus, and the mountaineers of Kurdistan adopted Iranian dialects. I must reiterate here what I have said many years ago: if there is one fact which the Assyrian monuments make clear and indubitable, it is that up to the closing days of the Assyrian monarchy no Indo-European

¹ Bréal, *Mélanges de Mythologie et de Linguistique* (1878), pp. 207-215; De Harlez, *Introduction à l'Étude de l'Avesta*, pp. ccxiii, 427. Compare Darmesteter's *Introduction to the Zend-Avesta*, part I, in *The Sacred Books of the East*.

² According to Eustathios (*in Dion.* v. 694).

languages were spoken in the vast tract of civilized country which lay between Kurdistan and western Asia Minor. South of the Caucasus they were unknown until the irruption of the Phrygians into Armenia. Among the multitudinous names of persons and localities belonging to this region which are recorded in the Assyrian inscriptions during a space of several centuries, there is only one which bears upon it the Indo-European stamp. This is the name of the leader of the Cimmerians,—a nomad tribe from the north-east which descended upon the frontiers of Assyria in the reign of Esar-haddon, and was driven by him into Asia Minor. The fact is made the more striking by the further fact, that, as soon as we clear the Kurdish ranges and enter Median territory, names of Indo-European origin meet us thick and fast. We can draw but one conclusion from these facts. Whether the Indo-European languages of Europe migrated from Asia, or whether the converse were the case, the line of march must have been northward of the Caspian, through the inhospitable steppes of Tartary and over the snow-covered heights of the Ural Mountains.

An ingenious argument has lately been put forward, which at first sight seems to tell in favor of the Asiatic origin of Indo-European speech. Dr. Penka has drawn attention to the fact that several of the European languages agree in possessing the same word for "eel;" and that, whereas the eel abounds in the rivers and lakes of Scandinavia, it is unknown in those cold regions of western Asia where, as we have seen, it has been proposed to place the cradle of the Indo-European family. But it is a curious fact that in Greek and Latin, and apparently also in Lithuanian, the word for "eel" is a diminutive derived from a word which denotes a snake or snake-like creature. This, it has been urged, may be interpreted to mean that the primeval habitat of the Indo-European languages was one where the snake was known but the eel was not. The argument, however, cannot be pressed. We all agree that the first speakers of the Indo-European languages lived on the land, not on the water, and that they were herdsmen rather than fishermen. Naturally, therefore, they would become acquainted with the snake before they became acquainted with the eel, however much it might abound in the rivers near them, and its resemblance to the snake would lend to it its name. In Celtic the eel is called "a water-snake," and to this day a prejudice against eating it on the ground that it is a snake exists in Celtic districts. All we can infer from the diminutives *anguilla*, *ἔγχελυς*, is that the Italians and Greeks in the first instance gave the name to the fresh-water eel, and not to the huge conger.

I cannot now enter fully into the reasons which have led me gradually to give up my old belief in the Asiatic origin of the Indo-European tongues, and to subscribe to the views of those who would refer them to a northern European birthplace. The argument is a complicated one, and is necessarily a cumulative character. The individual links in the chain may not be strong, but collectively they afford that amount of probability which is all we can hope to attain in historical research. Those who wish to study them may do so in Dr. Penka's work on the "Herkunft der Arier," published in 1886. His hypothesis that southern Scandinavia was the primitive "Aryan home" seems to me to have more in its favor than any other hypothesis on the subject which has as yet been put forward. It needs verification, it is true; but if it is sound, the verification will not be long in coming. A more profound examination of Teutonic and Celtic mythology, a more exact knowledge of the words in the several Indo-European languages which are not of Indo-European origin, and the progress of archæological discovery, will furnish the verification we need.

Meanwhile it must be allowed that the hypothesis has the countenance of history. Scandinavia, even before the sixth century, was characterized as "the manufactory of nations;"¹ and the voyages and settlements of the Norse vikings offer an historical illustration of what the prehistoric migrations and settlements of the speakers of the Indo-European languages must have been. They differed from the latter only in being conducted by sea, whereas the prehistoric migrations followed the valleys of the great rivers. It was not until the age of the Roman Empire that the northern nations became acquainted with the sailing-boat; our English

"sail" is the Latin *sagulum* ("the little cloak of the soldier") borrowed by the Teutons along with its name, and used to propel their boats in imitation of the sails of the Roman vessels. The introduction of the sail allowed the inhabitants of the Scandinavian "hive" to push boldly out to sea, and ushered in the era of Saxon pirates and Danish invasions.

Dr. Penka's arguments are partly anthropological, partly archæological. He shows that the Celts and Teutons of Roman antiquity were the tall, blue-eyed, fair-haired, dolichocephalic race which is now being fast absorbed in Celtic lands by the older inhabitants of them. The typical Frenchman of to-day has but little in common with the typical Gaul of the age of Cæsar. The typical Gaul was, in fact, as such a conqueror in Gallia as he was in Galatia, or, as modern researches have shown, as the typical Celt was in Ireland. It seems to have been the same in Greece. Here, too, the golden-haired hero of art and song was a representative of the ruling class, of that military aristocracy which overthrew the early culture of the Peloponnese, and of whom tradition averred that it had come from the bleak North. Little trace of it now remains: it is rarely that the traveller can discover any longer the modern kinsfolk of the golden-haired Apollo or the blue-eyed Athéné.

If we would still find the ancient blonde race of northern Europe in its purity, we must go to Scandinavia. Here the prevailing type of the population is still that of the broad-shouldered, long-headed blondes who served as models for the Dying Gladiator. And it is in southern Scandinavia alone that the prehistoric tumuli and burying-grounds yield hardly any other skeletons than those of the same tall dolichocephalic race which still inhabits the country. Elsewhere such skeletons are either wanting or else mixed with the remains of other races. It is therefore reasonable to conclude that it was from southern Scandinavia that those bands of hardy warriors originally emerged who made their way southward and westward, and even eastward; the Celts of Galatia penetrating, like the Phrygians before them, into the heart of Asia Minor. The Norse migrations in later times were even more extensive, and what the Norse vikings were able to achieve could have been achieved by their ancestors centuries before.

Now, the Celts and Teutons of the Roman age spoke Indo-European languages. It is more probable that the subject populations should have been compelled to learn the language of their conquerors than that the conquerors should have taken the trouble to learn the language of their serfs. We know, at any rate, that it was so in Ireland. Here the old "Ivernian" population adopted the language of the small band of Celtic invaders that settled in its midst. It is only where the conquered possess a higher civilization than the conquerors, above all, where they have a literature and an organized form of religion, that Franks will adapt their tongues to Latin speech, or Manichæus learn to speak Chinese. Moreover, in southern Scandinavia, where we have archæological evidence that the tall blonde race was scarcely at any time in close contact with other races, it is hardly possible for it to have borrowed its language from some other people. The Indo-European languages still spoken in the country must, it would seem, be descended from languages spoken there from the earliest period to which the evidence of human occupation reaches back. The conclusion is obvious: southern Scandinavia and the adjacent districts must be the first home and starting-point of the western branch of the Indo-European family.

If we turn to the eastern branch, we find that the farther east we go, the fainter become the traces of the tall blonde race, and the greater is the resemblance between the speakers of Indo-European languages and the native tribes. In the highlands of Persia, tall, long-headed blondes with blue eyes can still be met with; but, as we approach the hot plains of India, the type grows rarer and rarer until it ceases altogether. An Indo-European dialect must be spoken in India by a dark-skinned people before it can endure to the third and fourth generation. As we leave the frontiers of Europe behind us, we lose sight of the race with which Dr. Penka's arguments would tend to connect the parent-speech of the Indo-European family.

I cannot now follow him in the interesting comparison he draws between the social condition of the southern Scandinavians as dis-

¹ "Quasi officina gentium aut certe velut vagina nationum."—Jordanes, *De Getarum sive Gothorum origine*, ed. Closs, C. 4.

closed by the contents of the prehistoric "kitchen-middens," and the social condition of the speakers of the Indo-European parent-speech according to the sobered estimate of recent linguistic research. The resemblance is certainly very striking; though, on the other hand, it cannot be denied that archaeological science is still in its infancy, and that Dr. Penka too often assumes that a word common to the European languages belonged to the parent-speech,—an assumption which will not, of course, be admitted by his opponents.

What more nearly concerns us here, however, is the name we should give to the race or people who spoke the parent-language. We cannot call them "Indo-Europeans;" that would lead to endless ambiguities, while the term itself has already been appropriated in a linguistic sense. Dr. Penka has called them "Aryans," and I can see no better title with which to endow them. The name is short; it has already been used in an ethnological as well as in a linguistic sense; and, since our German friends have rejected it in its linguistic application, it is open to every one to confine it to a purely ethnological meaning. I know that the author has protested against such an application of the term; but it is not the first time that a father has been robbed of his offspring, and he cannot object to the robbery when it is committed in the cause of science. For some time past the name of "Aryan" has been without a definition, while the first speakers of the Indo-European parent-speech have been vainly demanding a name; and the priests of anthropology cannot do better than lead them to the font of science, and there baptize them with the name of "Aryan."

A. H. SAYCE.

THE GRAIN PLANT-LOUSE.

THE present season is characterized by one of those widespread and very damaging insect-invasions that are so discouraging to the farmer, this time an onslaught on the wheat-crop by the grain *Aphis* or plant-louse, *Aphis avenæ*. This louse attacks wheat, barley, oats, and rye, and is to be found in small numbers on these grains every year. This year occurs one of those terrible attacks that seem to threaten very serious loss, extending from Ohio west to Indiana, and north to Grand Rapids, Mich. So abundant are these lice, that they have attracted wide attention and awakened serious alarm. For the last two weeks in June Mr. A. J. Cook, of the Agricultural College of Michigan, received daily numerous specimens of these lice with the inquiry, "What is to be the outcome of this attack?"

This is not the first season that this *Aphis avenæ* has come like a destroying flood upon the grain-fields. In 1861 the lice swarmed upon the cereal crops of New England and New York, at which time Dr. Asa Fitch fully described it in his sixth report. In 1866, and again ten years later, it did great damage in various sections of the West. We see, then, that this louse does not come yearly, but only at long intervals. Why is this? It is doubtless owing in some measure to the weather, but more to its insect enemies. Its enormous prolificness would make it as the sands of the seashore every year, except that some natural agent held it in check. Fitch describes three such enemies. Even now, as we visit the oat and wheat fields, we find many forms different from any previously described. These have short, rounded bodies, which are of a dirty-white color. The cause of this is that these are attacked by parasites, which are eating them up. These little benefactors are now busily engaged in the fields, laying the eggs that will destroy the lice. These minute parasitic insects lay a great many eggs, one in each louse, and their presence and prosperity mark the doom of the lice. Thus through the agency of these minute parasitic forms, aided by climatic influences, we are to be saved from a raid by this grain *Aphis* next year, and will be greatly benefited this year. Indeed, in some cases, these little friends will very likely save us from serious damage. Why the parasites are not able to come successfully to the rescue each year is still unknown. Dry weather is a great promoter of insect productivity. It is more than probable that the exceeding drought of 1887, 1888, and of the April and May just past, together with the mild winter of 1888-1889, have had much to do with the present invasion. We might expect much aid from the frequent

June rains, but they were perhaps too late. Observation shows that the lice are more than holding their own: so we may conclude that the warm rains are not greatly depleting their ranks.

Where the lice are very numerous, as they seem to be over a widespread area of our country, they must do great injury. Where ten or twelve lice are collected about a single kernel of wheat, there is little hope for that kernel. Mr. Cook has counted one hundred and sixty lice on a single head of wheat. It is hoping too much of the little parasitic flies to expect them to save the present crop. We can but expect much injury, especially where the lice are in such countless numbers as are now seen in many of the wheat-fields of Indiana, Ohio, and Michigan.

The excellent specific against plant-louse ravages, the kerosene and soap mixture, cannot be used without much injury to the crop. To apply it might be like the jump from frying-pan to fire. Again: the lice are so protected by the close cluster of the kernels, that very likely the remedy would not be fully effective.

The name "green midge," which is going the rounds of the papers, is very incorrect, and should not be used. The Hessian-fly and wheat-midge are very different insects. These midges are two-winged flies, whose larvæ are footless maggots. They belong to the great two-winged fly order, *Diptera*, while these are plant-lice or *Aphides*, and belong to the order of bugs, or *Hemiptera*. Let all speak of this as the grain *Aphis*, or plant-louse, and not as the green midge, which is entirely wrong, as they are not always even green in color.

NOTES AND NEWS.

A SPECIAL limited Pullman train with dining and composite cars will leave the foot of Chambers Street, New York, via the Erie Railroad, on Monday, Aug. 5, at 9 o'clock A.M., for the accommodation of the members of the National Electric Light Association and their friends, who will attend the convention at Niagara Falls, Aug. 6, 7, and 8. One car will be reserved for gentlemen accompanied by ladies. Tickets on this train, including Pullman service, will cost ten dollars each. Return tickets (to be obtained at Niagara Falls), including Pullman service, will cost four dollars and sixty cents each. As the cost of this train must be guaranteed the road, all members are urged to remit ten dollars to the secretary at the earliest possible moment, for which they will receive their railway-tickets and Pullman seat-checks by return mail. Tickets may also be obtained at the offices of the *Electrical Review*, 13 Park Row, and the *Electrical World*, Times Building.

—The Boston *Herald* says that "some figures presented at the meeting of the United States Brewers' Association show a wonderful growth of the business during the last twenty-five years. For instance, receipts of the government from the internal revenue tax on fermented liquors amounted to about \$1,500,000 in 1863, when the tax was first imposed. In 1866 the figures rose to \$5,000,000; in 1879, to \$10,000,000; in 1882, to \$15,000,000; and last year the tax amounted to \$23,000,000. The quantity increased in the same ratio from 2,000,000 barrels in 1863 to over 24,000,000 in 1888. At this rate of growth, it is small wonder that Englishmen think they see a chance of making money by buying up American breweries."

—The San Francisco *Chronicle* says that "some of the New York dealers in California wines assert that the reason why the price of our wines in the East is so low is that growers dump quantities of sick wine on the market, and spoil the tone of the California product. They say that the grower sends on several hundred barrels of wine, which arrives in New York sick with the voyage, if not altogether sour, necessitating rest and new barrels before it is salable at all. These dealers go on to say, 'Perhaps the grower has no warehouse, no time to wait, no change of cooperage, no other wine to mix with: therefore he puts his wine on the market at a ridiculous price below what cooperage, freight, and insurance cost. He makes no money, and the buyer is disgusted with California wine.'"

—The French minister of commerce has appointed a committee for the purpose of organizing an international photographic congress to be held during the Paris Exhibition. The committee, headed by the well-known astronomer, Professor Janssen, have

already commenced work. The congress will meet from Aug. 6 to Aug. 17, and discuss the following subjects: (1) introduction of a uniform photometric unit; (2) uniform measurements of focal lengths of objectives; (3) a uniform scale for the determination of the photometric effect of objective diaphragms; (4) uniform periods of exposure in instantaneous work; (5) the adoption of a uniform and easily applicable method for fitting different objectives on to cameras; (6) a universal form of plate; (7) a uniform terminology for photographic operations; (8) universal agreement of photographic formulae; (9) uniform adjustment of customs procedure with regard to substances sensitive to light; and (10) protection of artistic copyright in photographic works. A conference, in which the work of the congress will be publicly discussed, is to take place on Aug. 20.

— The extreme summit of the Eiffel Tower consists of a small circular gallery less than six feet in diameter, and surrounded by a hand-rail. The floor is three hundred metres above the ground, and from the centre rises the rod that serves as a lightning conductor and flagstaff. In this small gallery M. Mascart presides over the Bureau Central Météorologique established there. The instruments comprise a registering thermometer and hygrometer, a psychrometer, and several maximum and minimum thermometers. There are, in addition, a set of Richards's thermometers and hygrometers that constantly transmit their readings electrically to the Arts Libéraux building, where they are recorded. Outside the gallery are placed a recording actinometer and rain-gauge, and sixty feet below is a large registering barometer. An admirably installed anemometer forms a part of the apparatus. It is mounted on a rod about ten feet high. The vanes, which are of aluminium, are mounted so as to move under the lightest wind-current. Electrical contacts are so arranged as to record each displacement of air of one metre, each displacement of fifty metres, and each of five kilometres. These contacts transmit the effects to the ground station, where they are recorded in speeds per second. A number of other apparatus are included in this very complete laboratory, which has been in regular working for some time. It was asserted, as one of the many objections raised against the Eiffel Tower, that the oscillations at the summit would, under certain unfavorable conditions, be dangerous: it is therefore satisfactory to record, that, with the highest wind-velocities yet observed, the movement at the summit of the tower is hardly appreciable.

— The high temperature produced during the slaking of lime has been but rarely utilized except as an agent in matters of accident in setting fire to vessels and to buildings. *Engineering* adds to these the ordinary method of the helpers to masons, who warm up the coffee for their dinner in cold weather by placing the pail of coffee on a lump of lime, sprinkling on a little water, and watching it carefully to see that it does not boil too hard. Many years ago, before the invention of the diving-bell, a large wager was made between two gentlemen in regard to the possibility of one cooking a pudding at the bottom of the Thames. The winner had his pudding placed in the middle of a large sack of lime, lowered to the bottom of the river, and in due time pulled up, with the result of finding that the conditions of the wager, in regard to the cooking of the pudding, had been fully carried out. But of late lime has been frequently used to remove the frost from the ground in winter, and also to melt out water-pipes; as it has been found that a heap of lime laid on the earth, wet slightly, and covered over with blankets and other non-conducting materials, will draw the frost out of the ground. This is the complement of the process of facilitating engineering work in quicksand by means of the freezing processes frequently used for such purposes.

— With regard to the accident which has occurred to the German Navy at Apia, H. E. Gunther, in the *Photographic News*, says, it might be advisable to refer once more to the theory of Dr. Zenger of Prague, who suggested, as it will be remembered, to make use of photography for the prediction of the weather. According to the doctor, photographs of the sun taken on orthochromatic plates offer a most infallible means to indicate with almost absolute certainty the approaching atmospheric and subterranean disturbances at least twenty-four hours before their setting in. In

these photographs zones are often to be seen around the sun's disk,—i.e., rings of circular or elliptical form, of white or grayish color,—and if these zones appear of very large diameter, and of unusual heaviness, this indicates that violent storms, thunderstorms, or magnetical disturbances will soon set in at the place of observation. At every ship's station should therefore be established a small photographic laboratory, in which photographs of the sun could be taken as often as possible. A much more reliable prediction of the weather would be afforded by this means than by the aid of the barometer now generally in use for this purpose, and precautions could therefore be taken in good time.

— The "Fourth Annual Report of the Maine State Board of Health" is now in press, and will be distributed as soon as possible. Among the papers which it will contain are, "Small-Pox at Cumberland Mills;" "Diphtheria at the Insane-Hospital;" "Typhoid-Fever at Washburn;" "Circulars;" "Water-Analysis;" "Public Water-Supplies;" "Pneumonia as an Infectious or Epidemic Disease;" "Epidemic Jaundice;" "Cerebro-Spinal Meningitis;" "As to the Infectiousness of Diphtheria;" "On the Identity of Croup and Diphtheria;" "On the Filtering Capacity of the Soil;" "Public Health Work in Portland;" "Light Gymnastics for Schools;" "Pollution of Water-Supplies;" "As to the Spontaneity of Infectious Diseases."

— In 1886 the Prince of Monaco, wishing to study the course of the Gulf Stream, threw into it some copper flasks from the "Hirondelle." Three of these flasks have come ashore on the south coast of Iceland,—two near the O Mountains, in the Rangárvall district; and the third at Flöj, in the Arnaes district.

— At a recent meeting of the Scientific Society of Copenhagen, says *Nature*, Professor Steenstrup gave an account of the results of his examination, last year, of the great mammoth deposit at Predmost, in Moravia. Dr. Wankel and Professor Maschka, who have devoted much attention to the subject, are of opinion that the mammoths whose remains are found in this district were killed by man, and that their bodies were dragged thither to be eaten. Professor Steenstrup, on the contrary, holds that the mammoths themselves sought the locality, and that they must have died from want of water, or from some other cause with which man had nothing to do. The splits in the remains are due, he thinks, to the action of water and sand, and afford no support to the notion that the knuckles were cleft for the sake of the marrow. It is certain that some of the bones have been exposed to the action of fire; but Professor Steenstrup maintains that the traces of fire may be due to the fact that fires were at one time lighted upon them. On some of them, decorative lines have been scratched, but these may have been made long after the mammoth was extinct in Moravia. The lines, according to Professor Steenstrup, are identical with the ornamentation of pottery of the neolithic age.

— In his last "Meteorological Report for India," Mr. Elliot, referring to sun-spots and weather in India,—a subject which has been frequently mentioned in these reports, says, "So far as India is concerned, it would appear that it is the period of minimum sun-spots which is associated with the largest and most abnormal variations of meteorological conditions and actions. Thus exceptionally heavy snow fell in the North-West Himalayas in the winter of 1866, and again in 1876 and 1877. The latter is to some extent described in the annual reports on the meteorology of India for these two years. Again: the most striking and disastrous famines of recent years in India have occurred near the period of minimum sun-spots; as, for example, the Orissa famine of 1866, the Behar famine of 1874, and the Madras famine in 1876-77. Similarly, there is a clearly marked tendency for the largest and most intense cyclones to occur shortly before the period of minimum sun-spots; as, for example, the great Calcutta cyclone of 1864, in which 60,000 people were drowned by the storm-wave, and the still larger Backerganj cyclone of 1876, in which 100,000 lives were lost by drowning. As we are now approaching or passing through the same phase of the sun-spot period, it is interesting to inquire whether there are any large abnormal variations common to the present period of minimum sun-spots, and the previous corresponding periods of 1865-66 and 1876-77."

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WE PUBLISH IN THIS NUMBER certain suggestions that have been made, by those best able to judge, as to improvements in the taking of the census of the deaf. At the same time we would call attention to certain suggestions by Dr. A. Graham Bell on the census-taking of the deaf which may lead to important results in the study of the heredity of this affection, and to its introduction into certain families through unfortunate marriages. One of the sections in the article to which we refer has reference to the offspring of first-cousin marriages. This is a point of grave importance, and one upon which, up to this time, no special data have been obtained in this country. The committee of the deaf, as it will be seen, recommends the introduction into the census schedules of a question bearing on this point, and it is certainly to be hoped that such a question will be inserted. In examining the ancestry of deaf-mutes, Dr. Bell has had occasion to consult the original population schedules of former censuses, which are preserved in the Department of the Interior, and he has found little difficulty in tracing the families backward from census to census in the male line of ascent. If the name of the father had been given in former censuses, it might now be possible for genealogical experts to trace from these records the American ancestry of every person now living in the United States in every branch, for the name of the father would give the maiden name of females. Dr. Bell therefore suggests that in the census of 1890 the father's

name should be noted in that part of the schedule that relates to the nativity of the parents, so that the people of the United States may leave to their descendants genealogical records from which their full ancestry may at any time be ascertained. This suggestion is full of interest to the genealogists of the country, and, if carried into effect, would undoubtedly prove of great value to them. The committee of the New England Historical and Genealogical Society, to whom this matter was referred, has strongly indorsed it, and it is hoped that a question on this point, as shown in the proposed schedule, will be inserted.

THE ENUMERATION OF THE DEAF.

A MEETING of the executive committee of the conference of American instructors of the deaf was held in Washington, May 9 of this year, to consider the best method of enumerating the deaf of the next census, and confer with the superintendent of the census, Hon. Robert D. Porter, on the subject. Dr. Alexander Graham Bell and Mr. Frederick Howard Wines were invited to act with the committee. All the members of the committee, including Dr. Bell, were present; but Mr. Wines was unable to attend. After a discussion of several hours and a pleasant interview with Mr. Porter and Dr. J. S. Billings, who has charge of the mortality and vital statistics of the "Eleventh Census," Mr. Porter acceded to the request of the committee, that in the next census the deaf should be separated from the pauper and criminal classes, and promised to give careful consideration to any suggestions the committee might make. In accordance with this, the committee, — consisting of Edward M. Gallaudet, president of the National College for Deaf-Mutes; Isaac Lewis Peet, principal of the New York Institution for the Deaf and Dumb; Philip G. Gillett, superintendent of the Illinois Institution for the Deaf and Dumb; J. L. Noyes, superintendent of the Minnesota School for the Deaf; Caroline A. Yale, principal of the Clarke Institution for the Deaf at Northampton, Mass.; Alexander Graham Bell; and Edward Allen Fay, editor of the *American Annals of the Deaf*, — on June 21, addressed a letter to Mr. Porter, in which they made the following statements and suggestions: —

"At the sixth conference of principals and superintendents of American schools for the deaf, held at Jackson, Miss., April 14-17, 1888, — a body representing all the schools for the deaf in the United States, numbering last year 8,372 pupils, — we were appointed a committee to endeavor to effect a reform in the method of enumerating the deaf in the United States census, in the hope of securing fuller and more accurate statistics in 1890 than have heretofore been obtained. In accordance with your request at our interview on the 9th of May last, that we should make such suggestions as might seem desirable in this direction, we respectfully submit the following recommendations: —

"1. Section 17 of the act of Congress, entitled 'An Act to provide for taking the tenth and subsequent censuses' [approved March 3, 1879], provides that 'Schedule No. 1 (here reproduced) shall contain inquiries . . . as to the physical and mental health of each person enumerated, whether active or disabled, maimed, crippled, bedridden, deaf, dumb, blind, insane, or idiotic, and whether employed or unemployed, and, if unemployed, during what portion of the year.' In accordance with this provision, inquiries were made in the 'Tenth Census' concerning the disabled; and full returns were sought of all the classes named in the act, excepting the deaf and the dumb. Only those dumb were enumerated who were also deaf, and only those deaf who had lost hearing before the age of sixteen years. We urge that in the 'Eleventh Census' all the classes named in the act be fully enumerated; and we specially urge that the returns of the deaf be not limited to that sub-class of the deaf formerly denominated the 'deaf and dumb.' If the requirements of the law are fully complied with, the returns will be much more useful to us, as teachers of the deaf, than if the plan pursued in former censuses of inquiring only for the 'deaf and dumb' is continued. Pupils are admitted to the schools we represent, not on account of their dumbness, but on account of their deafness. Persons who are merely dumb are not received; persons who are merely deaf are received. Our schools are open to

all children of school age who are debarred by deafness from attending ordinary schools for hearing persons. We wish the aid of the census in obtaining the names and post-office addresses of such children, in order to bring them into the special schools suited to their condition.

"2. The age or period of life at which deafness occurred is a

which the deafness occurred. They should be instructed that this point is of such vital importance to the correct classification of the deaf that an answer must be obtained in every case, or a reason assigned for non-reply. This reason may in some cases itself reveal the point desired.

"3. We recommend that in Schedule No. 1 the physical and

FORM OF QUESTIONS USED IN SCHEDULE NO. 1 OF THE TENTH CENSUS [1880.]

HEALTH		EDUCATION		NATIVITY	
15	Is the person (at the time the Deaf-mutes were visited) sick or temporarily disabled so as to be unable to attend to ordinary business or duties? If so, what is the sickness or disability?	21	Attended school within the census year, /.	24	Place of birth of this person, naming State or Territory of United States, or the country if of foreign birth.
16	Blind, /.	22	Cannot read, /.	25	Place of birth of the person, naming the State or Territory of United States, or the country if of foreign birth.
17	Deaf and Dumb, /.	23	Cannot write, /.	26	Place of birth of the mother of this person, naming the State or Territory of United States, or the country if of foreign birth.
18	Idiotic, /.			27	Were the parents of this person first cousins? Yes, /, No, X.
19	Insane, /.			28	Name of the father of this person.
20	Maimed, Crippled, Bedridden, or otherwise disabled, /.				

FIG. 1.

SUGGESTED FORM OF QUESTIONS FOR SCHEDULE NO. 1 OF THE ELEVENTH CENSUS [1890].

PHYSICAL AND MENTAL CONDITION.			EDUCATION.			NATIVITY AND PARENTAGE.		
15	Is the person (on the day of the Deaf-mutes' visit) sick or temporarily disabled so as to be unable to attend to ordinary business or duties? If so, what is the sickness or disability?		21	Attended school within the census year? Yes — No X.		24	Place of birth of this person, naming State or Territory of United States, or the country if of foreign birth.	
16	Sight	Good — Not good / Cannot see well enough to read X.	22	Can this person read? Yes — No X.		25	Place of birth of the person, naming State or Territory of United States, or the country if of foreign birth.	
17	Hearing.	Good — Not good / Cannot hear loud conversation X.	23	Can this person write? Yes — No X.		26	Place of birth of the mother of this person, naming State or Territory of United States, or the country if of foreign birth.	
18	Speech.	Good — Not good / Cannot speak so as to be understood X.				27	Were the parents of this person first cousins? Yes, /, No, X.	
19	Mind.	Mental condition good — Not good / Mentally disabled X.				28	Name of the father of this person.	
20	Body.	Physical condition good — Not good / Physically disabled X.						

FIG. 2.

FORM OF QUESTIONS ON DEFECTIVE CLASSES FOR TENTH CENSUS AND PROPOSED FORM FOR ELEVENTH CENSUS COMPARED.

more reliable element in determining the sub-class of the deaf to which a person belongs than the presence or absence of the power of speech, or the exact amount of muteness involved. We therefore recommend, that, in taking a census of the deaf, the enumerators be specially required to ascertain the age or period of life at

mental condition of each person be noted. The form of questions as to physical and mental condition, as shown in Fig. 2, is suggested for incorporation in that schedule. To ascertain the condition of the hearing, the enumerator should be instructed to ask first whether the person can hear well. If the answer is 'Yes,' the

enumerator should indicate the reply by a horizontal mark (—) placed in the 'Hearing' column; if the hearing is not good, by a mark sloping from right to left (/); and if the question is not answered, the column should be left blank. If the hearing is reported as 'not good' (/), the enumerator should then ascertain the extent of the disability. If the person is too deaf to be taught in ordinary schools for hearing persons, or cannot hear conversation in a loud tone of voice, the enumerator should convert the sloping mark (/) into a cross (×), and proceed to put the interrogatories contained in the supplementary schedule or card relating to the deaf (see Paragraph 4, below). If, on the other hand, the person is merely 'hard of hearing,' or if there is doubt whether the deafness is sufficient to constitute the disability above specified, the cross should not be made, and the person should not be entered on the supplementary schedule or card relating to the deaf.

"The condition of the speech should be ascertained and recorded in a similar manner. If the person speaks well, the enumerator should make a horizontal mark (—) in the 'Speech' column; if not, a sloping mark (/); and if the person cannot speak so as to be understood, or cannot speak at all, the sloping mark should be converted into a cross (×).

"The deaf and the dumb would then be indicated as follows, in Schedule No. 1:—

	CONDITION OF THE —				
	Sight.	Hearing.	Speech.	Mind.	Body.
The deaf.....		×			
The dumb (because of deafness).....		×	×		
The dumb (because of idiocy).....			×	×	
The dumb (because of defective vocal organs).....			×		

"The fact that there are three classes of dumb persons shows the liability to error when the enumerator is instructed, as heretofore, to inquire for the 'deaf and dumb.' Out of 29,776 idiots, whose powers of speech were ascertained from physicians in the last census, 7,396, or about one-fourth of the whole number, could not articulate at all, or had no use of spoken language; 14,707, or about one-half, could articulate but imperfectly, or their use of language was very defective; the number who spoke intelligibly was only 7,673. It thus appears that a large proportion of the idiotic are no less 'dumb' than deaf-mutes; and it is almost inevitable, that, when dumbness is made prominent (as in the term 'deaf and dumb'), the one class should be confused with the other, resulting in the return of intelligent deaf-mutes as 'idiotic,' and of idiotic hearing persons as 'deaf and dumb.' In the last census, moreover, 2,339 persons were returned as both 'deaf-mute and idiotic.' It is extremely probable that among these were some deaf-mutes of good mind, and some idiots who could hear. If a census of the deaf is taken, this source of error will be removed. Other advantages of the form of questions above proposed over the former plan of asking for the 'blind, deaf and dumb, idiotic, insane, maimed, crippled, bedridden, or otherwise disabled,' are explained in Dr. Alexander Graham Bell's communication to Senator Hale (Paragraphs 20-39), which was published in *Science* of Jan. 18.

"4. Mr. F. H. Wines of Springfield, Ill., special agent of the "Tenth Census," in charge of the statistics relating to the deaf and other special classes of the population, who was invited to act with this committee, but was unable to be present at our meeting, suggested to us by letter, that, instead of supplementary schedules, the enumerators should be provided with special cards, on which the questions to be asked in the case of each deaf person should be printed, with spaces for the answers; and that the enumerators be required to fill out these cards in duplicate,—one copy for use, and the other for preservation. We approve of the suggestion of special cards, and recommend the following form, in addition to such references as may be necessary for identification with Schedule No. 1.

[Face of Card.]

[This space may be used for the necessary references for identification with Schedule No. 1.]

THE DEAF.

Instructions to the Enumerator.

Note A.—The questions on this card should be asked in the case of every person who is too deaf to be taught in ordinary schools for hearing persons, or who cannot hear conversation in a loud tone of voice.

Note B.—Question No. 5 is very important, and every possible effort must be made to obtain a correct answer.

If the person was born deaf, write B; if not, state the age at which the hearing was lost.

If it is difficult to find out the exact age at which the person became deaf, ask at what period of life deafness occurred; as, for instance, whether it was in infancy (under 4 years of age), in childhood (under 10), in youth (under 20), in adult life (from 20 to 50), or in old age.

If you cannot get an answer to Question No. 5, state here the reason why you cannot.

Note C.—In answering Question No. 8, use the same check-marks as in Schedule No. 1.

1. Name of the deaf person?
2. Residence when at home: Town? County? State?
- Post-office address?
3. Name of this person's father?

[Reverse of Card.]

4. Race or color of this person? Sex? Age?
5. At what age or period of life did this person become deaf? [See Note B.]
6. Cause of deafness?
7. Did the deafness result from military service?
8. Physical and mental condition [see Note C]. Sight? Hearing? Speech? Mind? Body?
9. Can this person hear sufficiently to perceive a warning shout in case of danger?
10. Is this person educated? Where taught?
11. What is this person's occupation? Monthly earnings? \$ Value of property? \$
12. Is this person a pauper?
13. Were the parents of this person first-cousins?
14. Has this person had any deaf brothers or sisters?
15. Is this person single (s); married (m); widowed (wid); or divorced (d)?
- If married, name of the wife (or husband)?
16. Name of the wife's (or husband's) father?
17. Has the wife (or husband) had any deaf brothers or sisters?
18. How many children have been born of this marriage? How many of the children were deaf? How many died young?
19. Is the wife (or husband) deaf? If so, became deaf at what age or period of life? [See Note B.]

"5. In addition to the statistics gathered by the enumerators, much valuable information relating to the deaf can be obtained by means of inquiries addressed to principals of schools for the deaf, teachers of common schools, physicians, and intelligent deaf persons. We recommend that special cards with suitable questions be addressed to each of these classes of persons.

"6. We recommend that some one thoroughly qualified by familiarity with the deaf be placed in charge of the entire work of the census relating to this class.

"7. We recommend that in the publication of the results of the census the deaf be separated from the pauper and criminal classes.

"8. In the last census, 4,597 persons were returned as doubly or trebly afflicted with deaf-mutism, idiocy, insanity, and blindness. Those who were returned as 'deaf and dumb and idiotic' were reported among 'the deaf and dumb' and again among 'the idiotic,' etc.; each of the doubly afflicted persons being thus counted twice, and each of the trebly afflicted persons thrice. In this way the 4,597 doubly and trebly afflicted persons counted in the summing-up of the insane, idiots, blind, and deaf-mutes ('Tenth Census,' vol. xxi. p. vii.), as 9,441 persons, more than double their actual number, making the total of these classes appear greater by 4,844 individuals than it really was. In order to insure accuracy with

respect to these classes, we recommend that the returns of persons doubly and trebly afflicted be not classed with the deaf, the idiotic, etc., respectively, but be grouped in classes by themselves, and placed in charge of some specially qualified person for the careful examination and verification of the returns, and for an investigation into the causes of these terrible afflictions.

"9. An impression is prevalent that deafness, blindness, idiocy, and insanity are often due to consanguinity in the parents; and statistics have been collected which show that a considerable percentage of the deaf, blind, idiotic, and insane are the children of first-cousins. These statistics, however, can be of little value in determining the questions involved until we know what percentage of the general population are the offspring of such unions. We therefore recommend that in Schedule No. 1 the question be asked, 'Were the parents of this person first-cousins?'

"We trust that these suggestions will commend themselves to your judgment, and believe that, if adopted, they will result in a more accurate and satisfactory census of the class in whose welfare we are especially interested than has yet been obtained."

HEALTH MATTERS.

Baking Bacilli.

At a meeting of the New York Academy of Medicine, June 20, Dr. A. Jacobi read some notes on the baking of bacilli, being a denunciation of Weigert's advertising scheme, and a review of his own experience with the inhalation of hot air in the treatment of phthisis. Weigert, supposed to be an American physician, now of Germany, claimed to have discovered a method of curing phthisis by the inhalation of hot air, and he had made free use of Dr. Jacobi's name in advertising his apparatus for carrying out this treatment. The treatment was not original with Weigert; nor had Dr. Jacobi, as had been asserted, bought, indorsed, or recommended the apparatus in question. Moreover, as appeared further along, he had little confidence in the method. To Halter belonged the honor of suggesting the treatment of phthisis by the inhalation of hot air with the view of killing the bacilli in the lungs. The idea arose from observing the immunity from phthisis of workmen in a lime-kiln where they were exposed to a high degree of heat (122° to 158° F.),—so high that it would destroy the tubercle bacilli, provided it continued at that degree until it had reached the lungs. The air inhaled by workmen in a lime-kiln was dry and rarefied. A moist atmosphere of a like temperature would be more destructive of the bacilli, but was less endurable by the phthisical patient. Dr. Jacobi said, that, having been requested to admit Weigert's apparatus into his wards at Bellevue Hospital, he did experiment with it some time ago, and for a while the results made a favorable impression on the physicians in attendance, for the patients, or a part of them, seemed to improve under the treatment. More careful observation, however, showed that the improvement was doubtless due to rest in the hospital, in an atmosphere much purer than that in which the patients had lived in their tenement homes. The instrument itself was not as good as that which one of ordinary ingenuity could improvise. The atmosphere on its way to the lungs from the flame was found to have fallen from above 300° F. to about the temperature of the body when it had reached the mouth. Of course, if it were above the temperature of the blood, it would become further cooled on its passage toward the lungs. Some of the hot air might get into the alveoli, but very little. In order to obtain benefit from such treatment, it would be necessary not only that the air inhaled be of a high temperature, but that the patient be in a room in which the thermometer registered at least 105.5° F.: in other words, it would be necessary to produce a sort of artificial fever, and it was evident that such treatment must prove injurious to any other than patients in the very first stage of phthisis.

Professor Huxley and M. Pasteur on Hydrophobia.

On Monday, July 1, a meeting called by the lord mayor of London to hear statements from men of science with regard to the recent increase of rabies in England, and the efficiency of the treatment discovered by M. Pasteur for the prevention of hydrophobia, was held at the Mansion House. Several letters were read from those who were unable to attend. Among these letters was one from

Professor Huxley, in which he says, "I greatly regret my inability to be present at the meeting which is to be held, under your lordship's auspices, in reference to M. Pasteur and his institute. The unremitting labors of that eminent Frenchman during the last half-century have yielded rich harvests of new truths, and are models of exact and refined research. As such they deserve, and have received, all the honors which those who are the best judges of their purely scientific merits are able to bestow. But it so happens that these subtle and patient searchings-out of the ways of the infinitely little—of that swarming life where the creature that measures one-thousandth part of an inch is a giant—have also yielded results of supreme practical importance. The path of M. Pasteur's investigations is strewn with gifts of vast monetary value to the silk-trader, the brewer, and the wine merchant; and, this being so, it might well be a proper and a graceful act, on the part of the representatives of trade and commerce in its greatest centre, to make some public recognition of M. Pasteur's services, even if there were nothing further to be said about them. But there is much more to be said. M. Pasteur's direct and indirect contributions to our knowledge of the causes of diseased states, and of the means of preventing their occurrence, are not measurable by money values, but by those of healthy life and diminished suffering to men. Medicine, surgery, and hygiene have all been powerfully affected by M. Pasteur's work, which has culminated in his method of treating hydrophobia. I cannot conceive that any competently instructed person can consider M. Pasteur's labors in this direction without arriving at the conclusion, that, if any man has earned the praise and honor of his fellows, he has. I find it no less difficult to imagine that our wealthy country should be other than ashamed to continue to allow its citizens to profit by the treatment freely given at the institute without contributing to its support. Opposition to the proposals which your lordship sanctions would be equally inconceivable if it arose out of nothing but the facts of the case thus presented. But the opposition which, as I see from the English papers, is threatened, has really, for the most part, nothing on earth to do either with M. Pasteur's merits or with the efficacy of his method of treating hydrophobia. It proceeds partly from the fanatics of *laissez faire*, who think it better to rot and die than to be kept whole and lively by State interference, partly from the blind opponents of properly conducted physiological experimentation, who prefer that men should suffer rather than rabbits or dogs, and partly from those who for other but not less powerful motives hate every thing which contributes to prove the value of strictly scientific methods of inquiry in all those questions which affect the welfare of society. I sincerely trust that the good sense of the meeting over which your lordship will preside will preserve it from being influenced by these unworthy antagonisms, and that the just and benevolent enterprise you have undertaken may have a happy issue."

M. Pasteur, in a letter dated Paris, the 27th ult., and read by Sir H. Roscoe, writes, "I am obliged by your sending me a copy of the letter of invitation issued by the lord mayor for the meeting on July 1. Its perusal has given me great pleasure. The questions relating to the prophylactic treatment for hydrophobia in persons who have been bitten, and the steps which ought to be taken to stamp out the disease, are discussed in a manner both exact and judicious. Seeing that hydrophobia has existed in England for a long time, and that medical science has failed to ward off the occurrence even of the premonitory symptoms, it is clear that the prophylactic method of treating this malady which I have discovered ought to be adopted in the case of every person bitten by a rabid animal. The treatment required by this method is painless during the whole of its course, and not disagreeable. In the early days of the application of this method, contradictions such as invariably take place with every new discovery were found to occur, and especially for the reason that it is not every bite by a rabid animal which gives rise to a fatal outburst of hydrophobia: hence prejudiced people may pretend that all the successful cases of treatment were cases in which the natural contagion of the disease had not taken effect. This specious reasoning has gradually lost its force with the continually increasing number of persons treated. To-day, and speaking solely for the one anti-rabic laboratory of Paris, this total number exceeds 7,000; or exactly, up to the 31st of May, 1889, 6,950. Of

these, the total number of deaths was only 71. It is only by palpable and wilful misrepresentation that a number differing from the above, and differing by more than double, has been published by those who are systematic enemies of the method. In short, the general mortality applicable to the whole of the operations is 1 per cent; and, if we subtract from the total number of deaths those of persons in whom the symptoms of hydrophobia appeared a few days after the treatment,—that is to say, cases in which hydrophobia had burst out (often owing to delay in arrival) before the curative process was completed,—the general mortality is reduced to .68 per cent. But let us for the present only consider the facts relating to the English subjects whom we have treated in Paris. Up to May 31, 1889, their total number was 214. Of these, there have been five unsuccessful cases after completion of the treatment, and two more during treatment, or a total mortality of 3.2 per cent, or, more properly, 2.3 per cent. But the method of treatment has been continually undergoing improvement; so that in 1888 and 1889, on a total of sixty-four English persons bitten by mad dogs and treated in Paris, not a single case has succumbed, although among these sixty-four there were ten individuals bitten on the head, and fifty-four bitten on the limbs, often to a very serious extent. I have already said that the lord mayor, in his invitation, has treated the subject in a judicious manner, from the double point of view of prophylaxis after the bite and of the extinction of the disease by administrative measures. It is also my own profound conviction that a rigorous observance of simple police regulations would altogether stamp out hydrophobia in a country like the British Isles. Why am I so confident of this? Because, in spite of an old-fashioned and widespread prejudice, to which even science has sometimes given a mistaken countenance, rabies is never spontaneous. It is caused, without a single exception, by the bite of an animal affected with the malady. It is needless to say that in the beginning there must have been a first case of hydrophobia. This is certain; but to try to solve this problem is to raise uselessly the question of the origin of life itself. It is sufficient for me here, in order to prove the truth of my assertion, to remind you that neither in Norway, nor in Sweden, nor in Australia, does rabies exist; and yet nothing would be easier than to introduce this terrible disease into those countries by importing a few mad dogs. Let England, which has exterminated its wolves, make a vigorous effort, and it will easily succeed in extirpating rabies. If firmly resolved to do so, your country may secure this great benefit in a few years; but, until that has been accomplished, and in the present state of science, it is absolutely necessary that all persons bitten by mad dogs should be compelled to undergo the anti-rabic treatment. Such, it seems, is a summary of the statement of the case by the lord mayor. The Pasteur Institute is profoundly touched by the movement in support of the meeting. The interest which his royal Highness the Prince of Wales has evinced in the proposed manifestation is of itself enough to secure its success. Allow me, my dear colleague, to express my feelings of affectionate devotion."

BOOK-REVIEWS.

Der Hypnotismus. Von Dr. Med. ALBERT MALL. Berlin. 8°.

THE modern study of hypnotism may now be said to have outgrown the limits of its birthplace, France, and to have acquired that universal recognition that belongs to a scientifically established body of doctrines. The attitude of Germany towards these extremely fascinating experiments and results was at first suspicious, then rather adversely critical. Now, while retaining a judicious scepticism regarding the more surprising results, German scholars have come to recognize the intrinsic value of hypnotism as a psychological method, as well as the importance of the place it occupies in modern psychology.

The German literature consists in the main of single contributions, partly critical and partly original, dealing with single phases of the various hypnotic conditions. There have been but few general treatises aiming at a convenient *résumé* of what has been established, and the present work by Dr. Mall is a rather successful attempt to supply this lack.

The work is methodically arranged, intelligibly written, but is

defective in laying too much stress upon individual minor points of special interest to the author, and in a lack of clear distinctions between the important and the subsidiary, perhaps uncertain points.

After a brief historical introduction, in which some hitherto neglected points in the history of hypnotism in Germany are noted, the general symptoms of the hypnotic conditions are described. The various stages are distinguished as to their intensity merely, no other criterion as yet offered being found satisfactory. The more detailed description consists of a physiological and a psychological portion. In the former the changes in the movements and sensations, in the latter effects brought about in the region of memory association and more complicated processes, are described. This is naturally the most important part of the work, and is a useful *résumé* of the position taken by the Nancy school. The processes are described throughout as explicable on the ground of suggestion, conscious or unconscious. The *résumé* of the latter is particularly important, and finds here due recognition. A further point of view pervading the entire exposition is the assimilation of psychic and physiological conditions observed in hypnotism with analogous occurrences in sleep and waking life. This analogy with the phenomena of normal sleep is both real and important; and, while it does not warrant our regarding hypnotism as something entirely normal, it ought to remove the usual view that places it entirely in the region of pathology.

The latter half of the work deals with various aspects of hypnotic study, its theoretical bearings, its practical bearings as a therapeutic agent, its forensic aspect as a means of concealing crime, the allied conditions found in the lower animals, and so on. While some of the opinions there set forth will doubtless have to be modified, the work none the less, reflects the present state of knowledge very well. The work is not original, except in its arrangement and the various degrees of importance it attaches to different results of experimentation. The chief objection to its use by the laity is the rather uncritical collation of good and indifferent works, of important and trivial points. As a contribution to the German literature on hypnotism, it is welcome, and will find use.

AMONG THE PUBLISHERS.

A HOST of boys and girls under eighteen years of age have been profiting themselves, and at the same time entertaining their teachers, parents, and friends, by telling prize-stories in *Treasure Trove Magazine* of New York. They have won cash prizes to the extent of two hundred dollars, besides seventy dollars' worth of books. Story-telling as a means of education is taking a first place in the regular exercises of our public schools, where the usually irksome task of composition-writing, upon which so many other studies depend, has been turned by these prize-story competitions into a genuine pastime.

— *Babyhood* for July contains much seasonable advice for mothers of young children, the question of where to go and where not to go during the summer months being thoroughly discussed. "Botany for the Little Ones" is continued, and there are entertaining and instructive contributions concerning the many perplexing questions that are apt to arise at the present time in the city nursery as well as in the temporary country home.

— Messrs. E. & F. N. Spon announce as in preparation "Chemical Technology: the Application of Chemistry to the Arts and Manufactures," by C. E. Groves and William Thorp (about 8 volumes); and "Egyptian Irrigation," by W. Willcocks, M.I.C.E., with introduction by Lieut.-Col. J. C. Ross, R.E., C.M.G., being a physical description of Egypt, with particulars of various methods of irrigation and drainage, and full details of engineering construction, and illustrated by numerous plates. They also announce as nearly ready, "The Engineer's Sketch-Book of Mechanical Movements, Devices, Appliances, and Contrivances," by Thomas Walter Barber, containing details employed in the design and construction of machinery for every purpose; collected from numerous sources and from actual work; classified and arranged for reference for the use of engineers, mechanical draughtsmen, managers, mechanics, inventors, patent agents, and all engaged in the mechanical

arts; with nearly two thousand illustrations, descriptive notes, and memoranda: and as ready July 1, "Practical Gold Mining: a Comprehensive Treatise on the Origin and Occurrence of Gold-Bearing Gravels, Rocks, and Ores, and the Methods by which the Gold is Extracted," by C. G. Warnford Lock, illustrated by numerous plates and engravings.

— The frontispiece of the August issue of *Scribner's Magazine* will be a striking portrait of Lord Tennyson, engraved by Kruell from a recent photograph. Recognition is thus made of Tennyson's eightieth birthday, which occurs in August. The same number will contain a short essay by Dr. Henry van Dyke on Tennyson's earliest poems published with his brother; and the end paper, by Professor T. R. Lounsbury of Yale, will discuss Tennyson's attitude toward life in youth and old age, under the title of "The Two Locksley Halls." The time has arrived when every one wants to know what is being done to advance and extend the art of electric lighting, and President Henry Morton of Stevens Institute, in his article in the same number of *Scribner's*, will explain some of the most recent achievements. He will describe such matters as lighting the Hoosac Tunnel with glow-lamps, the lighting of Hell Gate, of the great public squares, and other interesting undertakings, all very fully illustrated. James Dwight, M.D., a leading authority in this country and England, on the game of lawn tennis, will contribute a careful study of "Forn in Lawn Tennis," based on a series of instantaneous photographs of the best players at work, showing the exact position taken in making all the principal strokes. Models for these photographs were Mr. R. D. Sears, the late champion, assisted by his brother, Mr. P. S. Sears, and Mr. Thomas Pettitt, the professional tennis champion. These have been excellently engraved, and are very picturesque as well as of great value to tennis players. Benjamin Norton, the nephew of Austin Corbin, and second vice-president of the Long Island Railway, will contribute a short paper entitled "How to Feed a Railway," which will describe the purchasing and supply department. The closing article in the railway series will appear in the September number under the title of "Safety Appliances in Railroad Working," by H. G. Prout, editor of the *Railroad Gazette*.

— "The Spirit of Manual Training" will be set forth by Professor C. H. Henderson of Philadelphia, in an article which is to open the August *Popular Science Monthly*. Professor Henderson says that the ideal school will aim to develop men, not to produce fine articles of wood or iron, or to cram heads with information, and that the name "manual-training school" does not rightly describe an institution designed to train the "whole boy." Professor Huxley will review the main points of the controversy in which he has been engaged, in an article entitled "Agnosticism and Christianity." Some of Cardinal Newman's writings will receive a share of caustic criticism in this paper. A suggestive article on "The Wastes of Modern Civilization," by Felix L. Oswald, M.D., will appear, in which Dr. Oswald will point out a number of ways in which the resources of the modern world are used up, with no care for their replenishment, or in producing useless or harmful results; and "Mr. Mallock on Optimism" is the title of a critical article which Mr. W. D. Le Sueur will contribute to the August *Popular Science*. It repels the assertions of Mr. Mallock, that there is not sufficient reason for being gratified with the prospects of the human race, and that no meaning in life can be seen without the light of theological faith.

— Messrs. Ginn & Co. announce for publication in August "The Irregular Verbs of Attic Prose, their Forms, Prominent Meanings, and Important Compounds, together with Lists of Related Words and English Derivatives," by Addison Hogue, professor of Greek in the University of Mississippi. The material treated in this book is here much fuller than in the lists of irregular verbs in the grammars, and much more accessible than in the lexicons. The book contains, after the regular verbs, — pure, mute, and liquid, — the irregular verbs of Attic prose in alphabetical order. Prominent meanings and special uses of frequent occurrence are given, often illustrated by translated examples. The most important compounds are added, and also many related words, forming a very practical sort of introduction to word-formation. The first declen-

sion alone is represented by about 400 substantives, and this indicates the range of vocabulary. The English derivatives, of which there are over 450, will prove, it is hoped, an attractive feature to teachers and students alike. To the latter they will be an additional support in learning some five or six hundred Greek words, and will broaden their knowledge of their own tongue.

— At this time, when the centennial anniversaries of the various events connected with the beginning of the French Revolution are coming so thick and fast, many who desire to make new studies of that great period of history will get help from the Old South leaflet on the French Revolution, issued by the directors of the Old South Studies in History, and published by D. C. Heath & Co. This little sixteen-page leaflet, which is sold for five cents, contains one of the powerful chapters from Carlyle's history, on the condition of France on the eve of the Revolution, brief extracts from John Morley and others, and several pages of historical and bibliographical notes by Mr. Edwin D. Mead. All the important books upon the Revolution are noticed, with brief estimates of their several merits; the French Revolution is compared with the English Revolution of 1688 and with the American Revolution; and a special section is devoted to the various significant events taking place in the world in the eighteenth century, which will prove useful for fixing in the minds of students some important dates worth remembering in relation to each other.

— The *Quarterly Journal of Economics* (Boston, George H. Ellis) closes its third year with the July number. Edward Cummings contributes a study of the present condition of the English trades-unions, made with great advantages on the spot; Professor Dunbar reviews the history of the direct taxes of the United States, from the tax of 1798 to the last, in 1861; Stuart Wood develops his new theory of wages; and several notes on a variety of topics follow, including one by the new president of Brown University, Professor Andrews, on the late copper syndicate. The usual full bibliography and copious indexes for the volume fill the remaining pages.

— The *Educational Times* (London) says, "We cannot be too lavish in our praise of the series of Greek authors now being published by Messrs. Ginn & Co. The book before us ["Homer's Odyssey," Books I. — IV., by B. Perrin] forms one of this series, and is in no way inferior in binding, paper, printing, and general style, to the other productions of this firm, which we have previously noticed with real pleasure. The notes and appendices furnish considerable material for the higher criticism of the poem, but at the same time sufficient assistance of an elementary character has been provided to make the volume useful as an introduction to the study of Homer. Text and notes appear on the same page, which does not seem to us a good plan; but, to make the work thoroughly complete, with each edition of text and notes the purchaser receives a separate copy containing the text only, and, since this text edition can only be obtained separately at a very small cost, we heartily recommend it to our readers."

— We have received from the Theosophical Book Company of Boston a pamphlet entitled "Light on the Path," which is intended as an initiation into the mysteries of occultism. It is said to have been "written down by M. C.," the real author, we suppose, being some supermundane intelligence. The actual contents of the pamphlet are in part taken from Buddhism and other Eastern systems, and in part concocted by the author himself. The Buddhist doctrine of Karma is taught, and the reader is also told that he must kill out every kind of earthly desire. Besides these two tenets of Buddhism, various precepts are set forth, of which the following are specimens: "Hold fast to that which is neither substance nor existence. Listen only to the voice which is soundless. Look only on that which is invisible alike to the inner and the outer sense" (p. 17). The whole work, we are told, "is written in an astral cipher, and can therefore only be deciphered by one who reads astrally;" and we should think so. At the end of the pamphlet is a catalogue of the books issued by the publishers, to which they prefix this request: "Send us the addresses of those among your acquaintances who might be interested in the class of literature of which we make a specialty." So if any of our readers

choose to make a list of the fools they know, they can send it to the Theosophical Book Company.

— John Wiley & Sons announce as ready, "A Treatise on the Ordinary and Partial Differential Equations," by William Woolsey Johnson, professor of mathematics in the United States Naval Academy, Annapolis, Md.; "Submarine Mines and Torpedoes as applied to Harbor Defence," by John Townsend Bucknill, lieutenant-colonel Royal Engineers; "Elements of the Art of War," prepared for the use of the cadets of the United States Military Academy, West Point, N.Y., by James Mercur, professor of civil and military engineering; "A Laboratory Guide in Chemical Analysis," by David O'Brine, professor of chemistry in Colorado State Agricultural College; and "A History of the Planing-Mill," with practical suggestions for the construction, care, and management of wood-working machinery, by C. R. Tompkins, M.E.

— Messrs. Longmans, Green, & Co. announce that they have made arrangements to supplement their series, Epochs of Modern History, by a short series of books treating of the history of America, which will be published under the general title "Epochs of American History." The series will be under the editorship of Dr. Albert Bushnell Hart, assistant professor of history in Harvard College. Each volume will contain about two hundred and fifty pages, similar in size and style to the page of the volumes in the Epochs of History Series, with full marginal analysis, working bibliographies, maps, introductions, and index. The volumes will be issued separately, and each will be complete in itself. Those already arranged for will, it is hoped, provide a continuous history of the United States from the foundation of the Colonies to the present time, which shall be suited to class use as well as for general reading and reference. The volumes in preparation are as follows: "The Colonies (1492-1763)," by Reuben Gold Thwaites, secretary of the State Historical Society of Wisconsin, author of "Historic Waterways," etc.; "Formation of the Union (1763-1829)," by Albert Bushnell Hart, A.B., Ph.D., the editor of the series; and "Division and Re-union (1829-1889)," by Woodrow Wilson, Ph.D., LL.D., professor of history and political economy in Wesleyan University, Middletown, Conn., author of "Congressional Government," etc.

LETTERS TO THE EDITOR.

Are Beech-Trees ever struck by Lightning?

THIS is the question implied in your note on p. 7 of *Science* for July 5, 1889.

In August, 1885, at Mason, Ingham County, Mich., a number of men were at work harvesting wheat in a large field west of the village.

A heavy thunder-storm came up, and all but one of them, Aura Hines, fled for shelter to a saw-mill about a quarter of a mile distant. He said that his shoes hurt his feet, and he did not like to run so far; he would go to the woods, which bounded the field south, not far distant. After the storm (accompanied with heavy thunder and lightning) had passed, the men returned from the mill

to their work, but Hines did not appear. They went in search, and found him sitting under and against a large beech-tree, dead.

Without disturbing his position, they sent to the village for help, and I went and saw him.

The tree was a large and tall one, about two feet in diameter, and leaned a little eastward. A pile of brushwood had been burned on the east side, which had killed the tree on that side from the roots to the height of seven feet from the ground. The storm came from westward, and Hines sat on the east side crouched against the tree, which sheltered him from the rain. Two or three holes of half an inch diameter, near his right foot, showed where the current passed from the earth to his body, partly tearing the sole from his shoe, and passing through the crown of the coarse straw hat on his head, making a half-inch hole, as if a bullet had been fired through it; the broken straws pointing upward and outward.

There was a plain furrowed trace on the burned and dead bark of the tree above his head, to the green and living wood, but no farther.

The wood of the beech is very close grained, and in the living tree full of sap, and the green bark is also filled with sap, while the outer or ross bark is thin and quite smooth.

Has not such a tree the elements of a good conductor, over which the electric fluid passes, without shattering it or leaving a trace?

If this is true, beech-trees are probably struck by lightning as often as any others, but it leaves no trace of its passage over them.

H. D. POST.

Holland, Mich., July 14.

A Navajo Tree-Burial.

FOR a number of years I enjoyed the opportunity of studying the customs and traditions of three or four tribes of Indians in the vicinity of Fort Wingate, N. Mex., and during that period became very familiar with the method of disposing of their dead resorted to by the Navajos, one of the tribes to which I refer. They are, as we know, "cliff-buriers," as I have elsewhere described; and personally I never met with a case where they do not bury their deceased — men, women, and children — in the more capacious rents in the rocky cañons of the mountain-sides, where this tribe now inhabits. Recently, however, a well-authenticated case has been sent me where the Navajos had buried one of their dead children in a tree. This was done not long ago, only about a mile from Fort Wingate, and was discovered by Mr. Benjamin Wittick, who has taken an admirable photograph of the tree and the locality. The body of the child had been deposited, after having been wrapped in cloth and blankets, longitudinally on the limb of a large piñon-tree, about fifteen feet above the ground. A rude platform of dead and broken limbs was constructed to hold the body in position. Indeed, in all particulars the burial is characterized as a typical tree-burial, and is interesting from the fact that it constitutes such a remarkable departure from the general mortuary custom of that tribe of our Indians.

R. W. SHUFFELDT.

Takoma, D.C., July 16.

INDUSTRIAL NOTES.

New Outfit of Electrical Engineering Apparatus for Princeton College.

MESSRS. JAMES W. QUEEN & Co. of Philadelphia, the well-known manufacturers and importers of electrical test instruments, report the sale of a bill of goods amounting to four thousand dollars to Princeton College for the equipment of their course in electrical engineering to be inaugurated in September next. The list embraces several of Queen's large Wheatstone bridge sets as devised by Professor William A. Anthony, and pronounced by Professor B. F. Thomas of Ohio State University "to be superior to Elliott's Dial Form." These sets, as well as several of the next size smaller, also ordered by Princeton College, are all guaranteed by Professor Anthony to be accurate within $\frac{1}{100}$ of one per cent. There is also a large \$375 reflecting galvanometer made for the special purpose of measuring high insulation resistance, the galvanometer itself having a resistance of 500,000 ohms. This will be

the only instrument of this character in the United States. For measuring induction co-efficients, etc., there is provided one of Ayrton & Perry's Secohmmeters. For the determination of magnetic constants there is a large Weber earth inductor which will be used, in addition to the Kew magnetometer already possessed by the physical department. There is also a Kohlrausch unifilar electro dynamometer for the measurement of very weak currents, such as those used in telephone work, etc. This suspension has the minimum amount of torsion as the current is conveyed out of the instrument by means of a platinum strip attached to the movable coil, and dipping into a dilute solution of sulphuric acid. A pair of Wiedemann's large dead beat reflecting galvanometers, Sir William Thomson's astatic reflecting galvanometer, one of Elliott's differential galvanometers as well as his ballistic instrument, a Wheatstone Kirchoff cylinder bridge, Kohlrausch's mirror differential galvanometer, condensers, telescopes, etc., go to make up the remainder of as fine an outfit of electrical test apparatus as has ever been sold at any one time in this country.

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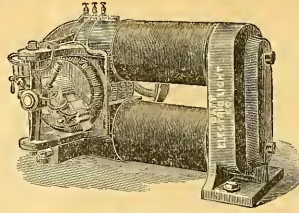
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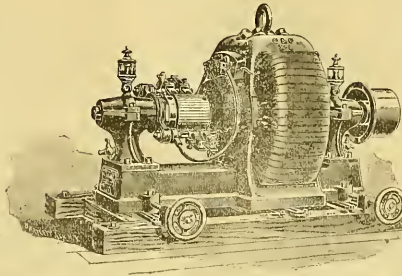
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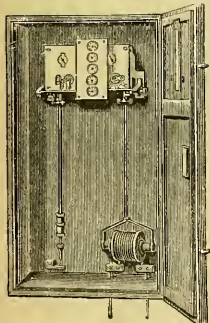
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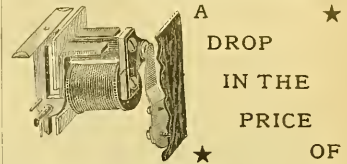
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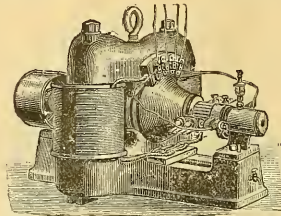
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VOL. XIV. No. 335.

NEW YORK, JULY 26, 1889.

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THE BRUSH ELECTRIC COMPANY'S NEW ALTERNATING-CURRENT SYSTEM.

THE end attained in the system of long-distance transmission of electrical energy illustrated herewith has been reached by an abandonment of the long-traversed routes already familiar to the public.

A glance at the dynamo (Fig. 1) shows that it is compact, simple, and symmetrical. An examination shows that it is of the alternating type; that its field-magnets are many, and carried by the shaft; that the armature is fixed, and absolutely free from any magnetic material; that its parts are easily accessible; and that

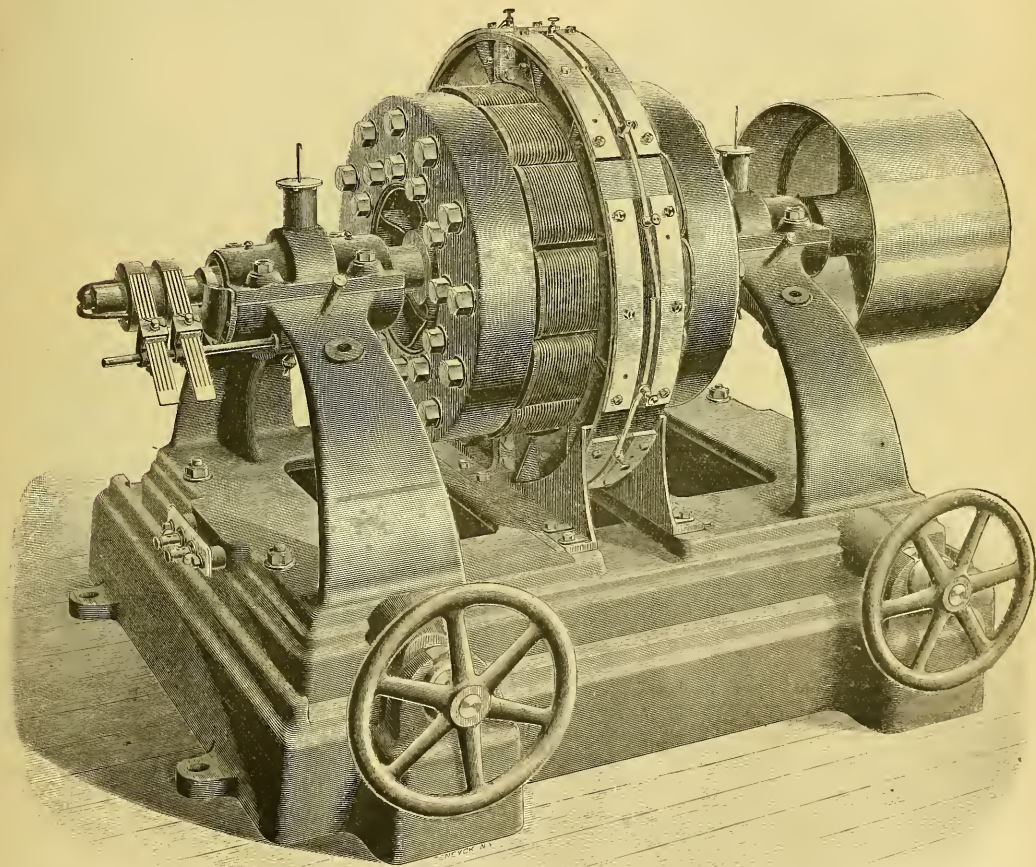


FIG. 1.—NEW BRUSH ALTERNATING CURRENT DYNAMO.

The underlying principle of the "coreless" dynamo here illustrated was discovered and applied by Mr. Brush more than ten years ago, and new demands have now called for its extended application on a regular scale.

an armature-coil may be cut out, removed, or replaced without stopping the machine. The machine illustrated has an output of 60,000 watts, and supplies current for a thousand 16-candle-power lamps.

The shaft bearings, bearing standards, base plate, and armature-slides are cast in one piece. The shaft carries two heavy cast-iron yoke-pieces 27 inches in diameter. To each of these are screwed, at equal radial and circumferential distances, the wrought-iron cores of 12 magnets of alternating polarity. Thus the whole rotating mass acts as a fly-wheel, tending to neutralize any variation in the speed of the prime generator. As the nominal speed of the machine is less than 1,100 revolutions per minute, the structural strength is more than sufficient to meet all demands made by centrifugal force. Further than this, the mechanical stress is less when the magnets are excited than when the alternator is running without load, as the lines of magnetic force between the faces of opposing poles tend to counteract centrifugal force. In machines

silver frame consisting of two semicircles bolted together on the line of the vertical diameter. Into the slots of the frame slip the six mounted armature-coils, the tongue on the edge of the one engaging with the groove on the edge of the next. The coils thus thrust into the intense magnetic field constitute a disk nine-sixteenths of an inch in thickness, and with an opening in the centre through which passes the revolving shaft. As there is no magnetic metal in the armature, there are no local currents to waste the energy.

The several coils are insulated carefully; and the stationary armature, as a whole, is insulated from the bed-plate on which it rests. The coils are joined in series, the binding-posts adjacent to any radial line of division between the two coils constituting fixed

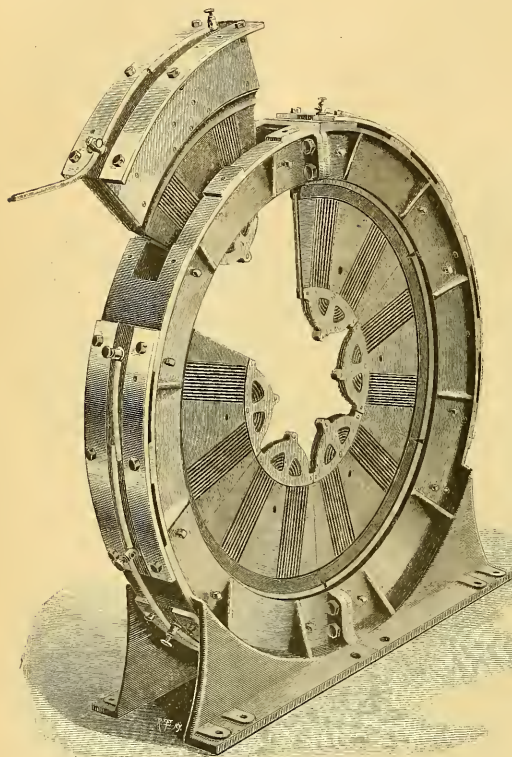


FIG. 2.

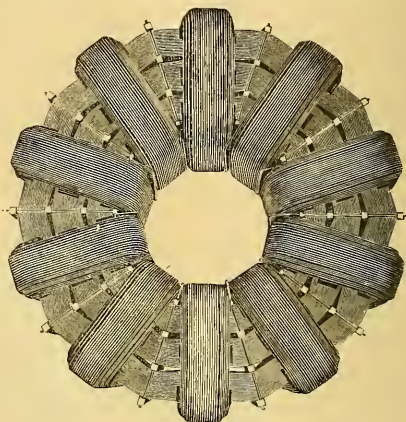


FIG. 3.

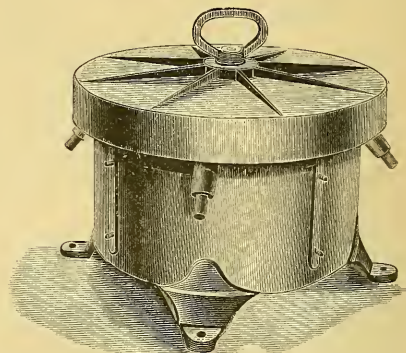


FIG. 8.

FIGS. 3, 6, AND 8.—BRUSH ALTERNATING SYSTEM.

of larger size, as usual, the speed is less, that of the 150,000-watt dynamo being not more than 700 revolutions per minute.

The most interesting part of the alternator is the fixed armature, shown in Fig. 2. The vertical disk is occupied by flat armature-coils made of insulated copper ribbon wound on porcelain cores. The copper ribbon of each coil is re-enforced on either side with strong insulating material of the same thickness as the porcelain. One of these re-enforcements is grooved, and the other tongued. The coil, consisting thus of core, ribbon, and re-enforcements, has an angular width of 60 degrees. The upper part of each face of each coil is covered with an insulating plate five-sixteenths of an inch thick. The coil thus built up and insulated is set in German-silver holders, cut from turning rings, and held together by sunk-headed screws. Each terminal of the copper ribbon connects with a binding-post, as shown.

The six armature-coils thus mounted are carried in a German-

silver frame consisting of two semicircles bolted together on the line of the vertical diameter. There is no commutator, and there are no collecting brushes to take the alternating current from the rotating parts.

The low resistance of the armature-coils is evident. It would seem impossible for one of them to burn out. None ever has burned out; but if one should, it may be removed, and a new one readily put in its place, in three minutes, or the injured coil may be shunted out of the circuit and the dynamo kept running with the other five until the time for shutting down. The coil section complete weighs only about 20 pounds. The whole armature may be removed by loosening the coupling-bolts, and sliding each half of the frame from between the field-magnets (Fig. 3).

In action, the 24 field-magnets of the alternator are excited by the direct current from a Brush dynamo of the well-known form. This exciting current is carried to the brushes that rest upon the two uncut insulating rings (shown at the left of Fig. 1), and thence

through the hollow shaft to the magnets. A rheostat (Fig. 4), worked by hand or automatically, is placed in the shunt circuit around the field-magnets of the exciter; so that perfect regulation is secured without re-adjustment of the brushes, or any necessity of handling the high-tension alternating current.

is less than ten per cent, as is shown in the curve, Fig. 5, which represents a diagram taken from one of the first machines. All this is accomplished without compound winding or artificial regulation of any kind, — a result which, it is claimed, has not been approached by any alternator with an iron core in its armature. All

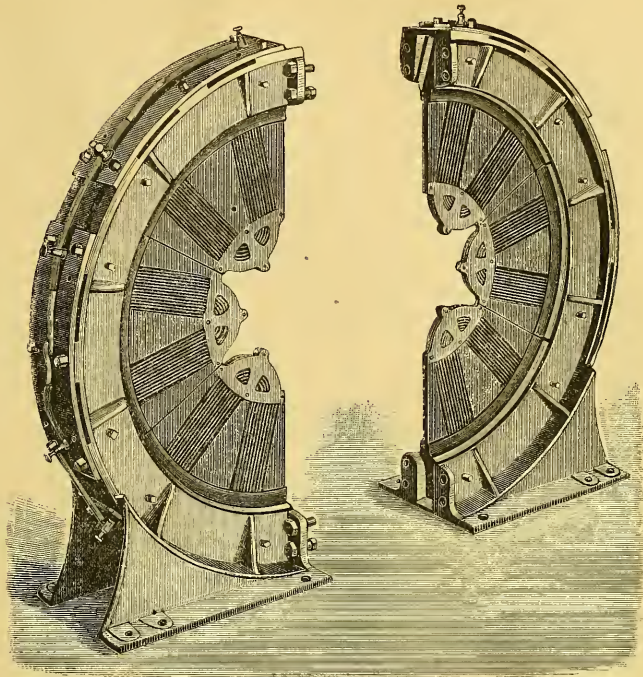


FIG. 3.—BRUSH ALTERNATING SYSTEM.

The Brush "coreless" alternator is built at present for an electro-motive force of 2,000 volts, although it would be easy to develop a much greater difference of potential. It is confidently expected that the necessity of long-distance transmission with a line of

the regulation needed is applied at the exciter, as already described. This results in a more even distribution of potential in the feeders and at the converter terminals, and a more even pressure at the terminals of the lamps beyond.

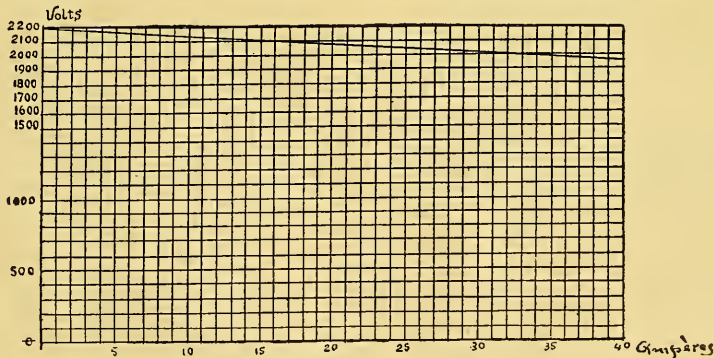


FIG. 5.—BRUSH ALTERNATING SYSTEM.

moderate cost will soon call for currents of higher tension, as economy of power as well as economy of copper point in this direction.

The fall of the potential in the machine from no load to full load

Though the high-tension current of the alternator is well adapted for economical carriage to distant points, it is not of the kind most desirable for introduction to the household, or for use in the lamp. Having brought electric energy from the place where it is devel-

oped to the place where it is to be used, the form given to it for economy of transportation may be changed so as to adapt it fully to the uses for which it is intended. High tension may be exchanged for greater current, volts for ampères. This transformation is accomplished by the converter shown in Fig. 6. In this converter, the core consists of a polygonal ring made of insulated iron wire, so wound as to leave several concentric air-spaces in the core. In the converters of the smaller sizes, the core is built up of

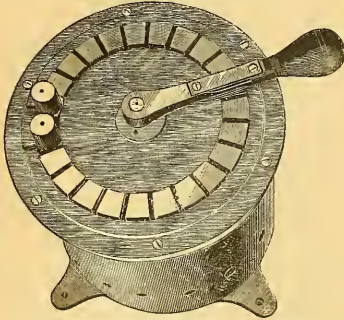


FIG. 4.— BRUSH ALTERNATING SYSTEM.

perforated thin iron plates (Fig. 7). In either case, the iron is so divided that the efficiency of the converter is little less with half than with full load. Upon each side of this core or iron ring is wound a single layer of heavy copper wire. The four or five single-layer coils carried by each half of the core are joined in series; and the two groups, borne by the two halves of the core, are joined in multiple, the whole constituting the secondary coil. The terminals of this secondary coil connect with the secondary main line running into houses and supplying current for the lamps. Most of the converters are wound so as to give a secondary current of

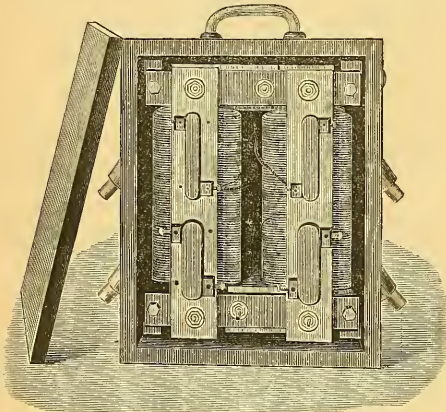


FIG. 7.— BRUSH ALTERNATING SYSTEM.

about 100 volts, but may instantly be connected to give 50 volts and twice as many ampères as before. They are made in sizes that supply each from 5 to 250 16-candle-power lamps, or more.

Between the fine iron wire of the core and the heavy copper wire of the superposed secondary coil, insulating pads one-eighth of an inch thick are placed at the corners of the core. Between these insulating corner-pieces are insulating air-spaces. Thus the copper and the iron are separated from each other at the corners of the core by their respective coverings and the insulating pads, and at all other points by their respective coverings and open air-spaces, the latter affording ample ventilation and facility of examination.

Over each of these single-layer parts of the secondary coil are bound a few layers of smaller copper wire to form a corresponding part of the primary coil. These corresponding parts of the secondary and primary coils are separated from each other by insulating pads at the corners and intervening air-spaces in the same manner and with the same advantages as previously described.

The ventilation of these converters is specially provided for, and the insulation resistance is exceedingly high. It is impossible to so overload the wire of the primary circuit as to force its current into the secondary circuit: in other words, the high-tension current cannot pass the converter. The converters are tested at the factory with double load, and, though no one has ever given out, overloading is made impossible by the use of safety-fuzes for the primary coils. These are extra long, and so mounted on slate or porcelain strips that they may be removed or replaced with the fingers merely, and without touching any metallic part of the converter.

The converter-coils, with safety-fuzes, etc., are placed in wind and weather proof cast-iron boxes of pleasing design (Fig. 8), and may be placed wherever most convenient; the governing

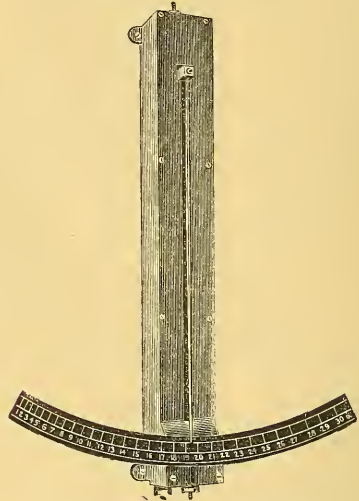


FIG. 9.— BRUSH ALTERNATING SYSTEM.

principle being to do as much work as possible with the less expensive primary wire, and to shorten the more costly secondary main. These converters are now made in sizes ranging from 2-lamp to 250-lamp capacity. With converters, as with dynamos, the larger sizes are the most economical. With a 100-volt converter fed by a 2,000-volt primary current, it is more easy and profitable to run a short secondary main to supply several consumers than to provide a converter for each consumer.

Fig. 9 represents the ammeter, which is placed in the main or feed circuit, wherever it is desirable to measure the strength of the current. It is a compensated expansion device, acting on the principle of one type of Brush arc lamp. It is free from any magnetic action, the simple compensating arrangement insuring the normal working of the apparatus at all temperatures. It is equally efficient with direct and with alternating currents.

The alternating-current apparatus of the Brush Electric Company here described is based on the patents of Charles F. Brush and Gustav Pfannkuche, the latter having the supervision of this branch of the Brush Electric Company's business.

THE heat in Russia and other parts of northern Europe has been intense of late. The Central Observatory at St. Petersburg has not recorded such a high temperature at the same time of the year since 1774.

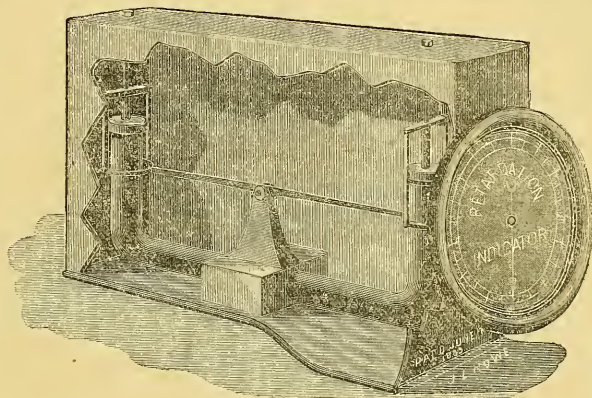
ARNOLD'S RETARDATION INDICATOR.

THE retardation indicator shown in the accompanying engraving is an apparatus intended to be placed in the cab of a locomotive, for indicating the relative measure of resistance exerted by the air-brakes when arresting the momentum of the train. By its use the person operating the brakes may be enabled to so regulate the steam or air pressure applied to the brakes as to prevent a too rapid stoppage of the train, and the consequent discomfort to the passengers.

The indicator consists of a tube, with upturned ends, arranged horizontally in the cab or car, the axis of the tube being parallel with the direction in which the train is to move. This tube contains mercury, which, as the train starts or stops, shows a difference of level in the upturned ends of the tube, governed by the rapidity of the starting or stopping, the change of momentum being proportional to the impulse producing it. Each end of the tube is provided with a freely moving piston, which rests upon the surface of the mercury. These pistons are attached to an arm which is pivoted in the centre, the pistons exactly balancing each other. Attached to an extension of this arm is a bevel-gear sector, which meshes into a pinion connected with the pointer on the dial-plate. When the train is at rest, or moving at uniform speed, the pointer remains at zero on the dial; but, when starting up or slowing

of these vessels and ducts combined with the wood-cells in any stem to render the structure exceedingly heterogeneous. Most of these cells and vessels have their longer diameter parallel with the general direction of the stem. Groups of thin-walled, prismatic cells pass radially from the central portion of the stem to the circumference. These groups of cells are called medullary rays. It is impossible to cut a filament from any of these woods so that the medullary rays will not cross it many times at right angles to the ducts and long cells. The character of the cells forming these rays is so very different from the others in the filament, as to shape, direction, and thickness of the walls, that at the crossing points resistance is greatly increased, thus causing rapid burning and destruction at such points.

Such woods as hickory and rock-elm furnish the very best of our timbers. They are the toughest and most durable of our woods, but they do not make good filaments. The medullary rays are very numerous, and the walls of the cells composing them are greatly thickened. The long, pointed, thick-walled wood-cells do not follow a parallel course, but interlace with each other. This interlacing of the cells gives to these woods their toughness. It is the main characteristic, also, which renders them worthless when made into electric filaments. Upon carbonization of such filaments, the tension of the interlacing cells is relieved, and the tissues composing it become friable, and easily fall apart.



ARNOLD'S RETARDATION INDICATOR

down, the pointer moves around the dial, to the right or the left, a distance proportional to the rapidity of the starting or the stopping.

Among the advantages claimed for it are the following: it shows the engineer at any instant the effect of the brakes upon the wheels, and enables him to retard the train uniformly, regardless of the condition of the track or of the air-pressure; it economizes the air, and prevents an undue shock or strain on the brake-rigging or the car-body; and it enables the engineer to apply the brakes gradually, and with increasing effect, until the train is brought to rest. The indicator is manufactured by J. H. Reynolds of Troy, N.Y.

ELECTRICAL NEWS.

Incandescent Electric Lamp Filaments.

IN a recent communication to the Academy of Natural Sciences of Philadelphia, on the use of bamboo in incandescent electric lighting, Professor William P. Wilson states, that, for want of a homogeneous structure, the ordinary exogenous woods are not adapted to the construction of lamp-filaments. Such woods are made up of wood-cells of varying lengths and shapes in combination with a variety of ducts and vessels.

The walls of the wood-cells may be more or less thickened, the vessels and ducts may be larger or smaller, numerous or infrequent, according to the kind of wood examined. There are always enough

In the adult stem of the bamboo a combination of anatomical characters has brought about a result which makes it the most fitting material, so far as now known, for the electric filament. The nearly parallel fibro-vascular bundles grow more numerous as they approach the circumference of the stem, and, as is usual in similar stems, lose most, or sometimes all, of the woody elements, thus becoming pure bast. The parenchymatic tissue, which toward the centre of the stem may be composed of a layer of five or six cells between the bundles, decreases in amount near the circumference until but one layer of cells remains. The walls of the cells in this single layer often become so thickened, and at the same time compressed by the growth of the bast, that these bundles appear to make a solid zone of bast around the circumference of the stem. The bast-cells also continue to thicken their walls until they become, in the best specimens for the filament, completely filled and solid. It is from this zone of bast at the circumference of the stem that the filament is always taken. It is perhaps the nearest approach, in its continuity of structure and uniform character, to a metallic conductor, of any tissue which can be found in the vegetable kingdom.

Photographs of Lightning.

At a meeting of the Physical Society of London held June 22, and reported in *Nature*, Mr. A. W. Clayden presented a note on some photographs of lightning, and of "black" electric sparks. The lightning photographs, three in number, were obtained dur-

ing the storm on June 6. Two flashes, seen on one plate, show complicated and beautiful structure: one of them is a multiple flash, and flame-like appendages point upwards from every angle; the other is a broad ribbon, and, although the plate shows signs of movement, the displacement is not in a direction such as would produce a ribbon-like effect from a linear flash. The second plate shows four flashes, none of which are ribbon-like, though the camera had moved considerably. The third plate was exposed to six flashes, one of which was believed to pass down the middle of the plate; but, on development, only a triple flash in one corner of the plate was seen. Careful search, however, revealed the central flash as a dark one with a white core, and other dark flashes were subsequently found. The plate was very much over-exposed, and this suggested that black flashes might be due to a sort of cumulative action caused by the superposition of the glare from a white cloud upon the normal image of the flash. To test this, sparks from a Wimshurst machine were photographed, and, before development, the plates were exposed to diffused gaslight for a short time. The bright sparks yielded normal images with reversed margins, and the faint ones were completely reversed. Other experiments showed the reversal to spread inwards as the time of exposure to gaslight increased. Finally, reversal was effected by placing a white screen behind the spark, to represent a white cloud, the only illumination being that of the spark itself.

In the discussion which followed, Mr. W. N. Shaw exhibited a photograph taken during the same storm, which is particularly rich in dark flashes branching outwards from an intensely bright one. In some places the bright line has dark edges, and in one part a thin bright line runs along the middle of an otherwise dark portion of the flash. In answer to Mr. Inwards, Mr. Shaw said the plate was exposed about half a minute; and the former thought, that, under those conditions, the appearance of the plate did not contradict Mr. Clayden's hypothesis. Speaking of the same photograph, Professor Perry considered that Mr. Clayden's observations would explain the result, for a bright flash required more exposure to diffused light to reverse it than a faint one did. Professor Ramsay reminded the meeting that Professor Stokes's "oxides of nitrogen" explanation was still a possible one; and Mr. C. V. Burton asked whether they may be due to faint sparks cutting off light from brightly illuminated clouds, just as a gas-flame absorbs light from a brighter source. In reply, Mr. Clayden thought the "oxides of nitrogen" hypothesis improbable, and said his experiments did not enable him to answer Mr. Burton's question. As regards Mr. Shaw's plate, he believed the diffused light from the clouds would be sufficient to reverse the fainter tributary flashes, although it was insufficient to reverse the primary one. From data obtained when the ribbon-flash was taken, he had made some calculations which gave the height of the clouds about 1,000 yards, and the ribbon-flash 1,300 yards long and 100 yards wide.

PERMEABILITY OF IRON.—From experiments conducted during the last two years, J. T. Bottomley, F.R.S., finds that the permeability of iron can be enormously reduced by repeated heatings and coolings while undergoing magnetic cycles of small range.

AUTOMATIC ELECTRIC RAILWAY-LAMPS.—Mr. H. J. Dowsing, in a letter to the *Electrical Review* of July 12 (London), claims to have invented a lamp for train use. A penny is dropped into the apparatus, a handle half turned, and the light immediately shines forth; and without any arrangement of clockwork trains, springs, etc., the time is controlled and the light goes out at the end of half an hour. An advantage which perhaps could not be so easily managed by clockwork is, that one can arrange the apparatus to burn any time, from two minutes to say ten hours, by one half-turn of the handle.

HEALTH MATTERS.

Water-Supply of Paris.

THE Paris correspondent of the *Lancet*, writing in the issue for June 22, says that a great danger to visitors to Paris is due to the insufficiency of the water-supply. Paris is in a most unfortunate position. It cannot be said that the water-supply is bad. On the contrary, at immense cost, Paris has secured one of the best water-

supplies enjoyed in any town of Europe. According to the last report, Paris was receiving 121,000 cubic metres of the Vannes water, 21,000 cubic metres derived from the Dhuis, and 5,000 cubic metres from the St. Maur springs,—in all, 147,000 cubic metres of pure and excellent spring-water. This, however, is not enough. The daily consumption is estimated at 158,000 cubic metres. The deficiency is not very great: still it is enough to compromise the whole town; for, when the store of good water is exhausted, the Seine water is provided, and this through the same channels and without warning. Thus, though a person may, as a rule, drink wholesome water, he will receive for a week or so, during the course of the year, water taken from the Seine, which is very likely to be contaminated. Again: a person may drink a glass of water in one quarter of Paris which is perfectly pure, while in another district he may, on the same day, get water that is certainly not free from the occasional presence of injurious organic matter. At the present moment, the supply of spring-water having reached a low ebb, the Seine water is turned on in four arrondissements. For twenty days these unfortunate districts are to receive only the Seine water; then three other arrondissements are to be served in the same way.

In the pavilion of the prefecture of the Seine, situated in the central court or garden of the exhibition, will be seen three glass tanks of water side by side. One receives the water of the Ourcq Canal, another of the Seine, and the third of the Vannes. The first two are more or less opaque, are of a green-yellowish tint, and vary more or less in aspect from day to day; but that which contains the water of the Vannes is always perfectly transparent, and never changes. Members of the Municipal Council have urged, so far in vain, that the water-supply should be increased. There are numerous projects, and recently a resolution was passed by the council, calling upon the legislative chambers to discuss at once the scheme for bringing the waters of the Avre to Paris.

That the Seine water may be dangerous will be obvious to all who are acquainted with the neighborhood of Paris. The intake for the supply is, of course, outside the town, and some little distance up the stream, but it is unpleasantly near the large manufactories of *poudrette*, or human guano. Also there are boats containing tanks which are filled with the contents of cesspools, and the manure is thus conveyed up the river to the works. A few years ago some scavengers, in their impatience to finish their day's toil, instead of conveying all the soil the barges contained to the works, simply threw a considerable portion over into the river. Fortunately this was discovered; and now there is a service of inspection organized both day and night, and careful watch is kept that these tank-barges should not again contaminate the water. But there are other causes of pollution, and it is an undeniable fact that many outbreaks of typhoid-fever in Paris have occurred about a fortnight after the substitution of Seine water for the usual and pure supply of water from the Vannes or the Dhuis. The question of water-supply is a very serious problem, which the French authorities should lose no time in settling.

THE NAPHTHA HABIT.—The *Medical Standard* calls attention to the growth of the "naphtha habit" among the female employees of rubber-factories. The inhalation of naphtha-fumes produces a peculiarly agreeable inebriation. Naphtha is used to clean rubbers, and is kept in large boilers, to the valve of which the female employees obtain access, and breathe the fumes. The habit was introduced from Germany, and is chiefly found in the New England States.

NOTES AND NEWS.

THROUGH the efforts of Dr. Filip Trybom, the Swedish Oyster-Culture Society is attempting to acclimatize the American oyster, imported from Connecticut, in several places along the coast of the province of Bohus. The young oysters seem to thrive well.

—The Victorian Government statist has published a return of the estimated population of the Australian colonies for 1888. In Victoria the estimated population on Dec. 31 last was 1,090,869; New South Wales, 1,085,356; Queensland, 387,463; South Australia, 313,065; western Australia, 42,137; Tasmania, 146,149; New Zealand, 607,380; making a total of 3,672,419 for the whole

of the colonies. During the year the population of the Australian colonies increased 120,668: the increase in Victoria being 54,750; New South Wales, 42,437; Queensland, 20,523; South Australia, 4,381; western Australia, 351; Tasmania, 3,671; New Zealand, 4,019.

— The rôle played by vegetation in determining the character of land surface is well shown in the so-called "banana-holes," so abundant in New Providence and other of the Bahama Islands, — holes varying in size from that of a pint cup to that of a large cistern. They are suggestive of pot-holes, but can have no such origin, and are evidently not cut out by the waves at any previous period of subsidence. Professor Charles S. Dolley, who recently examined these holes, could account for their formation in but one way, and that is through the action of decaying vegetable matter. Each of these holes contains large quantities of leaves and other vegetable substances, which, being kept wet by the heavy rains and by the fresh water elevated by each rising tide (almost all wells have a regular ebb and flow in these porous islands), undergo fermentative changes, by the products of which the soft calcareous rock is dissolved, and leaches away.

— *L'Economiste Française* says that on the 31st of December, 1887, the total length of railways worked in Europe amounted to 207,939 kilometres (the kilometre being equivalent to .621 of a mile), as compared with 201,468 kilometres in the preceding year. The increase in 1887 was therefore 6,471 kilometres, or at the rate of 3.21 per cent. The openings to traffic of the new lines which took place in 1887 increased by 2.67 per cent the length of the French system, while the percentage increase was 3.18 in Germany, 5.59 in Austria-Hungary, 3.71 in Belgium, 1.03 only in the United Kingdom, 3.92 in Italy, 2.96 in Russia. Roumanian lines increased 21.25 per cent in 1887. The extent of French railway lines opened in the course of 1887 represents 13.77 per cent of the total length of line opened in the whole of Europe during the same period. The participation of Germany in the increase of the European railway system is 18.87 per cent; Austria, 20.21 per cent; Belgium, 2.60 per cent; Great Britain and Ireland, 5 per cent; Italy, 6.76 per cent; and Russia, 12.67 per cent.

— Professor Edward H. Griffin of Williams College has accepted in Johns Hopkins University the office of dean, and professor of the history of philosophy, and he will enter upon his new duties at the beginning of the next session. He was graduated at Williams College in 1862, and subsequently pursued the study of theology in Princeton and in New York. Since 1872 he has been a professor in Williams College, having recently occupied the chair of intellectual and moral philosophy which bears the name of Mark Hopkins. Professor Griffin received the honorary degree of D.D. from Amherst in 1880, and of LL.D. from Princeton in 1888.

— It appears, according to *Nature*, that the meteoric stone found in Scania, and acquired by Baron Nordenskiöld for the National Museum at Stockholm, fell on April 6, and that its fall was accompanied by a red flash like lightning and a thunder-like detonation. It weighs eleven kilograms, and had made a hole thirty centimetres in depth; but, having recoiled, it lay on the level ground at the edge of the hole. The color is grayish black, and the fracture grayish white. From a hasty analysis made by Herr A. Wingardh of Helsingborg, the chief mass appears to consist of manganese, in which are yellow and gray particles of metal. The meteorite seems to have been in a red-hot state, being covered with a glazed coating of fused metal half a millimetre in thickness.

— The international congress which met in Paris in 1887 to make arrangements for the preparation of a photographic chart of the heavens expressed a wish that a similar congress might meet for the discussion of questions relating to celestial photography in general. M. Janssen and Mr. Common were asked to take such steps as might be necessary for the attainment of this object; and afterwards, by a ministerial decision at Paris, an organizing committee, with M. Janssen as president, was appointed. The arrangements have now been completed, and the congress will be held in Paris from Aug. 22 to Sept. 3. The aim of the congress will be to determine the methods which are most suitable for each branch of celestial photography, and the means by which the results obtained by these methods can be most effectually published and preserved.

— W. F. C. Hasson, a graduate of the United States Naval Academy, and now an assistant engineer of the United States Navy, has been detailed by the United States Navy Department to give instruction for the next three years in mechanics and engineering at Johns Hopkins University, and has already entered upon the duties of his new post.

— W. J. Stillman writes to *Nature*, June 27, from Canea, Crete, that he has just witnessed a curious case of bird instinct which seems worth recording. A gardener living at Zukaleria, three miles from Canea, caught in his garden a young but fully fledged sparrow, which he brought to the house of a friend with whom the writer was staying in Canea, leaving home early in the morning. He presented the bird to one of the children in the house, and it was put in a cage and hung at the window, where it seemed likely to be contented, losing its fright after a few hours. Late in the afternoon an old bird was noticed fluttering about the cage, apparently trying to get at the little one; and the young bird, on its appearance, became frantic to get out to the old one. It was evidently the mother of the young one, as the recognition was too cordial to have been owing to the interest of a strange bird; and when Mr. Stillman's daughter opened the cage, as she did after a little, they both flew off rapidly in the direction of Zukaleria. It is impossible that the old bird should have followed the gardener, as it would have been seen by them earlier in the day.

— The Botanical Society of France announces the following programme of the forthcoming botanical congress to be held in Paris: Tuesday, Aug. 20, opening sitting of the congress at 2 P.M., at the hotel of the Horticultural Society, 84 Rue de Grenelle; reception of foreign members at 8.30 P.M. Wednesday, Aug. 21, sitting at 9 A.M., devoted to the consideration of the first question, on the utility of an agreement between the different botanical societies and museums, for the purpose of drawing up charts of the distribution of species and genera of plants on the globe; and other communications, if time allows. Thursday, Aug. 22, excursion in the neighborhood of Paris. Friday, Aug. 23, sitting at 9 A.M., devoted to the consideration of the second question, on the characters furnished by anatomy for classification, and other communications if time allows; in the afternoon a visit to the botanical collections and laboratories of the Museum of Natural History, and of the other large scientific establishments in Paris. Saturday, Aug. 24, sitting at 9 A.M., miscellaneous contributions; in the afternoon a visit to the exhibition. Sunday, Aug. 25, banquet to the foreign botanists. During the following week several botanical excursions will also be arranged. Special arrangements with regard to railway-fares will be made in favor of botanists announcing their intention to be present to M. P. Maury, the secretary to the committee of organization, 84 Rue de Grenelle, before July 25.

— The sixty-second meeting of German naturalists and physicians will be held at Heidelberg from Sept. 17 to Sept. 23. One whole day will be devoted to excursions in the neighborhood, and on the evening of Sept. 23 the Castle of Heidelberg will be brilliantly illuminated.

— Satisfactory progress is being made with the preliminary arrangements in connection with the Electrical Engineering and Mechanical Inventions Exhibition, which is to be held in Edinburgh next year to commemorate the opening of the Forth Bridge. Support has been promised from this country, and some of the exhibits in the Paris Exhibition are to be transferred to Edinburgh.

— In 1887-88 the courses in astronomy at Johns Hopkins were so extended as to justify its being chosen as a principal subject by candidates for the degree of doctor of philosophy. A small observatory has been erected, and is fitted up with a meridian circle by Fauth & Co., a portable transit instrument by Troughton, a clock, a chronograph, and other subsidiary apparatus. In the dome of the physical laboratory is mounted an equatorial of 94 inches aperture, so fitted that the student can learn to make the usual determinations with the largest instruments of that class. The work in astronomy consists in a study of the history and practice of the subject, supplemented by instruction in the use of the instruments, and exercises in astronomical computation. During the year 1889-90 the courses are intended to cover a wider range of individual subjects than usual.

— Dr. Henry M. Hurd, now superintendent of the State Hospital for the Insane at Pontiac, Mich., in the neighborhood of Detroit, has been appointed superintendent of the Johns Hopkins Hospital. His life has been devoted to hospital service, and he has acquired distinction as an administrator, and also as a writer. He was graduated in arts and in medicine at the University of Michigan, and has twice been called by his *alma mater* to a professorship of medicine. He has already visited Baltimore, and will permanently assume his new responsibilities on the first of August next.

— Messrs. Dubois and François of Seraing, Belgium, have devised a system of drilling and breaking down rock and coal, to which they have given the name of "Bosseyage Mécanique." This system consists in first boring a hole, and then in breaking down the rock by a compound wedge formed of two half round outer portions, and a central tongue or arrow. The boring or jumping tool is taken off the drill spindle, and is replaced by a tup, by which the central wedge is driven forward by repeated blows until the rock gives way, and a part of it falls down.

— It is stated, apparently on good authority, that the money taken at the Eiffel Tower elevators between May 15 and July 2 has amounted to 1,298,944 francs, or nearly \$260,000. If these figures be correct (and there seems no reason to doubt them), the Eiffel Tower will prove as great a success as every other part of this wonderful centennial celebration.

— Mr. and Mrs. Lawrence Turnbull of Baltimore have founded in the Johns Hopkins University a lectureship of poetry in memory of their deceased son, Percy Graeme, who was born May 28, 1878, and died Feb. 12, 1887. The lectureship will bear the name of "The Percy Turnbull Memorial Lectureship." The income of the foundation is one thousand dollars per annum, and the first course of lectures may be expected in the session of 1889-90.

— Mr. Eugene Levering of Baltimore has offered to the Johns Hopkins University the sum of twenty thousand dollars for the construction of a building for the uses of the Young Men's Christian Association, and for the promotion in other ways of the interests of that society.

— On the motion of Lord Charles Beresford, a parliamentary return has been prepared, giving particulars of all breech-loading iron and steel guns that have failed after delivery for service. The return states that no guns have burst, or "blown out," or rendered the breech-piece useless, and no gun has been rendered useless by erosion, though between Dec. 31, 1885, and March 19, 1888, nine guns have had to be relined. The number of rounds fired from these nine before relining became necessary varied in the different instances from 114 to 1,480. Six guns were injured from other causes, and required retubing or relining. Only one Elswick gun has failed during the period covered by the report, the rest being all of Woolwich manufacture.

— Among the recent appointments of graduates of Johns Hopkins University we have learned of the following: William J. Alexander (fellow 1881-83, Ph.D. 1883), professor of English, University of Toronto; John C. Adair (graduate student 1887-89), professor of chemistry, Tarkio College, Missouri; Charles M. Andrews (fellow 1888-89, Ph.D. 1889), associate professor of history, Bryn Mawr College; Louis Bevier (fellow 1879-81, Ph.D. 1881), adjunct professor of modern languages, Rutgers College; Frank W. Blackmar (fellow 1888-89, Ph.D. 1889), professor of history and sociology, University of Kansas; Oskar Bolza (reader in mathematics, 1888-89), associate in mathematics, Clark University; Benjamin L. Bowen (Ph.D. 1888), associate professor of French and German, Ohio University; William M. Burton (fellow 1888-89, Ph.D. 1889), chemist, Standard Oil Company, Cleveland, O.; Morgan Callaway, jun. (fellow 1888-89, Ph.D. 1889), professor of English, South-Western University, Georgetown, Tex.; John Daniel (graduate student 1886-88), instructor in physics, Vanderbilt University; Paul J. Dashiell (A.B. 1887), instructor in organic chemistry, Lehigh University; Henry H. Donaldson (fellow 1881-83, Ph.D. 1885, associate and instructor 1885-89), assistant professor of neurology, Clark University; Charles G. Dunlap (graduate student 1883-86), associate professor of English, University of Kansas; Alfred Emerson (fellow 1882-84), professor of Greek, Lake Forest University, Illinois; Joseph A. Fontaine (Ph.D. 1886),

professor of modern languages, University of Mississippi; Samuel Garner (Ph.D. 1881), assistant professor of modern languages, United States Naval Academy; Richmond Harding (Ph.D. 1887), professor of Greek, Davidson College, North Carolina; James T. Hatfield (fellow 1888-89), professor of German, North-Western University, Illinois; Clifton F. Hodge (fellow 1888-89, Ph.D. 1889), fellow in psychology, Clark University; James G. Hume (graduate student 1887-88), Rogers fellow in ethics, Harvard University; H. C. G. von Jagemann (fellow 1883-84, Ph.D. 1884), assistant professor of German, Harvard University; David J. Lingle (graduate student 1887-89), assistant professor of biology, Tulane University; Warren P. Lombard (graduate student 1886-87), assistant professor of physiology, Clark University; James L. Love (graduate student 1884-85), Morgan fellow in mathematics, Harvard University; Thomas McCabe (fellow 1887-88, Ph.D. 1888), professor of modern literatures and director of German department, Indiana University; Archibald MacMechan (fellow 1887-88, Ph.D. 1889), professor of the English language and literature, Dalhousie College, Nova Scotia; Franklin P. Mall (fellow 1886-88, assistant in pathology 1888-89), adjunct professor of anatomy, Clark University; Philippe B. Marcou (instructor in French 1880-83), instructor in French, University of Michigan; John E. Matzke (Ph.D. 1888), collegiate professor of French, Bowdoin College; Colyer Meriwether (A.B. 1886), instructor in the English language and literature, Second Higher Middle School, Sendai, Japan; Chase Palmer (A.B. 1879, fellow 1880-82, Ph.D. 1882), professor of chemistry, Wabash College, Indiana; Mansfield T. Peed (graduate student 1883-85 and 1887-89), professor of mathematics, Emory College, Georgia; Edmund C. Sanford (fellow 1887-88, Ph.D. 1888), instructor in psychology, Clark University; Charles L. Smith (fellow 1887-88, Ph.D. 1889), instructor in history, Johns Hopkins University; Kirby W. Smith (Ph.D. 1889), instructor in Latin, Johns Hopkins University; Henry N. Stokes (fellow 1881-83, Ph.D. 1884), chemist, United States Geological Survey, Washington, D.C.; John N. Swan (graduate student 1888-89), professor of chemistry, Westminster College, Pennsylvania; W. Scott Thomas (A.B. 1889), professor of Greek and Latin, Chaffee College, California; Frederick J. Turner (graduate student 1888-89), professor of American history, University of Wisconsin; Amos G. Warner (fellow 1886-87, Ph.D. 1888), professor of political economy, University of Nebraska; John R. Wightman (fellow 1886-87, Ph.D. 1888), professor of French, Iowa College; Lucius E. Williams (graduate student 1885-89), assistant professor of chemistry, Swarthmore College.

— The simple and successful method by which a high chimney was recently overthrown is described by an exchange. The stack was one hundred feet high by ten feet square, and was on the Griswold Mills property, New Bedford, Mass. It was undermined by knocking out the bricks on the west and north sides, and shored up by planks placed in the apertures. These planks were liberally covered with tar and kerosene. When the time arrived for felling the chimney, they were fired. As they became sufficiently burned to cease to support the chimney, the mass settled out of the perpendicular to the north, and then cracked and fell with a crash to the ground. The bricks at the top were scattered over quite an area, while the iron coping was broken in quite a number of pieces. Along the length of the chimney to the height of sixty or seventy feet, masses of brick for a length of two feet or more clung together, and did not break up.

— An interesting series of experiments have been conducted, says *Building*, by the Dutch state railways, for the purpose of ascertaining exactly the relative resistance of various pigments to atmospheric changes and to the corrosive action of sea-water. The results have proved that the red-lead paints are less affected by atmospheric influence than those which are composed of the brown oxides of iron, on account of their adhering more closely to the metal, and of their possession of greater elasticity. It was also discovered that any sort of paint afforded an increased protection if the plates were pickled in hydrochloric acid before its application. The prevention of corrosion by salt water was found to be possible by the admixture of the oxide of some electro-positive metal, such as caustic lime and soda; but the efficiency of such a

covering was destroyed when its alkaline properties had been neutralized by the absorption of carbonic acid. Magnesia, however, was proved to be most serviceable, seeing that it does not absorb carbonic acid; and not only does it protect the iron from galvanic action, but it also does not affect the anti-fouling qualities of the paint.

— We have received the "Annual Report of the Board of Education and the Superintendent of Public Instruction of New Jersey" for the year ending Aug. 31, 1888. The report of the board occupies but a single page, and is of no general interest, while that of the State superintendent is mainly statistical. The State has increased its expenditure for schools of late, the increase for the year reported over the previous year being \$450,000; and all the documents before us show that the authorities are alive to the need of educational improvement. It is not many years since the schools of the State were first graded, and the results of the change are reported as gratifying. Manual training has been introduced in a few places, but sufficient time has not yet elapsed to determine its real value. The reports of the county and city superintendents form the largest and most interesting part of the volume before us, but we have not space to particularize any of them. They detail the various methods employed in the different localities, with suggestions on various points. The report contains a large amount of statistical matter conveniently classified and arranged.

— The official returns of the last vintage of France show a sensible improvement over that of the previous year. It produced, says the *Journal of the Society of Arts*, 30,102,151 hectolitres of wine, being an increase of 5,768,867 hectolitres over 1887, and a diminution of 1,601,000 hectolitres only on comparison with the average production of the previous ten years. There were in 1888 1,843,580 hectares under vines. There is an augmentation of production in 37 departments, and a decrease in 40 departments. It is in the southern districts that the improvement is the most marked, while the regions of the east and west are most unfavorable. The departments of the south, which were the first attacked by the phylloxera, have been also the first to reconstitute their vineyards by the introduction of American stocks. These efforts have been in general successful, and in a short time it is hoped this region may regain its former importance. The mildew has in most of these departments been combated by the employment of sulphate of copper. The abundant rains during a portion of the summer, and the fine weather which followed in September, contributed to the development of the grapes, and the gathering was effected in excellent conditions. On the contrary, in the colder regions, the persistent rains of summer checked the ripening of the grapes, and retarded the vintage until the approach of frost. The wine-growers had recourse, as in preceding years, to the employment of sugar to improve the quality and increase the produce of their wines. No less than 36,633 tons of sugar were used for this purpose in 1888. Larger quantities of foreign wines were also imported to meet the demand for mixing. The imports were, from Spain, 7,008,000 hectolitres; Italy, 1,082,305 hectolitres; and Algeria, 1,089,000 hectolitres. The deficiency in the production was also made up by the manufacture of wines from the marc with sugar added, and from dry imported raisins. Of the former, 2,388,000 hectolitres were made; and of the latter, 2,220,000 hectolitres. The production of wine in Algeria is largely on the increase. The quantity made in 1888 was 2,728,373 hectolitres, against 1,902,457 in 1887. There are over 88,326 hectares under culture with vines in Algeria.

— On the evening of Jan. 31 last, about 9 o'clock, says *Nature*, the self-recording barometer at the Deutsche Seewarte showed a sudden dip of about .04 of an inch, with a corresponding jump upwards a few minutes afterwards; and in the course of a day or two it was found that the barographs at other stations exhibited a similar phenomenon. Although the disturbance cannot be compared in any way to the air-wave caused by the Krakatoa eruption, yet the rapidity of its translation proved it to be a noteworthy meteorological phenomenon, and its behavior over central Europe is discussed in an article contributed to the *Annalen der Hydrographie und maritimen Meteorologie* for June, by Dr. E. Herrmann of the Deutsche Seewarte. The disturbance is traced from Keitum (latitude 54° 54'), where it occurred at 7h. 50 m. P.M., Berlin time, on Jan. 31, to Pola (latitude 49° 42'), which it reached at 4h. 38m. A.M.

on Feb. 1, having travelled at the rate of about 71 miles per hour. In an easterly and westerly direction the disturbance seems to have been confined to narrow limits. The barometer was high over southern Europe (30.5 inches), with minima (28.7 inches) over northern Finland, and between Iceland and Norway. There was no earthquake in Europe at the time, and the cause of the phenomenon remains at present unexplained.

— During the year 1886 the masonry and iron-work of the Madrid and Baudin bridges at Paris, says *Engineering*, were thoroughly cleansed by the process of M. de Liebhauer. These processes, chemical in their nature, were at first applied to the cleaning of limestones, but in these bridges materials of a different nature were dealt with. The surfaces to be cleansed are submitted to the action of a jet of mixed (dilute) hydrochloric and sulphuric acids, and left for two or three hours, when they are brushed, and finally washed with a water-jet. In the case of limestone, the hydrochloric acid unites with the calcium, forming chloride of lime, which is then decomposed by the sulphuric acid, forming a calcium sulphate; this being precipitated on the face of the stone, and containing all the impurities, which are then removed by the action of the brush and water-jet. In many cases this treatment will not succeed unless the stone is previously prepared, as the masonry becomes coated with a deposit of impurities contained in the atmosphere, which prevents the acids reaching the stones. In this case, before applying the acids, the stone is covered with a paste, consisting of a mixture of carbonate of soda and calcium hydrate, which is called "tolugene." It is spread over the masonry to a thickness of from one-half of a millimetre to one millimetre, and left there for from three-quarters of an hour to an hour, when the excess is washed down and brushed off, and the acids applied as described. In cleaning iron-work, the "tolugene" alone is used. It is spread over the work either with a trowel or brush, and in the course of an hour or so will have united with all the oil of the paint, leaving the red lead on the work in the form of a powder, which can be easily washed off with a jet of water. In cleansing brick, the work is first painted with a solution of ammonium fluoride, and this immediately afterward is treated with a jet of concentrated sulphuric acid, which liberates hydrofluoric acid; and this attacks the silicates, depriving them of their silica. The whole surface is afterward thoroughly washed with water.

— Reaumur, more than one hundred and fifty years ago, made quite extensive researches on clothes-moths; and, observing that they never attacked the wool and hair on living animals, he inferred that the natural odor of the wool, or of the oily matter in it, was distasteful to them. He therefore rubbed various garments with the wool of fresh pelts, and also wet other garments with the water in which wool had been washed, and found that they were never attacked by moths. He also experimented with tobacco-smoke and the odors of spirits of turpentine, and found that both of these were destructive to the moths; but it was necessary to close the rooms very tightly, and keep the fumes very dense in them for twenty-four hours, to obtain satisfactory results. Mr. C. H. Fernald (Bulletin No. 5 of the Hatch Experiment Station of the Massachusetts Agricultural College) has always found that any material subject to the attacks of moths may be preserved from them if packed away with sprigs of cedar between the folds. The odor of cedar is so disagreeable to them that they will not deposit their eggs where this odor is at all strong. Chests of cedar, or closets finished in the same wood, will protect clothing from moths as long as the odor is strong; but this is lost with age, and then they are no protection. It must be remembered that the odor of cedar, camphor, etc., only prevents the moth from laying her eggs on the fabrics; but if the eggs are laid before the garments are packed away with cedar, etc., the odor will not prevent the hatching of the eggs nor the destructive work of the larvae afterwards. Clothing may also be protected from moths by packing it in bags made of either stout paper or cotton cloth, if made perfectly tight, but this must be done before the moths appear on the wing in the spring.

— Professor Edward S. Morse of Salem, Mass., has received notice of his election as corresponding member of the Berlin Society of Ethnology, Anthropology, and Archeology, accompanied by the society's diploma.

SCIENCE:

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

PUBLISHED BY

N. D. C. HODGES.

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ANTS.

IN the second bulletin issued by the Hatch Experiment Station of the Massachusetts Agricultural College, an account was given of experiments made for the destruction of ants in lawns and walks, but no methods were given for those that find their way into houses, and become an intolerable nuisance because of their desire for sugar and other sweets. These are more frequently the small species, but what they lack in size they usually make up for in numbers. Mr. C. H. Fernald is inclined to the opinion that they enter the houses and discover the coveted articles by chance; that their scouts, in exploring, find these articles, not by keen sight or smell, but by mere accident. When one has found some choice dainty, she (these wingless workers are undeveloped females, not neuters as some have supposed) sips her fill, and at once starts for home, where by some means she communicates the information of the locality of untold treasures to others, which return with her; and they, in turn, appear to spread the information on their return home; and soon the throngs that come and go are sufficient to disturb the most amiable of housekeepers. Various remedies have been suggested, one of which is to draw a chalk-mark on the floor around the sugar-barrels or other articles to be protected from them. It is undoubtedly true that ants travel in a regular beaten track, as it were, by the sense of smell; and, if this be removed from the ground over which they travel, they are at a loss, and often wander around for some time before they find the trail again. They may be thrown off the trail by drawing a chalk-mark or even the finger across it. This is only a temporary protection, however; for sooner or later they will find their way across, and then travel goes on as uninterrupted as before.

It has been recommended to sprinkle sugar into a sponge and place it in their path, and, as it fills up with ants several times a day, immerse it in hot water to kill those adhering to it. This will undoubtedly prove successful if carefully followed up for some time; but, when we remember that the females are constantly laying eggs to produce workers which will take the places of those already destroyed, the task seems almost hopeless.

There can be no doubt that a better method would be to follow the ants carefully, and discover, if possible, where their nest is, and then destroy the entire community by making one or more holes down through the nest, and then pouring in a teaspoonful of bisulphide of carbon, carefully stamping down the ground afterwards to close the holes. The fumes of this substance will penetrate the nest in all directions, and destroy the entire community.

COLIC OF HORSES.

BULLETIN No. 2, Vol. II., of the Ohio Agricultural Experiment Station, is a comprehensive treatise on colic of horses, by Dr. H. J. Detmers, the veterinarian of the station.

It begins with a brief introduction, and a definition of what is understood by the term "colic," showing that the same is applied, not to a single disease, but to quite a number of morbid processes which have their seat in the digestive canal, and produce violent manifestations of pain. It then dwells at length on the various causes, and not only explains their action, or their effect upon the animal organism, but also draws attention to formerly overlooked facts, which throw light upon the origin of many cases of colic and the morbid processes of the same, which cannot be accounted for in any other way. It fully and comprehensively describes the symptoms, gives all the data necessary for the diagnosis and prognosis, and finally, in plain language, maps out a rational treatment, which is simple enough to be understood by everybody, and easy enough of application to be executed by any intelligent person. One plate illustrating the cause of certain morbid changes peculiar to horses and mules, and predisposing the same to the most frequent of these diseases, usually called colic, accompanies the treatise.

In the "Fifth Annual Report of the Ohio Agricultural Experiment Station" for 1886 (pp. 296-303), Dr. Detmers published a brief article on the causes of colic of horses. He then stated that his observations had confirmed Professor Bollinger's assertion that nearly every aged horse has an aneurism (a soft, pulsating tumor in an artery) in the anterior mesenteric artery, that such an aneurism is produced by the presence of a small worm (*Sclerostomum*

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THE TWO EVENTS of scientific interest in New York at this time are the judicial investigation into the possibility of killing a human being by electricity without inflicting torture, the death to be instantaneous, and the progress of the arrangements for the world's fair to be held here in 1892. At the electrical hearing, all shades of opinion have been expressed by those called upon to testify. By some it is maintained that death is by no means sure to follow the application of currents of high potential, that the action of the electricity is liable to be erratic, and that the attempt to put to death by electricity the criminal now under sentence may lead to unlawful torture. By others, including Mr. Edison, it is testified that death will be sure and painless on applying the strong electric currents proposed. The exhibition plans have progressed to the stage of a meeting of prominent citizens at the mayor's office, for a discussion of preliminaries. The daily papers of this city, as well as many of the more prominent ones of other cities, have taken up the subject energetically, and appear to be unanimously in favor of the project. One or two of the larger Western cities seem to think that the proper place for such an exhibition would be at one of the great cities of the West, somewhere nearer the centre of the continent than New York; but the general consensus of opinion seems to be that the metropolis of the continent is the place at which to fitly celebrate the four hundredth anniversary of that continent's discovery.

equinum) belonging to the family of *Strongylide*, and that in many, perhaps in a majority of cases, the existence of such an aneurism must be considered, if not the sole, at any rate the principal, cause of colic.

Although not much that is really new can be added to what was said in the annual report of 1886, and although no important discoveries have since been made, the simple fact that since that report was published such an aneurism has been found in every one of the sixteen horses that have been killed for anatomical purposes in the Veterinary College, or Veterinary Department of the Ohio State University, and that said aneurism was found not only in old horses, but also in young horses and in mules, will more than corroborate what was said two years ago, and be of interest to science, and of practical value to the farmer and horse-owner. As to the occurrence of the aneurism in young horses, Dr. Detmers states, that, among the sixteen horses and mules killed for anatomical purposes since the publication of the fifth annual report, were two young horses (one last year, and one this winter) which were each less than two years old, consequently mere colts, and that both had big aneurisms containing quite a large number of worms.

As colic is one of the most frequent diseases of horses, which, notwithstanding its frequent occurrence, is but little understood even by the majority of veterinarians, and consequently a disease which is seldom rationally treated, and perhaps oftener than any other a subject of quackery of the grossest kind; further, as it causes every year great losses, partially due to its often dangerous character, and partially to irrational treatment, — this brief treatise on colic, showing the causal connection between the aneurism and the morbid process, explaining its true causes, describing the symptoms, etc., giving a rational treatment, and pointing out the means of prevention, will be appreciated by farmers and horse-owners.

As to colic, it will, on the whole, be easier to ward off or to prevent the exciting than the predisposing causes. A prevention of the principal and most frequent exciting causes will be effected if the horse is always regularly fed; if the food is sound, wholesome, and digestible; if feeding a heavy meal immediately before and immediately after severe exercise is avoided; if no food that has a tendency to ferment, or that is rich in alkalies, is given; if the feeding of new grain and of new hay that has not yet passed through the so-called "sweating process" is avoided, or, where that cannot be done, if such new hay and new grain are fed only in small quantities, and then with a small pinch of salt added to each meal; if no icy food, or food covered with hoar-frost, is allowed to be eaten; if no ice-cold water is given to drink, or, when it cannot be avoided, only in small quantities, and never when the horse is perspiring or has an empty stomach; and, finally, if meal or bran that may be used as food is never given until it has been thoroughly moistened.

The principal predisposing cause, according to Dr. Detmers, — the aneurism in the anterior mesenteric artery, — can be ward off by preventing the worm-brood of *Sclerostomum equinum* from entering the digestive canal of the horse; but this, it seems, can only be accomplished if the horse is never allowed to drink any water but what is positively free from the worm-brood. That this will be difficult, will not need any explanation.

This bulletin will be sent free to any resident of Ohio on application to the Ohio Agricultural Experiment Station, Columbus, O.

QUARTZ FIBRES.

IN almost all investigations which the physicist carries out in the laboratory, he has to deal with, and to measure with accuracy, those subtle and to our senses inappreciable forces to which the so-called laws of nature give rise. Whether he is observing by an electrometer the behavior of electricity at rest, or by a galvanometer the action of electricity in motion; whether in the tube of Crookes he is investigating the power of radiant matter, or with the famous experiment of Cavendish he is finding the mass of the earth, — in these and in a host of other cases he is bound to measure with certainty and accuracy forces so small that in no ordinary way could their existence be detected; while disturbing causes which might seem to be of no particular consequence must be eliminated, if his experiments are to have any value. It is not too much to say that the very existence of the physicist depends upon the

power which he possesses of producing at will and by artificial means forces against which he balances those that he wishes to measure.

The weight of a single grain is not to our senses appreciable, while the weight of a ton is sufficient to crush the life out of any one in a moment. A ton is about 15,000,000 grains. It is quite possible to measure with unfailling accuracy forces which bear the same relation to the weight of a grain that a grain bears to a ton.

To show how the torsion of wires or threads is made use of in measuring forces, simply hang a straw horizontally by a piece of wire. Rest on the straw a fragment of sheet-iron. A magnet so weak that it cannot lift the iron is able to pull the straw round through an angle so great that the existence of the feeble attraction is plainly evident.

Ordinary spun glass, a most beautiful material, is about one-thousandth of an inch in diameter, and this would appear to be an ideal torsion-thread. Owing to its fineness, its torsion would be extremely small, and the more so because glass is more easily deformed than metals. Owing to its very great strength, it can carry heavier loads than would be expected of it. It has every good quality but one, and that is its imperfect elasticity. For instance: if a mirror is hung by a piece of spun glass, and if you turn the mirror twice to the right, and then turn it back again, a ray of light reflected from the mirror does not come back to its old point of rest, but oscillates about a point on one side, which, however, is slowly changing, so that it is impossible to say what the point of rest really is. Further, if the glass is twisted one way first, and then the other way, the point of rest moves in a manner which shows that it is not influenced by the last deflection alone: the glass remembers what was done to it previously. For this reason spun glass is quite unsuitable as a torsion-thread. It is impossible to say what the twist is at any time, and therefore what is the force developed.

So great has the difficulty been in finding a fine torsion-thread, that the attempt has been given up, and in all the most exact instruments silk has been used. The natural cocoon fibres consist of two irregular lines gummed together, each about one two-thousandth of an inch in diameter. These fibres must be separated from one another and washed. Then each component will, according to the experiment of Gray, carry nearly 60 grains before breaking, and can be safely loaded with 15 grains. Silk is therefore very strong, carrying at the rate of from 10 to 20 tons to the square inch. It is further valuable in that its torsion is far less than that of a fibre of the same size of metal, or even of glass, if such could be produced. The torsion of silk, though exceedingly small, is quite sufficient to upset the working of any delicate instrument, because it is never constant. At one time the fibre twists one way, and another time in another, and the evil effect can only be mitigated by using large apparatus in which strong forces are developed. Any attempt that may be made to increase the delicacy of apparatus by reducing their dimensions is at once prevented by the relatively great importance of the vagaries of the silk suspension.

The result, then, is this: the smallness, the length of period, and therefore delicacy, of the instruments at the physicist's disposal, have until lately been simply limited by the behavior of silk. A more perfect suspension means still more perfect instruments, and therefore advance in knowledge.

As nothing that Mr. C. V. Boys, F.R.S., knew of could be obtained that would be of use to him, he was driven to the necessity of trying by experiment to find some new material. The result of these experiments was the development of a process of almost ridiculous simplicity.

The apparatus consists of a small cross-bow, and an arrow made of straw with a needle-point. To the tail of the arrow is attached a fine rod of quartz which has been melted and drawn out in the oxyhydrogen jet. The operator holds a piece of the same material in his hand, and, after melting their ends and joining them together, — an operation which produces a beautiful and dazzling light, — all he has to do is to liberate the string of the bow by pulling the trigger with one foot; and then, if all is well, a fibre will be drawn by the arrow, the existence of which can be made evident by fastening to it a piece of stamp-paper.

In this way threads can be produced of great length, of almost any degree of fineness, of extraordinary uniformity, and of enormous strength. A quartz fibre one five-thousandth of an inch in diameter Mr. Boys had in constant use in an instrument loaded with about 30 grains. It has a section only one-sixth of that of a single line of silk, and it is just as strong. Not being organic, it is in no way affected by changes of moisture and temperature, and so it is free from the vagaries of silk which give so much trouble. The piece used in the instrument was about 16 inches long. Had it been necessary to employ spun glass, which hitherto was the finest torsion material, then, instead of 16 inches, he would have required a piece 1,000 feet long, and an instrument as high as the Eiffel Tower to put it in.

There is no difficulty in obtaining pieces as fine as this, yards long if required, or in spinning it very much finer. Dr. Royston Piggott has estimated some of them at less than one-millionth of an inch; but, whatever they are, they supply for the first time objects of extreme smallness the form of which is certainly known, and therefore one cannot help looking upon them as more satisfactory tests for the microscope than diatoms and other things of the real shape of which we know nothing whatever.

Since figures as large as a million cannot be realized properly, it may be worth while to give an illustration of what is meant by a fibre one-millionth of an inch in diameter. A piece of quartz an inch long and an inch in diameter would, if drawn out to this degree of fineness, be sufficient to go all the way round the world 658 times; or a grain of sand just visible—that is, one-hundredth of an inch long and one-hundredth of an inch in diameter—would make 1,000 miles of such thread. Mr. Boys has made use of fibres one ten-thousandth of an inch in diameter, and in these the torsion is 10,000 times less than that of spun glass.

As these fibres are made finer, their strength increases in proportion to their size, and surpasses that of ordinary bar steel, reaching, to use the language of engineers, as high a figure as 80 tons to the inch. While these fibres give us the means of producing an exceedingly small torsion, and one that is not affected by weather, it is also true that they do not show the same fatigue that makes spun glass useless. A peculiar property of melted quartz makes threads such as these a possibility. A liquid cylinder, as Plateau has so beautifully shown, is an unstable form. It can no more exist than can a pencil stand on its point. It immediately breaks up into a series of spheres. This is well illustrated in that very ancient experiment of shooting threads of resin electrically. When the resin is hot, the liquid cylinders which are projected in all directions break up into spheres. As the resin cools, they begin to develop tails; and when it is cool enough, i. e., sufficiently viscous, the tails thicken and the beads become less, and at last uniform threads are the result.

Now, in the case of the melted quartz, it is evident, that, if it ever became perfectly liquid, it could not exist as a fibre for an instant. It is the extreme viscosity of quartz, at the heat even of an electric arc, that makes these fibres possible. The only difference between quartz in the oxyhydrogen jet, and quartz in the arc, is that in the first you make threads, and in the second are blown bubbles.

CULTIVATION OF SUGAR IN PERSIA.

THE sugar-cane was introduced into Persia from its original home in Bengal at a very remote period. The first indisputable mention, says the United States consul at Teheran, of sugar by a Western writer, is that by Moses Chorenensis, in the fifth century, who describes the sugar-cane as he saw it growing on the banks of the Karun River, which joins the Shott-et-Arab at the head of the Persian Gulf. In the olden times, and as late as the fourteenth century, the sugar-cane was much cultivated in Susiana, the country intersected by the Karun River, and principally near Ahwaz and Jundi Shapur. Susiana was then one of the principal intermediate commercial stations between the present towns of Dizful and Shushter, and had its water from the Karun River by means of canals cut from the right bank some distance above Shushter, and from the Diz River by canals cut from the left bank, near the town of Dizful. With the decline of Jundi Shapur, in the

thirteenth century, the canals were neglected, and the cultivation of sugar-cane necessarily ceased. The present Ahwaz is a small village of about fifty houses, on a mound which covers the ruins of a part of the former town. Hundreds of millstones or wheels, formerly used for squeezing the juice out of the cane, are lying about in all directions. Persian historians do not ascribe the ruin of Ahwaz to the failure of the water-supply, but to scorpions. They say that an Indian merchant, with the view of raising the price, bought up all the sugar he could, and stored it for a year or two. When he opened his stores, all the sugar had turned into scorpions. Millions of scorpions came out of the sugar-store, all the inhabitants of Ahwaz fled, and the city has remained a desert from that day. There is still current in Persia a proverb which says, "At Ahwaz sugar-cane produces scorpions;" and one of the Persian poets, referring to the ringlets of his mistress, says, "They are as deadly as the scorpions of Ahwaz." The only district in Persia where sugar-cane is now cultivated is Mazanderan, which is the principal rice-producing district, and it was probably introduced during the last century. The sugar-cane in Mazanderan requires twelve months to ripen; but the canes are small and poor, few being ever found thicker than a man's finger, and the produce is of very inferior quality, being dark and moist. Both of these defects in all probability arose from want of skill in the cultivation and preparation of this valuable plant. The sugar is mostly consumed in the province; a considerable portion, however, is exported to Gilan, and some to Russia. The canes are planted in slips with two or three joints, in February or March, and ripen about eight or nine months after, having then a height of about five feet. One mill turns out per day about 200,000 pounds of juice, and about 60 to 70 pounds of sugar. The juice, therefore, yields 30 to 35 per cent of sugar. Only raw sugar is manufactured in Mazanderan. There are no sugar-refineries. The raw sugar is sold at the place of manufacture in the villages at from three farthings to a penny a pound, and in the markets of Sari and Barfush at from a penny to twopence a pound, according to quality. In some towns of Persia, principally Yezd and Isfahan, Jaru raw sugar was, up to a few years ago, refined, and made into loaf-sugar. The loaf-sugar made in Persia was seldom perfectly crystallized, and was on that account very soft; it was also more or less impure and dirty, the loaves not having been properly washed, and the green sirup not having been completely removed. The imported loaf-sugar becoming very cheap, sugar-refining in Persia ceased to be profitable. The general Persian word for "sugar" is *shakar*, "the sugar-cane" is *udi-i-shakar*, while "refined sugar" is *kand*, "a loaf of sugar" is *kelleh-i-kand*, "sugar-candy" is *nabat*. Persia is famous for its sugar-candy. This is made in the ordinary way, but is left to crystallize on strings in a bowl of earthenware or china. The strings are kept at the bottom of the bowl by a piece of lead, and at the top by strips of wood. When taken out of the bowl, it retains its shape, and is called *kasch-i-nabat*; i. e., a bowl of candy. Consul Schindler is of opinion that sugar-candy would thrive well in some districts of Persia and southern Persia, at altitudes of from 1,000 to 3,000 feet above the level of the sea. The plain of Bugh-i-Mailik, east of Shushter, at an elevation of 2,600 feet; that of Shapur, west of Shiraz, elevation 2,500 feet; those of Fihift and Rudbar, south of Kerma, elevation 2,500 feet,—appear to him to be eminently suited to the cultivation of the sugar-cane.

FRUIT-CANDYING INDUSTRY OF LEGHORN.

THE English consul at Leghorn says that that city occupies the first place in Italy, and perhaps throughout the Mediterranean, for the preparation of the candied citron and orange peel so largely used in all branches of confectionery—citron being brought for this purpose from Corsica, from Sicily, from Calabria and other southern provinces of Italy, from Tunis and Tripoli, and even from Morocco; while the candied peel of the fruit is exported to North America, to the United Kingdom, and to Hamburg for distribution throughout Germany. Sugar also is imported for the purpose of the manufacture from Egypt. The wood of the boxes in which the candied peel is packed comes from Trieste, and the immense earthenware vessels necessary for the saturation of the fruit in

sugar-sirup are made in the neighborhood of Florence. The oranges imported into Leghorn, whether for consumption or for candying, are nearly all brought from the islands of Sicily, Sardinia, and Corsica. In all the countries contributing the raw fruit for this industry, it is treated in the same manner for the over-sea passage. The fruit is simply halved and placed in hogsheds or large casks filled with a fairly strong solution of brine, the fruit being halved merely to insure thorough preservation of the rind by an equal saturation of the interior as well as the exterior surface. In these casks it arrives at the doors of the manufactory. The first process to which it is then subjected is the separation of the fruit from the rind. This is done by women, who, seated round a large vessel, take out the fruit, skilfully gouge out the inside with a few rapid motions of the forefinger and thumb, and, throwing this aside, place the rind unbroken in a vessel alongside them. The rind is next carried to large casks filled with fresh cold water, in which it is immersed for between two and three days to rid it of the salt it has absorbed. When taken out of these casks, the rinds are boiled, with the double object of making them tender and of completely driving out any trace of salt that may still be left in them. For this purpose they are boiled in a large copper caldron for a time varying from one to two hours, according to the quality of the fruit and the number of days it has been immersed in brine. When removed from this caldron, the peel should be quite free from any flavor of salt, and at the same time be sufficiently soft to absorb the sugar readily from the sirup in which it is now ready to be immersed. The next process to which the rind is subjected is that of a slow absorption of sugar, and this occupies no less than eight days. The absorption of sugar by fresh fruit, in order to be thorough, must be slow, and not only slow but also gradual; that is to say, the fruit should be at first treated with a weak solution of sugar, which may then be gradually strengthened, for the power of absorption is one that grows by feeding. The fruit has now passed into the saturating-room, where on every side are to be seen long rows of immense earthenware vessels, about four feet high and two feet and a half in extreme diameter, in outline roughly resembling the famed Etruscan jar, but with a girth altogether out of proportion to their height, and with very short necks and large open mouths. All the vessels are filled to the brim with citron and orange peel in every stage of absorption; that is to say, steeped in sugar-sirup of about eight different degrees of strength. This process almost always occupies eight days, the sirup in each jar being changed every day; and with vessels of such great size and weight, holding at least half a ton of fruit and sirup, it is clearly easier to deal with the sirup than with the fruit. To take the fruit out of one solution and to place it into the next stronger, and so on throughout the series, would be a very tedious process, and one, moreover, injurious to the fruit. In each of these jars, therefore, there is fixed a wooden well, into which, a simple hand suction-pump being introduced, the sirup is pumped from each jar daily into the adjoining one. A slight fermentation next takes place in most of the jars; but this, so far from being harmful, is regarded as necessary, but is not allowed to go too far. There is yet another stage, and that perhaps the most important, through which the peel has to pass before it can be pronounced sufficiently saturated with sugar. It is now boiled in a still stronger sirup of a density of forty degrees by the testing-tube; and this is done in large copper vessels over a slow coke fire, care being taken to prevent the peel adhering to the side of the vessel by gently stirring with a long paddle-shaped ladle. This second boiling occupies about an hour. Taken off the fire, the vessels are carried to a large wooden trough, over which is a coarse open wire netting. The contents are poured over this, and the peel distributed over the surface of the netting, so that the sirup, now thickened to the consistency of treacle, may drain off the surface of the peel into the trough below. The peel has now taken up as much sugar as is necessary. Next comes the final process, — the true candying, or covering the surface of the peel with the layer of sugar-crystals which is seen on all candied fruits. To effect this, a quantity of crystallized sugar (at Leghorn the same quality of sugar is used as is employed in the preparation of the sirup) is dissolved in a little water; and in this the now dried peel, taken off the wire netting, is immersed. The same copper vessels are used, and a mixture is again boiled over a slow fire.

A short boiling will suffice for this the last process; for the little water will quickly be driven off, and the sugar, upon cooling, will form its natural crystals over the surface of the fruit. Poured off from these vessels, it is again dried upon the surface of the wire netting, as before described. The candying is now complete, and the candied peel is ready for the packing-room, to which it is carried in shallow baskets. In the packing-room may be seen hundreds of boxes of oval shape and of different sizes, for each country prefers its boxes to be of a particular weight; Hamburg taking the largest (of 15 and 30 kilograms), the United States preferring smaller (of 10 and 12 kilograms), while England takes the smallest (of 5 kilograms), and one containing about 7 English pounds.

BOOK-REVIEWS.

Force and Energy. A Theory of Dynamics. By GRANT ALLEN. New York, Longmans. 8°. \$2.25.

IN this work the author presents a new view of some of the concepts of physical science. The current views he holds to be erroneous, and, though he says that he puts forth his work with profound diffidence, it is evident that he feels great confidence in its correctness. The essential point in his theory is the distinction he draws between force and energy, both of which he includes under the term "power." Power he defines as "that which initiates or terminates, accelerates or retards, motion." He then goes on to divide power into two varieties, — force, or aggregative power; and energy, or separative power. Among forces he reckons gravitation, cohesion, and chemical affinity; and among energies, heat, muscular power in many cases, and, in short, whatever separates bodies or particles from one another. This theory he first states in an abstract form, and afterwards proceeds to an account of the various actual concrete forces and energies in the universe, mechanical, chemical, and vital, endeavoring to show that his views are not only consistent with the known facts and laws of physical science, but are essential to a correct understanding of them.

As to the merits of Mr. Allen's views, we shall not now enter on any elaborate criticism; but certainly his use of terms is not according with the common practice either of scientists or of writers generally. The term "power" has always been used in philosophy to denote causality viewed hypothetically; as when we say that fire has power to melt wax, meaning that it will melt wax if the two are brought into contact. Force, on the other hand, is commonly used to mean what Mr. Allen calls power; namely, any cause that in any way affects motion. The distinction Mr. Allen draws between separative and aggregative powers is of course a real distinction; and yet he himself finds it impossible to maintain it with perfect consistency. Thus, he calls the motion of a falling body and the contraction of a cooling body, energies, although they are obviously aggregative; and his attempt to remove the inconsistency does not seem successful. We commend the work, however, to the attention of our readers, as it is well written and with earnestness of purpose, and will doubtless be provocative of thought.

Life of Charles Blacker Vignoles. By his son, Rev. OLINTHUS J. VIGNOLES. New York, Longmans. 8°. \$5.

THE subject of this memoir was one of the pioneers in railroad engineering, a work which in its early development required far more inventiveness and fertility of resource than is the case now; and his son has done well in laying an account of his life before the public. The book is well written, and with as much impartiality as could be expected in so near a relative of the hero. Vignoles was born in the last decade of the eighteenth century, and lived to the ripe age of eighty-two. He lost his parents in early life, and went to live with his maternal grandfather, with whom he afterwards had an irreconcilable quarrel. On reaching manhood, he entered the army, and by the aid of influential friends and his own merits rose in a few years to the position of lieutenant; but the conclusion of peace after Waterloo deprived him of the hope of further advancement, and he came over to America, and went to work as a civil engineer. He was employed in South Carolina and other Southern States, and by his experience there prepared himself for the more difficult work of railroad engineering, in which

he was soon to engage. Returning to England, he was in a few years employed as assistant in laying out and building the Liverpool and Manchester Railway, on which Stephenson's locomotive engine attained its memorable success. After a while he quarrelled with Stephenson, and parted from him; but he speedily found employment elsewhere, and for many years was occupied on various railroads in Great Britain and Ireland, and afterwards in Germany, Spain, and Brazil. He also built the suspension-bridge over the Dnieper River at Kief,—a structure half a mile long, the construction of which occupied seven years.

Such were the works performed by Vignoles; and they entitle him, as his biographer justly says, to a high position among the pioneers of modern engineering. The man had also some excellent personal qualities, such as honesty, energy, and conscientiousness in work; he had considerable literary skill, as the extracts from his diary and letters show; and he was considered a pleasant companion in society. On the other hand, as his biographer admits, his temper was not the best; and besides his quarrel with his grandfather, which is left unexplained, he had others with Stephenson and Brunel, which are passed over lightly in this book, but which were evidently not to his credit. He was also unskillful financially, and at one time lost eighty thousand pounds through his own imprudence, with the result that he had to begin all anew. In spite of his faults, however, he was a useful man; and the record of his life is an interesting story, particularly for members of the engineering profession and for all persons interested in railway history.

AMONG THE PUBLISHERS.

THE Catholic Publication Society Company will publish immediately "An Explanation of the Constitution of the United States of America," prepared for the use of Catholic schools and academies, by Francis T. Furey.

—Professor Max Müller's new book on "Natural Religion," being the Gifford lectures which he delivered at Glasgow last year, will be issued here in a few days by Longmans, Green, & Co.

—Lee & Shepard will publish shortly "Pens and Types, or Hints and Helps to Those who Write, Print, Speak, Teach, or Read," a volume full of new and original matter, by Benjamin Drew.

—The Forest and Stream Publishing Company have published a book on "Log Cabins and How to Build and Furnish Them," by William S. Wicks, illustrated with many plans and other illustrations.

—Messrs. Ginn & Co. have issued a catalogue and announcements for 1889. Although this catalogue is complete, yet, as it is primarily designed for high-school and college instructors, it gives but very little space to their common-school publications.

—The delegates of the Clarendon Press will shortly issue Mr. Oliver Aplin's "Birds of Oxfordshire;" the second volume (treating of electro-dynamics) of Messrs. Watson and Burbury's "Mathematical Theory of Electricity and Magnetism;" and a new edition of the fourth volume (on the dynamics of material systems) of Professor Bartholomew Price's "Treatise on Infinitesimal Calculus."

—Messrs. Trübner & Co. will publish, probably in October, "An Account of the Aborigines of Tasmania, their Manners, Customs, Wars, Hunting, Food, Morals, Language, Origin, and General Characteristics," by Henry Ling Roth, assisted by E. Marion Butler. The work will contain a chapter on the osteology, by Dr. J. G. Garson, and a preface will be contributed by Dr. E. B. Tylor. Numerous autotype plates, from original drawings made by Edith May Roth, will illustrate the text. The edition will be strictly limited to subscribers.

—Funk & Wagnalls have in preparation an "Encyclopædia of Missions." The encyclopædia proposes to give the history, geography, ethnology, and statistics of missions, from the apostolic times to the present. There will be full maps, diagrams, and a copious index. The best authorities on missions in this country and in England have been consulted, and the materials are

being furnished from all parts of the mission-field, by those best qualified to give the most accurate and complete information.

—Rand, McNally, & Co. have just issued the "Globe Series of School Maps," an entirely new series, newly engraved on a large scale, and corrected by the latest official and private data. The series comprises seven maps,—the United States, North America, South America, Europe, Asia, Africa, and the world on Mercator's projection. All excepting the map of the world (which is 58 by 41 inches) are 66 by 44 inches,—a size which permits of their use in the largest schoolrooms, where the details can be seen by the entire class.

—The annual report of the Ohio Agricultural Experiment Station will hereafter be issued in the form of a monthly bulletin, the issues of each calendar year constituting a volume. These bulletins will be consecutively paged, and the December number will contain an index to the entire series of the year, thus putting them in convenient shape for preservation for reference. By this change the results of the station's work for each season will be placed before the farmers of the State nearly or quite a year earlier than was possible when the annual report was issued in a single volume at the close of the year. The bulletins will be sent to any resident of Ohio free of charge, on application to the Experiment Station, Columbus, O.

—Messrs. Ginn & Co. announce for publication Sept. 1 the "Common School Song-Reader: A Music-Reader for Schools of Mixed Grades," by W. S. Tilden, teacher of music in the State Normal School, Framingham, Mass. This book is designed to adapt and apply the principles of the national system of musical instruction to those schools where the special conditions and grading are such that the full and regularly graded series cannot be so conveniently and effectively used. While containing an interesting repertory of school-songs, new and old, which fits it for use where systematic instruction in music is not attempted, it is especially intended for those schools in which the principles of elementary instruction and singing by note are to be taken up according to the most approved methods. Very full instructions for teachers are given at each step. Besides the work in the reading course, a collection of easy pleasing songs in one, two, and three parts (with bass clef), will be found.

—Robert Grant, the author of "The Confessions of a Frivolous Girl," has written the third article in *Scribner's* Fishing Series for the August issue, entitled "Tarpon Fishing in Florida." Mr. Grant, during the past winter, made a special trip to St. James City, Fla., to gather material for this article, and had the good fortune during the second day's fishing to capture an enormous tarpon, six feet long, and weighing 132 pounds. His description of his three-hours' fight with this tremendous fish is one of the most graphic pieces of sportman's literature of recent years. The article is fully illustrated from photographs made at the time, which have been carefully redrawn by Burns, Woodward, and others. President Henry Morton, in his article on "Electricity in Lighting," will describe the actual processes of manufacturing dynamos and incandescent lights as carried on in some of the largest factories in this country. The illustrations add very much to these descriptions, as they are made from instantaneous photographs taken while the men and women are at work.

—Messrs. Ginn & Co. announce for publication in the College Series of Greek authors, "Euripides, Iphigenia among the Taurians," edited by Professor Isaac Flagg. Professor Flagg's "Iphigenia" is not based upon any other commentary, but is an independent work, adapted to the needs of American colleges, and designed to facilitate the sympathetic study of this most charming and justly celebrated drama of Euripides. Since the play is well suited to be taken up as a first tragedy in a course of Greek reading, both the introduction and the notes have been written with especial regard to the enlightenment of beginners in the dramatic literature. At the same time, the finer insight and higher cravings of the advanced reader are constantly remembered. The introduction sets forth the celebrity of the play, with quotation in full of the most memorable classical passages that bear upon it; sketches the legend in its literary and popular development; ex-

plains the *rationale* of the plot with reference to the Aristotelian method of analysis; discusses the artistic structure of the tragedy as to prologue, narratives, *dénouement*, etc.; and gives a complete exposition of the metres and technique. In the notes, the grammatical material is presented with sufficient fullness, but mostly in a condensed form, with references to Goodwin and to Hadley & Allen; while the higher and more edifying matters of exegesis receive explicit treatment.

— A sketch of the colleges of Wisconsin by William F. Allen and David E. Spencer, recently published by the United States Bureau of Education, does not aim to give more than a very general outline of the career of each. In the sketch of the State University, only such matters are dwelt upon as have had a direct bearing upon the fortunes of the institution, and those which concern its relations to the educational movements that have taken place during its history, to the school system of the State, and to the practical progress of the people. While the graduates of the university are filling positions in many cases of greatest trust and usefulness, it is yet too early to estimate the precise drift and measure of the influence of the school upon the educational, political, and social life of the community. The older graduates are but now in the prime of life, in the midst of the years of greatest activity and influence. The university has not a sufficiently distant past to make its inner life of special interest as matter of history; nor does it fall within the scope of this sketch to trace, in any special manner, the influence of the graduates of the institution beyond its walls. There is considerable variety in the character of the chapters devoted to the five private colleges, since the sketches for the greater part are adapted from articles previously published; but the leading features in the character of each college, and the scope and tendency of its work, are indicated. Many other colleges have from time to time, especially in the first twenty-five or thirty years of our history, been established in Wisconsin. Of two of these which still exist, brief notices are given at the end of the work.

— With the June number commences the second volume of *Insect Life*. The last number was somewhat delayed by the preparation of the extensive indexes, which, however, will greatly increase the value of Volume I. Largely through the kindness of the authorities of the Government Printing-Office, the numbers during the past year appeared more regularly and promptly than anticipated, and it is hoped to continue this regularity through the coming volume. As stated in the salutatory to the first volume, however, the force of the Division of Entomology is so actively engaged during the larger part of the year with field-work and experimentation, that some lack of promptness in publication cannot but ensue. The publication of the bulletin met with even more favor than was hoped at the start, and almost no adverse comments have reached the editor's eye. The only criticism noticed was published in the review column of the *Atlantic Monthly*, in which slight exception was taken to the idea of the publication of a magazine by the government, which, by its free distribution, would compete on unfairly advantageous terms with private enterprises.

— A monograph on "Education in Georgia" has been prepared by C. E. Jones of Augusta, Ga., a son of the historian of that State, and late graduate student of Johns Hopkins University. This work was undertaken under the supervision of Dr. Herbert B. Adams, editor of the present series of Contributions to American Educational History, published by the United States Bureau of Education. Mr. Jones discusses the history of education in the State of Georgia. The paper opens with a sketch of the educational advantages afforded by the few schools which existed during the colonial epoch. The formation and conduct of academies after the revolutionary war are next considered. The author then addresses himself to a review of the elementary education afforded in the rural schools, the teachers of which were supported by the tuition derived from the attending scholars. Carefully, and with an exhaustive analysis of the laws and constitutional provisions bearing upon the subject, are the rise, development, and decadence of the "poor school system," noted. Prior to the late civil war, steps had

been taken to establish a system of common schools accessible to all white children between the ages of six and eighteen. They were, however, interrupted by the war, and it was not until some five or six years after the cessation of hostilities that the present system of public schools was inaugurated. Having discussed these preliminary topics, Mr. Jones turns his attention to the history and present status of higher education in Georgia, as represented in the university of the State and its branches, in various denominational colleges, and in special institutions designed to facilitate studies in law, medicine, theology, science, and art. All charitable and literary institutions ministering to intellectual, social, and moral improvement receive due consideration.

— The August *St. Nicholas* contains a full and interesting article by Dr. Jastrow, concerning the late Miss Laura Bridgman, with a portrait, — an exceedingly good likeness; Dr. Charles S. Robinson offers to mathematicians some curious speculations as to the present value of "An Egyptian Girl's Gold Necklace," if its value is regarded as having increased at compound interest for over three thousand years; and "Among the Florida Keys" is continued.

— In the August *Magazine of American History*, Dr. Everett's "Earliest American People" touches upon a theme dear to every antiquarian reader. "England's Struggle with the American Colonies," by Dr. William M. Taylor, is one of the prominent features of the number. The author traces the events in England, the needless misunderstandings and the crude mistakes which led to the war of the Revolution, and bestowed upon the Colonies their independence, and he does it so that fresh life is infused into the narrative; and one of the best condensed accounts of this part of our history extant is the result. Hon. J. O. Dykman concludes his series of papers of "The Last Twelve Days of Major André" in this number. J. P. Dunn, jun., contributes "The Founding of Post Vincennes," and Mr. William S. Pelletreau writes of "The Philippe Patent in the Highlands," furnishing portraits of Col. and Mrs. Roger Morris, and an interesting map. Mrs. Lamb's opening article is a vigorous pen-picture of the "Career of a Beneficent Enterprise," — now one hundred and forty years old, — "The General Society of Mechanics and Tradesmen," and this paper is profusely illustrated. A portion of the address of President Merrill E. Gates of Rutgers College, to the class of 1889, appears in these pages, entitled "Life and its Activities — the bearing of the Past on the Present and Future;" and there is a "Tribute to Mrs. Rutherford B. Hayes," from the editor. The frontispiece of the number is a portrait of Alexander Hamilton. "The Wit and Wisdom of Keokuk, Chief of the Sacs and Foxes," is one of the short articles; and an unpublished Washington letter is given to the reader in *Origina Documents*.

— The subject of a monograph, just published by the United States Bureau of Education, is the history of education in North Carolina. In this monograph Mr. Charles Lee Smith, who was trained in historical methods at the Johns Hopkins University, gives the results of a thorough and careful study of the educational history of his native State. For North Carolina this is pioneer work. The writer has traced the genesis and development of education in North Carolina from the first settlement of that State to the present time. For this purpose he is the first to exploit the colonial records, the publication of which was begun last year, and the early laws of the State. He has also utilized early newspaper files, and all the published biographical and historical works relating to his State to be found in the public libraries of Raleigh, Washington, and Baltimore, besides certain private collections and personal correspondence. The government is perhaps to be censured that schools were not earlier provided. It is an error, however, to suppose, as has been stated by some writers, that there were no good schools in the State previous to the Revolution, for it is shown that there were many creditable institutions, several having a wide reputation. The higher education has been principally treated in this sketch, although the history of primary and secondary instruction has not been neglected. The influence of certain classes of immigration and of institutions outside the State, especially of Princeton, which previous to the establishment of the

University of North Carolina was largely patronized by the young men of that State, is clearly shown. The sketch which is given of the University of North Carolina is the first full account of that institution which has ever been written. The writer thinks no institution of this country has a more honorable record; and it is claimed, that, in proportion to the number of its alumni, it stands second to none in the number of the distinguished public men it has given to the State and nation.

— Judge Benjamin F. Burnham has published through Messrs. Macdonald & Co. of Boston a little pamphlet bearing the title "Elsmere Elsewhere." What meaning there is in this title we are unable to see; but the book has considerable interest as marking the rapid change now in progress in this country in men's views of Christianity. The author's standpoint is essentially that of Mrs. Humphry Ward and other liberal English thinkers, and will probably seem pretty radical to many people in this country. He reviews the leading points of the Christian creed, and shows what changes are taking place or have already taken place in the interpretation of them; and all these changes he holds to be wise and beneficial. The style of the work is generally clear, and always concise, so that it presents a large amount of matter in a small compass. The appendix contains extracts from Mrs. Ward, Professor Huxley, and others, and also some curious notes about "demoniacal possession" and other "occult" phenomena.

— Of his purpose in building the Eiffel Tower, Mr. Eiffel says in the July number of the *New Review* (Longmans, Green, & Co.), "The beginning was difficult, and criticism as passionate as it was premature was addressed to me. I faced the storm as best I could, thanks to the constant support of M. Lockroy, then minister of commerce and industry; and I strove by the steady progress of the work to conciliate, if not the opinion of artists, at least that of engineers and scientific men. I desired to show, in spite of my personal insignificance, that France continued to hold a foremost place in the art of iron construction, in which from the earliest days her engineers have been more particularly distinguished, and by means of which they have covered Europe with the creations of their talent. Doubtless you are not ignorant that almost all the great engineering works of this nature, in Austria, Russia, Italy, Spain, and Portugal, are due to French engineers; and the traveller discovers with pride, as he passes through foreign countries, the traces of their activity and their science. The tower, 1,000 feet high, is, before every thing, a striking manifestation of our national genius in one of its most modern developments; and this is one of the principal reasons for its existence. If I may judge by the interest which it inspires, abroad as well as at home, I have reason to believe that my efforts have not been unavailing, and that we may make known to the world that France continues to lead the world, that she is the first of the nations to realize an enterprise

often attempted or dreamed of; for man has always sought to build high towers to manifest his power, but he soon recognized that the laws of gravity hampered him seriously, and that his means were very limited. It is owing to the progress of science, of the engineer's art, and of the iron industry, that we are enabled to surpass in this line the generations which have gone before us by the construction of this tower, which will be one of the characteristic feats of modern industry."

— The *Quarterly Journal of Economics* for July opens with a paper by Edward Cummings on "The English Trades-Unions," the special object of which is to show the present character and tendency of these associations. The writer points out that the policy of strikes is much less favored by the unions than it was a few years ago, and more care and intelligence shown in ordering strikes. On the other hand, the unions are assuming more and more the character of benefit societies, much to the gratification of the best friends of workingmen, and much to the dissatisfaction of the socialists, who charge the members of the unions with "apostasy to the cause of labor." Mr. Cummings also calls attention to the fact that the English unions really comprise but a small portion even of the skilled workmen of the country, but thinks these are "the flower of their respective trades." To students of the labor problem this article will be useful; and the same may be said of another in this number of the journal, that on "The International Protection of Workmen." It is a summary by A. C. Miller of a work by Dr. Georg Adler of Freiburg, with some account of the discussion the work has raised. Dr. Adler is anxious for legislation restricting the hours of labor, prohibiting the employment of children, and otherwise protecting workmen and their families against some of the evils they now suffer; but he thinks this cannot be enacted by any one nation independently, since the effect would be to raise the price of labor, and thus impede the nation in its competition with foreigners; hence he wants an international agreement on the subject, and believes that the end in view can be attained in no other way. Still another article on the labor question is "A New View of the Theory of Wages," by Stuart Wood, being a continuation of one published by him in the journal last October. We noticed the former article briefly at the time, and this one merely develops somewhat further the theory there laid down. The remaining article in this number is by Professor Dunbar, on "The Direct Tax of 1861." It gives a full and clear account of the levying and collection of the tax, so far as it was collected, and advises against refunding it to the States. The writer thinks it will be refunded, however, and he is probably right; for Congress appears to be searching for every available means of spending the money in the national treasury. Besides these longer articles, the journal has some interesting "Notes and Memoranda," including an account of the rise and fall of the French Copper Syndicate, which forms a curious chapter in industrial history.

INDUSTRIAL NOTES.

Natural Memory Method.

We take the following extract from an editorial in the *Journal of Education*, Boston: "We have taken no part in the Loiset-Fellows-Pick memory controversy, because we have not thought the advantage to be had from all systems of mnemonics sufficient to make it of interest to the world. Systems of the past have often required more effort to remember senseless things than would be required to remember the desired things. Any system based upon sounds, upon having letters stand for special figures, is impracticable for every-day affairs or educational uses. So long as mnemonics meant any thing of this kind, we merely examined them as curiosities; but within the past year John A. Shedd of New York City has discovered a purely original system, which is high above any unnatural system. It is simple (it may be understood in fifteen minutes), natural (all its principles may be learned in an hour by the dullest student), suggestive (two hours' practice makes it easy to use it every day, and almost literally every hour of life), comprehensive (it adapts itself to various subjects and branches of knowledge). There is not a moment's drudgery in learning it, not a feather-weight's burden in remembering it, and no perplexity in applying

it. It is educational and helpful, entirely apart from the memory phase of the subject."

Electrical Accumulators.

Judge Coxe, in the United States Circuit Court for the southern district of New York, rendered a decision on July 22, re-affirming his former judgment in favor of The Electrical Accumulator Company, in its suit against The Julien Electric Company to establish the validity of the Faure secondary battery patent, and denying The Julien Company's motion for a rehearing.

The Julien Company, in its argument, claimed, among other things, that it could manufacture batteries by the "dry-powder" process as good as or better than it was possible to manufacture under the Faure process by the use of a "paste;" and in this connection Judge Coxe very aptly says, "If it be true that Faure's batteries are inferior to or no better than others, the question naturally suggests itself, 'Why are not defendants content to use other batteries?' A rehearing is denied."

According to the views of The Electrical Accumulator Company, this gives the complete control of the manufacture and use of secondary batteries to that company, which owns the Faure-Sellon-Volckmar patents.

Publications received at Editor's Office,
July 1-6.

ALDEN's *Manifold Cyclopaedia of Knowledge and Language*. Vol. XIV. Exclude to Floyd. New York, J. B. Alden, 12^o. 50 cents.
BOONE, R. G. *Education in the United States; its History from the Earliest Settlements*. New York, Appleton, 402 p. 12^o. \$1.50
CROLL, J. *Stellar Evolution and its Relations to Geological Time*. New York, Appleton, 118 p. 12^o. \$1.
DAUBET, A. *La Belle-Nivernoise*. Ed. by James Boileau. Boston, Heath, 101 p. 16^o.
JOHNSON, W. W. *A Treatise on Ordinary and Partial Differential Equations*. New York, Wiley, 368 p. 12^o. \$3.50.
PENNSYLVANIA GEOLOGICAL SURVEY. *Atlas Northern Anthracite Field*. Part IV. Harrisburg, Geol. Surv. 8 maps. P.
SEYMOUR, T. D. *The First Three Books of Homer's Iliad*. Boston, Ginn, 103 p. 12^o. \$1.35.
SIZER, N. *Right Selection in Wedlock; Marriage not a Failure*. (The Human-Nature Library, No. 8.) New York, Fowler & Wells Co. 31 p. 16^o. 10 cents.
U. S. WAR DEPARTMENT. *Appendices Nos. 24, 27, 28, 29, 30, and 31 of Annual Report of the Chief Signal Officer, 1888*. Washington, Government, 57 p. 8^o.
VAN DAELL, A. N. *Pages Choieses des Mémoires du duc de Saint-Simon*. Boston, Ginn, 236 p. 12^o. 75 cents.

Wants.

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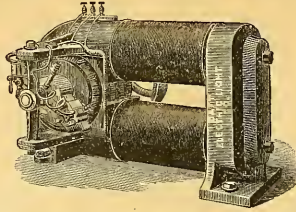
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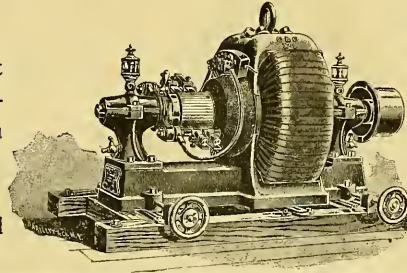
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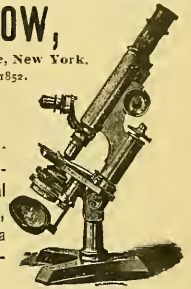
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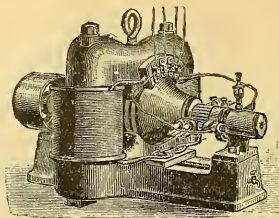
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ELECTRIC LIGHTING BY THE KNOWLES SYSTEM.

THIS system consists of a central station containing the dynamo for the generation of the current, which is then conducted to

lamp-use is obtained. It is maintained that this system is more economical, and that it allows of longer circuits, than that of direct distribution.

The system has been in operation for some time in Brooklyn,

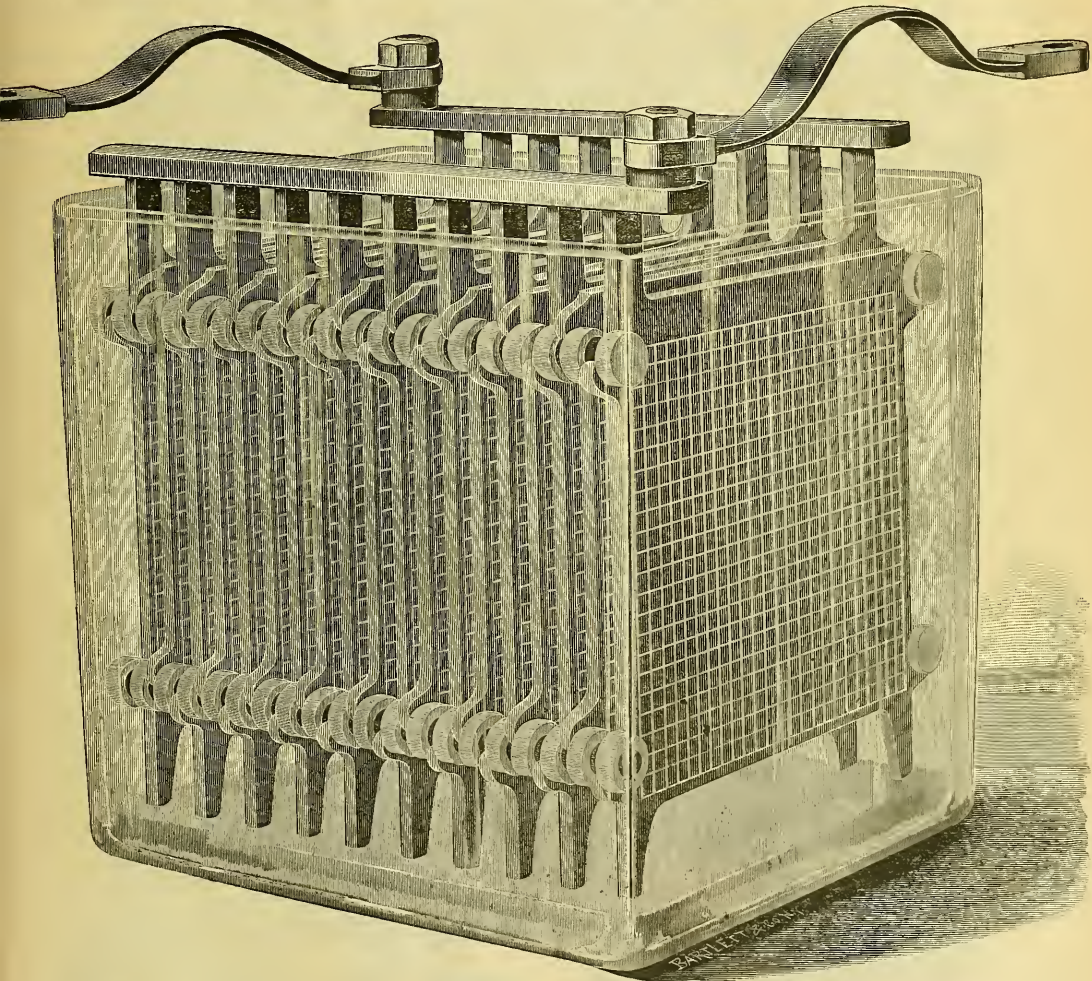


FIG. 1.—STORAGE-BATTERY OF MUTUAL ELECTRIC MANUFACTURING COMPANY, KNOWLES PATENT.

the several points at which it is to be used. At these points, instead of passing the current through the lamps, it is employed in storage-batteries; and from these storage-batteries the current for

one of the battery-plants being located at 187 Montague Street, the generating-station being on Graham Street, where will be found the necessary boilers, engines, dynamos, and regulators.

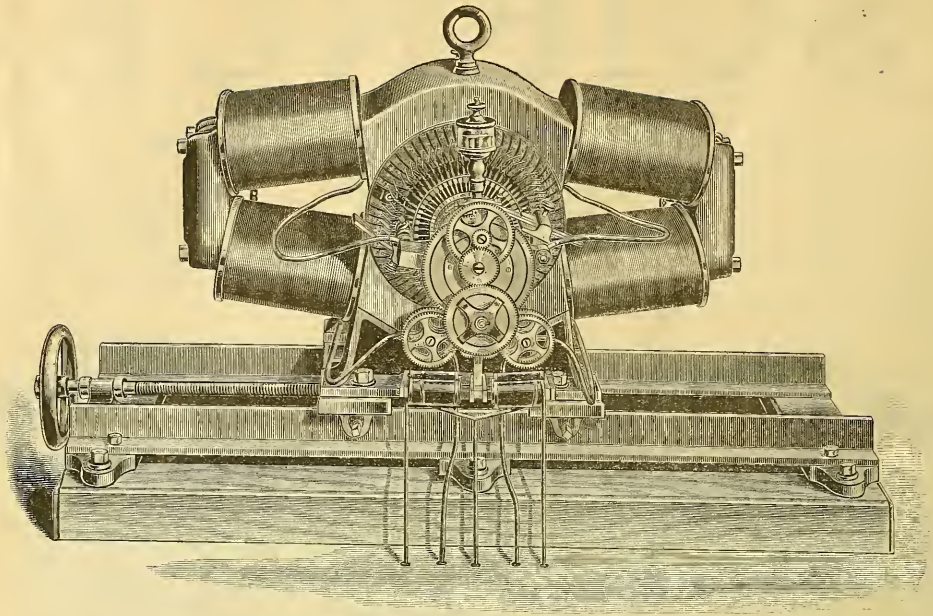


FIG. 2.—KNOWLES DYNAMO.

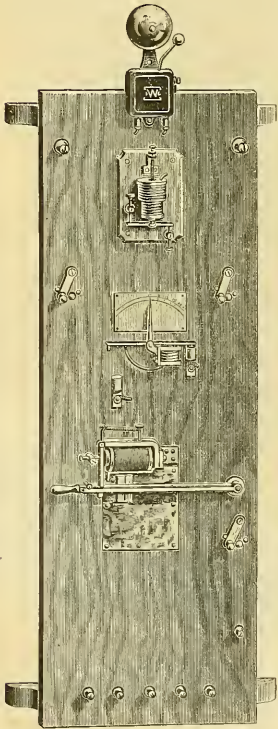


FIG. 3.—REGULATOR AND SAFETY CUT-OUT

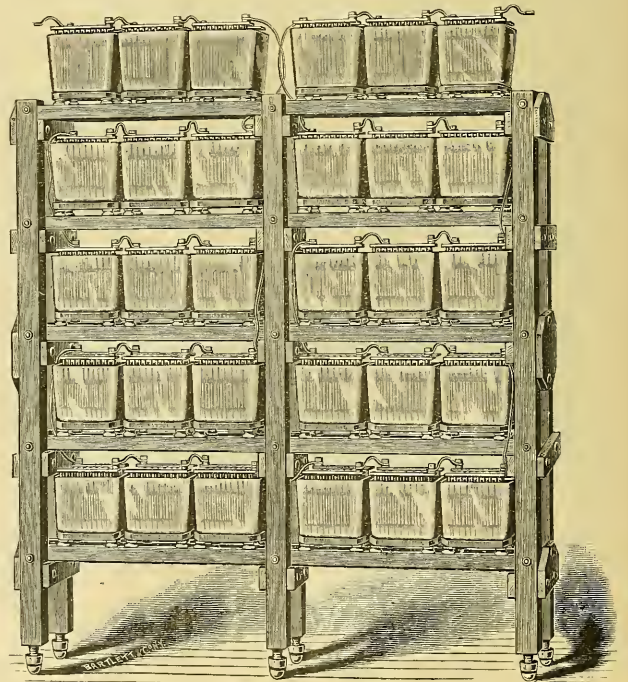


FIG. 5.—STORAGE-BATTERY AND RACK.

In charging a secondary battery from a dynamo, there is need of maintaining the charging current at a constant and suitable strength. For this purpose it will be seen in Fig. 2 that the dynamo is supplied with a clock-work arrangement, to one of the shafts of which the dynamo brushes are attached. Now, so long as the current strength is maintained, this clock-work remains

and has avoided the application of the active material as a paste. Fig. 1 shows the cell complete. The perforated plates of non-oxidizable alloy are made in two sheets, between which is held a layer of the active material, which is moulded to the right shape before being placed between the two halves of the retaining plates. When ready, the whole is assembled as shown in the illustration, flexible insulating-rod being passed through the hooks cast on the plates top and bottom.

In a later number we hope to give further details of this system, which is being introduced by the Mutual Electric Company of Brooklyn.

DESCRIPTION OF PERRET MOTORS AND DYNAMOS.

THE chief distinctive feature of these machines, manufactured by The Elektron Manufacturing Company, Brooklyn, N.Y., is the method of constructing the field-magnet, whereby the well-known advantages due to lamination and to the best quality of iron are secured, while the cost, which has heretofore been a bar to the commercial use of such magnets, is reduced nearly to that of forgings. This method of construction is peculiarly adapted to machines of small size; and by its use their efficiency is greatly increased, as a test will show. It may also be used to advantage in machines up to 10 horse-power, and even higher; as, by the ingenious shape and arrangement of the plates, a magnet of large size may be built up of comparatively small plates, which are stamped from sheet iron, no other machine-work being necessary. Eight sizes are now on the market, and others will be soon brought out.

In the $\frac{1}{2}$, $\frac{1}{4}$, and $\frac{1}{8}$ horse-power sizes, a magnet of the ordinary U-shape is used, in which the plates are so formed and put together that the limbs may be swung apart and clamped to the face plate of a lathe for winding, after which they are swung back and bolted fast. Fig. 1 shows one of these motors complete. Fig. 2 shows the magnet before winding.

In machines of $\frac{1}{2}$ horse-power and upwards, the double horse-shoe shape, with consequent poles, is used. These are shown in Fig. 3. Upon removing the two bolts which pass through the yoke, the top half of the magnet may be separated from the lower

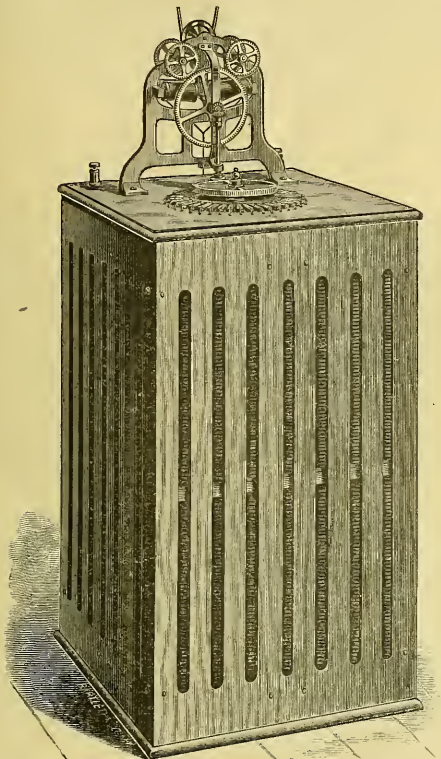


FIG. 4.—AUTOMATIC RHEOSTAT AND REGULATOR.

still; but upon any slight variation the contact-bar in the regulator (seen in the upper part of Fig. 3), consisting of a solenoid carrying a core with the contact-bar at its low end, closes a circuit passing through one or the other of the magnets of the dynamo clock-work, and causes this to move the brushes so as to increase or decrease the current, as need may be.

Again, to avoid the reversal of the polarity of the dynamo through an excessive fall in its current while charging the battery, which would allow of a reverse current passing through it from the storage-battery, the apparatus shown on the lower part of Fig. 3 is provided. On the occurrence of any sudden change, the lever shown near the bottom of the board would fall, breaking the main circuit, and causing the alarm-bell at the top to ring.

The practice of Mr. Knowles in charging is to start the dynamo on the resistances contained in the rheostat (Fig. 4), connecting the batteries when the due strength of current is reached, when, at the same time, the automatic contrivance shown on the top cuts out resistance in proportion.

The battery station in this Brooklyn plant is about half a mile from the dynamo station, but could be much farther away, it is maintained. Here the cells (Fig. 1) are arranged in batteries, as shown in Fig. 5. These racks are of wood, covered with insulating paint. Each cell rests on porcelain knobs, and the whole is again insulated from the floor.

In his secondary battery Mr. Knowles has several new features.

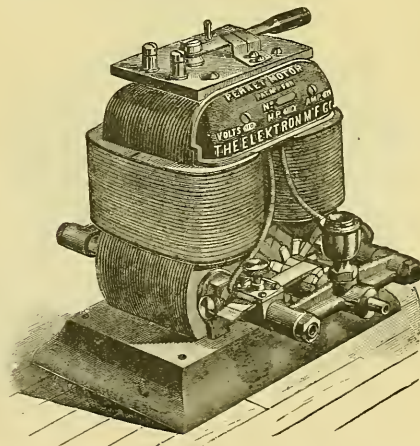


FIG. 1.

half. Each half is then attached to a lathe or other suitable machine, and wound by revolving it, after which they are put together and the bolts replaced, all these operations being very simple and very rapidly done.

One of the plates of which these magnets are built is shown in Fig. 4. Four of these are necessary to form the complete enclosure (see Fig. 5). It will be noticed that the plates interleave at the yoke, at which point their cross-section is enlarged, and they are

clamped firmly together by bolts. Little or no magnetic polarity is found at the yoke, which shows that the joint is good.

An important feature is the extremely low resistance of the magnetic circuit, which is due partly to superior quality of iron, the use of which is allowed by this construction, and partly to the smallness of the air-gap between the pole-pieces and the iron of the armature, which is of the drum type, with teeth. In the longi-

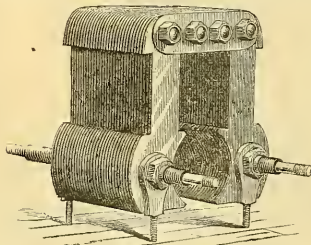


FIG. 2.

tudinal recesses formed by these teeth the armature-coils are wound.

This construction increases the efficiency, allows a large reduction in armature speed, and improves the regulation. As showing this, reference is made to the $\frac{1}{2}$ -horse-power machine (Fig. 3), which weighs complete, with pulley, seventy pounds, and has a commercial efficiency of from 80 to 85 per cent. As a shunt-wound dynamo, it will generate a current of 4 amperes at 110 volts when run at a speed of 1,800 revolutions per minute. The armature is wound with 7,000 inches of conductor, which is at the rate of about 64 inches per volt, at the remarkably low peripheral speed of 1,500 feet per minute. This showing is believed to be rarely equalled in machines of the largest size.

It may further be stated of the $\frac{1}{2}$ -horse-power machine that the drop in electro-motive force when run as a dynamo, and the varia-

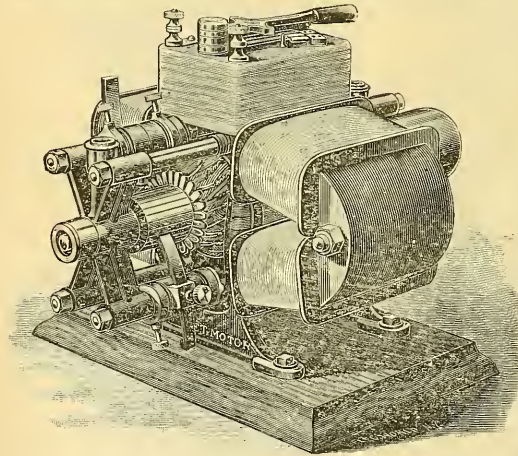


FIG. 3.

tion in speed as a motor, are less than 5 per cent between full load and no load (see details of Prony brake test). The motors are usually shunt-wound, and, on constant potential circuits, run at practically a constant speed, regardless of changes in load. In several instances parties requiring regulation so close that they believed compound winding absolutely necessary, have been induced to try the Perret shunt-wound machines, and have found them to fully meet the requirements.

This superior regulation is due to the fact, not always given its full weight, that the regulation of a shunt-wound machine depends

not only on the internal resistance of the armature-coils, but also to an equal if not larger degree on the intensity of the field: in other words, the lower the internal resistance of the armature-coils and the lower the resistance of the magnetic circuit, the closer the regulation.

This is clearly demonstrated by recent experiments with a $\frac{1}{2}$ -horse-power motor on a 110-volt circuit, which, with an armature without teeth (the air-gap being $\frac{7}{16}$ of an inch, and the internal resistance 11 ohms), showed a variation in speed of 15 per cent be-



FIG. 4.

tween no load and full load; while with an armature having teeth, by which the air-gap was reduced to $\frac{8}{32}$ of an inch, but with the internal resistance of armature increased to 20 ohms, it showed a speed variation of only 11 per cent. The same thing is shown by the performance of the $\frac{1}{2}$ -horse-power dynamo cited above, and also by details of the Prony brake test herewith.

Prony Brake Test $\frac{1}{2}$ -Horse-Power Perret Motor.

Brake H.P.	Speed.	Commercial Efficiency.
.146	2050	.73
.185	2048	.74
.219	2046	.745
.250	2044	.76
.290	2042	.77
.320	2040	.78
.365	2035	.79
.400	2030	.80
.432	2024	.81
.467	2018	.815
.501	2010	.82
.535	2000	.80
.569	1995	.78
.600	1990	.76

It is of course not claimed that the use of toothed drum armatures is new; but Mr. Perret finds that they possess some decided advantages over plain armatures, in addition to those already stated, as, for instance, positive driving of the coils, secured by winding them in the recesses. He also finds, that, when used with finely laminated field-magnets, they are free from some disadvantages experienced in other constructions. It is quite certain that such armatures, running in close proximity to solid pole-pieces, would produce heating effects therein which would be wasteful and very troublesome, to say the least. With laminated field-magnets, all trouble of this sort is avoided.

A strong point in favor of these machines is freedom from sparking at the commutator, provided this is kept in reasonably good condition; and the brushes, having been once set at the non-sparking point, require no changing under extreme changes in load. A rocker arm for the brush-holders is therefore unnecessary, and the machine is by so much the simpler. The reason for this will be readily seen by electricians in the foregoing description, and lies in the fact that the magnetism of the field is so powerful relatively to that of the armature, that no distortion of the lines of force is produced, and consequently the line of commutation remains unchanged regardless of changes in load.

A prominent electrician connected with another motor company was heard to remark, after testing some of these machines, that they were "harder to knock a spark out of than any he had ever seen." It may be said, further, that these machines have been

worked out very perfectly in every detail, and a high degree of mechanical skill is shown in their construction.

The armature-shafts are of high-grade steel. The bearings are all accurately fitted, and are very long in proportion to their diameter, being, in the smaller sizes, of hard composition, and in the larger, of babbit-metal. The commutators, which ordinarily are liable to great wear and damage, have received particular attention, being made of a special hard bronze. All the motors are provided with

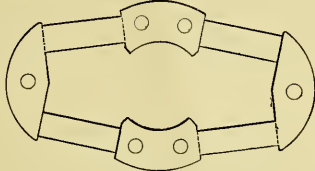


FIG. 5.

switches for starting and stopping, and in the larger sizes the switches are provided with resistance-coils,—an arrangement which is much handier than a separate rheostat.

In respect to simplicity, all parts needing attention, being in plain sight, are easily accessible. The armatures may be removed for inspection or any other purpose, and replaced in running order, in less than one minute. All parts are made to standard gauges, and are interchangeable.

CONSIDERATIONS CONCERNING SOME EXTERNAL SOURCES OF INFECTION IN THEIR BEARING ON PREVENTIVE MEDICINE.¹

No department of medicine has been cultivated in recent years with such zeal and with such fruitful results as that relating to the causes of infectious diseases. The most important of these results for preventive medicine and for the welfare of mankind is the knowledge that a large proportion of the causes of sickness and death are removable.

It is evident that efforts to preserve health will be most intelligently and effectually applied when they are based upon an accurate and full knowledge of the agencies which cause disease. Public and private hygiene, however, cannot wait, and fortunately has not waited, for the full light of that day, whose dawn has only begun to appear, when we shall have a clear insight into the causation of preventable diseases. Cleanliness and comfort demand that means shall be taken to render pure the ground on which we live, the air which we breathe, and the water and food with which we are supplied; and we must meet these needs without waiting to learn just what relation infectious agents bear to the earth, air, water, and food.

It is a fortunate circumstance that modern sanitation has been controlled so largely by the belief in the dependence of endemic and epidemic diseases upon organic impurities in the soil and in the water. Incomplete and even erroneous in many respects as are the views which have prevailed concerning the origin and spread of epidemic diseases by the decomposition of organic substances, the sanitary measures which have been directed toward the removal of filth have achieved great conquests in limiting the development and extension of many infectious diseases. The benefits which one commonwealth of this country has derived from the intelligent employment of public sanitary measures were clearly and forcibly presented before this association last year by Dr. Walcott, in his admirable address on State medicine.

While nothing should be said, or need be said, to lessen the importance of cleanliness for public health, it is important to bear in mind that hygienic cleanliness and æsthetic cleanliness are not identical. In water which meets the most severe chemical tests of purity, typhoid bacilli have been found. On the other hand, the air in the Berlin sewers, which certainly does not meet the most

modest demands of æsthetic cleanliness, has been found to be nearly or quite free from bacteria.

It needs only to be stated to be generally admitted that the scientific basis of preventive medicine must be the accurate knowledge of the causative agents of preventable diseases,—a knowledge which can be derived only from a careful study of all of the properties of these agents, the modes of their reception and of their elimination by the body, the circumstances which favor and those which retard or prevent their development and spread, their behavior in the various substances which surround us or which we take into our bodies, and the sources of infection, not only those which laboratory experiments show to be possible, but those which are actually operative.

So long as we were unacquainted with the living organisms causing infection, the means at our disposal for studying the etiology of infectious diseases were limited to the observation of all of the circumstances which we could determine regarding the origin and spread of these diseases. We could only infer what might be the properties of the infectious agents from the study of phenomena often obscure and difficult of interpretation. Chiefly by this method of investigation the science of epidemiology has been built up. It has established facts and laws no less of practical than of scientific importance; but it has left unsolved many problems, and has filled gaps with speculations. Admitted epidemiological facts are often open to various interpretations.

We are evidently at a great advantage when we can study the epidemiological facts with a knowledge of the substances which actually cause infection, and this we are now enabled to do for a limited number of the infectious diseases. This new method of research, which thus far has been mainly bacteriological, has aided us not so much by simplifying the problems of etiology, which still remain complicated enough, as by affording greater accuracy to the results.

It is my aim in this address to consider some results of the modern studies of pathogenic micro-organisms in their bearing upon preventive medicine, more particularly upon the sources of infection. It is, of course, impossible within the limits of the address to attempt a complete survey of this important field. Time will permit the presentation of only some of the salient points.

Infectious diseases are those which are caused by the multiplication within the body of pathogenic micro-organisms.

It has always been recognized that some infectious diseases, such as the exanthematous fevers, are conveyed directly from the sick to the healthy. It is not disputed that in these evidently contagious diseases the infectious germ is discharged from the body in a state capable at once of giving rise to infection.

In a second group of infectious diseases, of which malaria is the type, the infected individual neither transmits the disease to another person, nor, so far as we know, is capable of infecting a locality. Here there is reason to believe that the infectious germ is not thrown off in a living state from the body, but is destroyed within the body. In this group the origin of infection under natural conditions is always outside of the body.

In a third group there is still dispute whether the disease can be transmitted directly from person to person, but all are agreed that the infected individual can infect a locality. It is especially fortunate that the bacteria which cause cholera and typhoid-fever, the two most important representatives of this group of so-called miasmatic contagious diseases, have been discovered and isolated in pure culture. These are the diseases about whose origin and epidemic extension there has been the greatest controversy. They, above all other diseases, have given the impulse to public sanitation during the last half-century. The degree of success with which their extension in a community is prevented is an important gauge of the excellence of the local sanitary arrangements. A clear comprehension of the origin and spread of these diseases signifies a solution of many of the most vexed and important problems of epidemiology and of State hygiene.

It is difficult to understand how those who accept the discovery that the bacteria causing typhoid-fever and cholera have been found and cultivated from the stools of patients affected with these diseases can doubt that these patients are possible sources of contagion, or can entertain the view, once so widely prevalent, that the

¹ Address in State medicine, delivered before the American Medical Association, in Newport, on Friday, June 28, by William H. Welch, M.D., professor of pathology in Johns Hopkins University, Baltimore.

infectious germs of these diseases are discharged from the body in a condition incapable of producing immediate infection. In an address delivered on another occasion, I have endeavored to present the considerations which reconcile the comparative infrequency of direct contagion for these diseases with the belief in the elimination of the causative germs in an active state from the body, and have there pointed out several well-known factors which determine the frequency of conveyance of an infectious disease by contagion. There are reasons, some of them very obvious, why diseases in which the infectious substances are operative only when received into the digestive tract, and are discharged usually only with the feces, are less likely to be transmitted by immediate contagion than those diseases in which the virus is thrown off from the skin on epidermal scales.

But the field of operation of direct contagion for those so-called miasmatic contagious diseases is at most a restricted one, and the chief sources of infection are outside of the body from which primarily the infectious germs may have been derived. It is to these external sources of infection, which are of such importance in public hygiene, that I wish especially to direct attention.

A full comprehension of the sources of infection is, of course, to be obtained only by a detailed study of the etiology of the individual infectious diseases; but this is, of course, impossible within the limits of an address. It may, however, be useful to present some of the facts which have a general bearing upon the subject. Let us consider, then, from the point of view of modern bacteriological studies, what rôle in harboring or transporting infectious agents may be played by those substances or media with which we necessarily come into intimate contact, such as the air, the ground, the water, and our food.

It is universally admitted that many infectious agents may be transported by the air, but the extent of danger from this source has often been exaggerated. It is a popular error to suppose that most of the minute particles of dust in the air either are or contain living organisms. The methods for determining the number and kind of bacteria and fungi in the air are now fairly satisfactory, although by no means perfect. These have shown that while the number of living bacteria and fungi in the atmosphere in and around human habitations cannot be considered small, still it is greatly inferior to that in the ground or in most waters. Unlike fungus spores, bacteria do not seem to occur to any extent in the air as single detached particles, which would then necessarily be extremely minute, but rather in clumps or attached to particles of dust of relatively large size. As a result, in a perfectly quiet atmosphere these comparatively heavy particles which contain bacteria rapidly settle to the ground or upon underlying objects, and are easily filtered out by passing the air through porous substances, such as cotton-wool or sand. Rain washes down a large number of the bacteria from the air. That the air bacteria are derived from the ground, or objects upon it, is shown by their total absence, as a rule, from sea-air at a distance from land, this distance naturally varying with the direction and strength of the wind.

A fact of capital importance in understanding the relations of bacteria to the air, and one of great significance for preventive medicine, is the impossibility of currents of air detaching bacteria from moist surfaces. Substances containing pathogenic bacteria, as, for instance, sputum containing tubercle bacilli, or excreta holding typhoid bacilli, cannot, therefore, infect the air unless these substances first become dry and converted into a fine powder. We are able to understand why the expired breath is free from bacteria and cannot convey infection, except as little particles may be mechanically detached by acts of coughing, sneezing, or hawking. Those bacteria the vitality of which is rapidly destroyed by complete desiccation, such as those of Asiatic cholera, evidently are not likely to be transported as infectious agents by the air, if we except such occasional occurrences as their conveyance for a short distance in spray.

The only pathogenic bacteria which hitherto have been found in the air are the pus-organisms, including the streptococcus found by Prudden in a series of cases of diphtheria and tubercle bacilli; but no far-reaching conclusions can be drawn from the failure to find other infectious organisms, when we consider the imperfection

of our methods, and the small number of observations directed to this point. The evidence in other ways is conclusive that many infectious agents — and here the malarial germ should be prominently mentioned — can be, and often are, conveyed by the air. While we are inclined to restrict within narrower limits than has been customary the danger of infection through the air, we must recognize that this still remains an important source of infection for many diseases. All those, however, who have worked practically with the cultivation of micro-organisms, have come to regard contact with infected substances as more dangerous than exposure to the air; and the same lesson may be learned from the methods which modern surgeons have found best adapted to prevent the infection of wounds with the cosmopolitan bacteria which cause supuration.

We are not, of course, to suppose that infectious germs floating in the form of dust in the atmosphere are dangerous only from the possibility of our drawing them in with the breath. Such germs may be deposited on substances with which we readily come into contact, or they may fall on articles of food where they may find conditions suitable for their reproduction, which cannot occur when they are suspended in the air, in consequence of the lack of moisture.

From the facts which have been mentioned concerning the relations of bacteria to the air, what points of view present themselves to guide us in preventing infection through this channel? Surely something more than that this purpose is accomplished simply by abolishing foul odors.

Certain indications are so plain as to need only to be mentioned in this connection, such as the disinfection and removal, as far as possible, of all infected substances, — an indication which applies equally to all channels of infection, and which is much easier to mention than it is to describe how it shall be realized. But there are two indications which apply especially to the prevention of the transportation of disease-germs by the air. One is the necessity of guarding, so far as practicable, against the desiccation, when exposed to the air, of substances which contain infectious germs not destroyed by drying; and another is free ventilation.

For no disease is the importance of the first of these indications so evident and so well established as for tuberculosis, the most devastating of all infectious diseases. Against this disease, formidable as it may seem to cope with it, the courageous crusade of preventive medicine has begun, and is destined to continue.

It is now generally recognized that the principal, although not the sole, sources of tuberculous infection are the sputum of individuals affected with pulmonary tuberculosis, and the milk of tuberculous cows. Cornet, who has made a laborious and most instructive experimental study of the modes and dangers of infection from tuberculous sputum, has also elaborated the practical measures which should be adopted to diminish or annihilate those dangers. These measures have been so recently and so widely published in medical journals, and so clearly presented before a section of this association, that I mention them only to call the attention of practitioners of medicine to their importance, and to emphasize the fact that they are based chiefly upon the principle that infectious substances of such nature as tuberculous sputum should not be allowed to become dry and converted into dust when exposed to the air.

By means of free ventilation, disease-producing micro-organisms which may be present in the air of rooms are carried away, and distributed so far apart that the chance of infection from this source is removed, or reduced to a minimum. It is a well-established clinical observation that the distance through which the specific microbes of such diseases as small-pox or scarlatina are likely to be carried from the patient by the air in such concentration as to cause infection, is small, usually not more than a few feet, but increases by crowding of patients and absence of free ventilation. The well-known experiences in the prophylaxis and treatment of typhus-fever are a forcible illustration of the value of free ventilation.

It is, of course, not to be understood that by ventilation we accomplish the disinfection of a house or apartment. Ventilation is only an adjunct of such disinfection, which, as already mentioned, is of first importance. Time will not permit, nor is it in the plan

of this address, to discuss the details of such questions as house disinfection; but I may be permitted to say that the methods for disinfecting apartments have been worked out on a satisfactory experimental basis, and should be known, at least, by all public-health officers. Whether it be pertinent to this occasion or not, I cannot forbear to add my protest to that of others against placing reliance upon any method hitherto employed of disinfecting houses or apartments by fumigation; and I would furthermore call attention to the lack, in most cities of this country, of public disinfecting establishments, such as are in use with excellent results in most cities of Europe, and which are indispensable for the thorough and convenient disinfection of clothing, bedding, carpets, curtains, etc.

After this short digression, let us pass from the consideration of the air as a carrier of infection to another important external source of infection; namely, the ground. That the prevalence of many infectious diseases depends upon conditions pertaining to the soil cannot be questioned; but the nature and the extent of this influence have been and are the subjects of lively discussion. The epidemiological school led by Pettenkofer assigns, as is well known, to the ground the chief, and even a specific and indispensable, influence in the spread of many epidemic diseases, particularly cholera and typhoid-fever. The statistics, studies, and speculations of epidemiologists relating to this subject probably surpass in number and extent those concerning any other epidemiological factor. The exclusive ground-hypothesis has become an ingenious and carefully elaborated doctrine with those who believe that such diseases as cholera and typhoid-fever can never be transmitted by contagion. These authorities cling to this doctrine with a tenacity which indicates that on it depends the survival of the exclusively localistic dogma for these diseases.

To all who have not held aloof from modern bacteriological investigations it must be clear that views which have widely prevailed concerning the relations of many infectious germs to the soil require revision. The question is still a difficult and perplexing one; but on some hitherto obscure or misunderstood points these investigations have shed light, and from the same source we may expect further important contributions to a comprehension of the relations of the ground to the development of infectious diseases.

The ground, unlike the air, is the resting or the breeding place of a vast number of species of micro-organisms, including some which are pathogenic. Instead of a few bacteria or fungi in a litre, as with the air, we find in most specimens of earth thousands, and often hundreds of thousands, of micro-organisms in a cubic centimetre. Fraenkel found the virgin soil almost as rich in bacteria and fungi as that around human habitations. This vast richness in micro-organisms belongs, however, only to the superficial layers of the earth. Where the ground has not been greatly disturbed by human hands, there is, as a rule, about three to five feet below the surface an abrupt diminution in the number of living organisms; and at the depth where the subsoil water usually lies, bacteria and fungi have nearly or entirely disappeared. Fraenkel, who first observed this sudden diminution in the number of micro-organisms at a certain level beneath the surface, explains this singular fact by the formation at this level of that sticky accumulation of fine particles, consisting largely of bacteria, which forms the efficient layer in large sand-filters for water. Of course, the number of bacteria, and the depth to which they penetrate, will vary somewhat with the character, especially the porosity, of the soil, and its treatment; but the important fact that all, or nearly all, of the bacteria and fungi are retained in the ground above the level of the subsoil water, will doubtless hold true for most situations.

The conditions are not favorable for the multiplication of bacteria in the depth of the ground, as is shown by the fact that in specimens of earth brought to the surface from a depth of a few feet the bacteria which are at first present rapidly multiply. What all of the conditions are which prevent the reproduction of bacteria in the deep soil has not been ascertained, but the fact necessitates similar precautions in the bacteriological examination of the soil as in that of water.

We have but meagre information as to the kinds of bacteria present in the ground in comparison with their vast number.

Many of those which have been isolated and studied in pure culture possess but little interest for us, so far as we know. To some of the micro-organisms in the soil appears to be assigned the *role* of reducing or of oxidizing highly organized substances to the simple forms required for the nutrition of plants. We are in the habit of considering so much the injurious bacteria, that it is pleasant to contemplate this beneficent function so essential to the preservation of life on this globe.

Among the pathogenic bacteria which have their natural home in the soil, the most widely distributed are the bacilli of malignant oedema and those of tetanus. I have found some garden-earth in Baltimore extremely rich in tetanus bacilli, so that the inoculation of animals in the laboratory with small bits of this earth rarely fails to produce tetanus. In infected localities the anthrax bacillus, and in two instances the typhoid bacillus, so far as it was possible to identify it, have been discovered in the earth. There is reason to believe that other germs infectious to human beings may have their abiding-place in the ground; certainly no one doubts that the malarial germ lives there. As the malarial germ has been shown to be an organism entirely different from the bacteria and the fungi, we cannot apply directly to its behavior in the soil, and its transportation by the air, facts which have been ascertained only for the latter species of micro-organisms; and the same precautions must be observed for other diseases with whose agents of infection we are not acquainted, as, for instance, yellow-fever.

In view of the facility with which infectious germs derived from human beings or animals may gain access to the soil, it becomes a matter of great importance to determine how far such germs find in the soil conditions favorable for their preservation or their growth. We have, as is well known, a number of epidemiological observations bearing upon this subject; but, with few exceptions, these can be variously interpreted, and it is not my purpose to discuss them. The more exact bacteriological methods can, of course, be applied only to the comparatively small number of infectious diseases, the causative germs of which have been isolated and cultivated; and these methods hitherto have been applied to this question only imperfectly. We cannot regard the soil as a definite and unvarying substance in its chemical, physical, and biological properties. What has been found true of one kind of soil may not be so of another. Moreover, we cannot in our experiments bring together all of the conditions in nature which may have a bearing on the behavior of specific micro-organisms in the soil. We must therefore be cautious in coming to positive conclusions on this point on the basis of experiments, especially those with negative result. With these cautions kept constantly in mind, the question, however, is one eminently open to experimental study.

The experiments which have thus far been made to determine the behavior of infectious micro-organisms in the ground have related especially to the bacilli of anthrax, of typhoid-fever, and of cholera; and, fortunately, these are the diseases about whose relations to the ground there has been the most discussion, and concerning which we are most eager to acquire definite information.

(Continued on p. 78.)

NOTES AND NEWS.

ACCORDING to the Calcutta correspondent of the London *Times*, a herd of 100 wild elephants has been captured in Mysore by Superintendent Sanderson. The same correspondent states that there were 6,000 deaths by snake-bites in the North-West Provinces last year. In Madras, 10,096 cattle were killed by wild animals, and the loss of human life by snakes and wild animals was 1,642.

—The United States Bureau of Education has issued as circular of information No. 7, 1888, in the series of contributions to American educational history, edited by Herbert B. Adams, "A History of Education in Florida," by George Gary Bush, Ph.D.

—The preparations for the Niagara Falls electrical convention, Aug. 6, 7, and 8, have been completed. The convention will be welcomed to Niagara Falls by the Hon. W. C. Ely, who, in his salutatory address, will touch upon the utilization of water-power for electric-light purposes. President E. R. Weeks will open the convention with an address, including among other things a statistical

account of the present state of the electric light and power industries. The executive committee will report through its chairman, Mr. Benjamin Rhodes, who will record the general work of the association for the last six months, and more particularly that portion of it not fully covered in the other committee and official reports. This will be followed by the usual report of the secretary and treasurer. The committee on harmonizing the electric-light and insurance interests will report through its chairman, Mr. P. H. Alexander, who will present elaborate statistics on the fire losses collected and the insurance premiums paid by electric-light companies; the committee will also recommend measures by which insurance rates on electric-light stations may be lowered. The national committee on State and municipal legislation will report through its chairman, Mr. Allan R. Foote of Cincinnati. This committee, which is now composed of twenty-six gentlemen from as many different States, and whose object was set forth in Bulletin No. 1 of the National Electric Light Association of New York, is now fully organized and ready for work. The committee on the revision of the constitution will report through its chairman, Dr. Otto A. Moses, who will submit a carefully considered revision of the present constitution. Dr. Moses will also address the convention on the recent movement in New York State to introduce killing by electricity as a substitute for hanging in legal execution. He will supplement his remarks with well-digested statistics. The following papers will be read: "The Value of Economic Data to the Electric Industry," by Mr. Allan R. Foote of Cincinnati; "Electric Street-Railways," by Mr. George W. Mansfield of Boston; "An Ideal Station," a paper in two parts, — from an electrical standpoint, by Mr. Marsden J. Perry of Providence; from a mechanical standpoint, by Mr. John T. Henthorn of the same city; "The Economic Size of Line-Wire," by Benjamin Rhodes of Niagara Falls; "Station Accessories in the Shape of Measuring-Instruments," by C. C. Haskins of Chicago; "The Development and Progress of the Storage-Battery," by Mr. William Bracken of New York; "The Theoretically Perfect Arc-Light Station," by M. M. D. Law of Philadelphia; and "The Electrical Transmission of Power," by Professor E. P. Roberts of Cleveland. Mr. A. J. De Camp will address the convention on "The Methods of Arriving at the Cost of the Products of a Station." Gentlemen who propose attending the Niagara Falls convention are reminded, that to get the two-thirds rebate on their return railroad-ticket, it will be necessary for them to procure a Trunk Line or Central Traffic Association certificate from the ticket-agent when they buy their ticket to Niagara Falls. The secretary and treasurer, Allan V. Garratt, will be at the Electric Club Saturday and Sunday evenings, Aug. 3 and 4, and at the Erie Railroad Depot, at the foot of Chambers Street, New York, at 8.45 o'clock A.M., Monday, Aug. 5, to supply tickets and certificates for the special train at 9 o'clock A.M. on the same day.

— Mr. D. W. Langdon, jun., who has been for a number of years connected with the Alabama Geological Survey, has entered upon the duties of geologist and consulting mining engineer of the Chesapeake and Ohio Railway, probably with headquarters at Richmond, Va.

— Professor G. E. Morrow of the University of Illinois is now in Europe, in behalf of the United States Department of Agriculture, to make a report on the live-stock exhibited at the Royal Agricultural Society show at Windsor. He will also visit the Continent, and especially France and Germany.

— On July 15 a deep-sea exploration party started from Kiel, on board the steamer "National," for the Greenland coast, where they propose to carry on a series of submarine soundings and investigations. The expedition is directed by Professor Hensen.

— The next international archæological congress is to be held in Christiania in 1891. It was originally intended that it should be held in London. Dr. Ingvald Undseth of Christiania is the general secretary.

— According to a correspondent of the *Artisan*, a simple plan of preventing sheet-iron stacks from rusting is as follows: if before raising the new chimney, each section, as it comes from the shop, be coated with common coal-tar, then filled with light shav-

ings and fired, it will resist rust for an indefinite period, rendering future painting unnecessary. In proof of this, he cites a chimney which was erected in 1866, treated as above described, and is today as bright as it was the day it was raised, without having a particle of paint applied since. The theory by which he accounts for this result is that the coal-tar is literally burned into the iron, closing the pores, and rendering it rust-proof.

— In the *Engineering and Mining Journal* for July 27, Henry Wurtz maintains that asphalts and asphaltoids are mainly produced from rock-oils by polymerization of certain constituents of such oils under the influence of the air, or of the sun's rays, or of both, together with the influence of acid, saline, or other polymerizing agents incidentally present; and the author defines polymerization as due to and dependent on the coalescence of two or more molecules of an element or compound into one; being inclusive and explanatory, as thus regarded, of the allotropism of Berzelius.

— From some notes on the color of the eyes and hair in Norway, by Drs. Abbo and Faye, with tables and annotations by M. Topinard, in the *Revue d'Anthropologie*, it appears that the population of Norway exhibits a higher percentage (97.25) of light eyes than any other country in Europe. Flaxen hair occurs in 57.5 per cent of the people of the northern provinces; and, while absolutely black hair is found only in the ratio of 2 per cent, red hair does not rise higher than 1.5 per cent in the scale of hair-coloration.

— *Nature* gives the following summary of a paper on "Hallstatt in Austria, its Places of Burial, and its Civilization," by Dr. Hornes: "This is an extremely interesting summary of the important discoveries made within the last few years in the Hallstattian burying-grounds of Slavonian Austria, more especially at Watsch in Carniola, where the beauty and finish of the carved baldrics and belts have led contemporary paleontologists to regard them as an evidence of the existence in central Europe of an early civilization, which had already attained to considerable artistic culture before its extinction under the weight of advancing hordes of barbarian invaders. The necropolis of Hallstatt, for our acquaintance with which we are indebted to Baron Sacken, still remains unrivalled for the splendor and variety of its antiquities, notwithstanding the marvellous results of the recent Carniolian and Croatian finds. Between 1846 and 1863, Sacken and Ramsauer published reports of their explorations of nearly 1,000 tombs, while since that period the number of graves explored has risen to nearly 1,900. Both at Hallstatt and Watsch the rites of interment and incineration had been followed with nearly equal frequency; but, although in the case of the latter the graves appear to have been most richly supplied with gold ornaments and carved bronze arms, the abundance of yellow amber and of decorative objects of the toilet, which are found buried with the unburnt skeletons, renders it difficult to decide which of the two methods of disposing of the dead was regarded as the more distinguished. The cranial type is generally dolichocephalous, with a retreating forehead and long, slightly prognathic face, resembling what is known in Germany as the 'Reihengräbertypus.' According to Sacken, the necropolis of Hallstatt dates from the third or fourth century B.C., revealing the presence in those regions of the eastern Alps of the so-called Galli Faurisci, who, prior to the Roman domination, must have been familiar with an advanced stage of civilization and decorative art, in which the influence of Greek art is undeniable. This is indeed strongly manifested both in the workmanship and the forms of multitudinous objects revealed by the exploration not merely of the Hallstattian tombs, but of the prehistoric station of Salzberg, whose discovery last year has added new interest to the still contested problem of the origin of the early culture of the Alpine races of central Europe."

— A successful experiment is reported to have been made recently at the laboratory of the Joseph Dixon Crucible Company, in Jersey City, N.J. A piece of iron ten inches long, two inches wide, and a sixteenth of an inch thick, was used, and one-half of its surface painted with silica-graphite paint, while the other half was left unpainted. It was suspended for several days in a bath of dilute sulphuric acid. This bath was much stronger than any sulphur-water met with in mining. On taking the iron from the bath, the unpainted part was found eaten off to about one-half its original

bulk. The painted part did not sustain even the slightest blemish, thus apparently proving the ability of this paint to withstand sulphuric acid, and demonstrating its usefulness where iron piping is laid in acid water, such as is sometimes met with in mines containing pyrite or other sulphides, which, under certain conditions, produce acid waters in the form of sulphate solutions, resulting from the decomposition of the sulphide minerals.

— We learn from *Nature* that some interesting facts concerning the element tellurium have been brought to light by Dr. Brauner of Prague during the course of a series of atomic weight determinations, an account of which is given in the July number of the *Journal of the Chemical Society*. A determination of the atomic weight of tellurium made by Berzelius in 1832 yielded the number 128.3; and a later one in 1857, by Von Hauer, gave the value of 127.9; hence 128 has usually been accepted as the true atomic weight. The properties of tellurium, however, indicate that it belongs to the sulphur group of elements, and that its position in the periodic system lies between that of antimony (of atomic weight 120) and iodine (of atomic weight 127); but, according to the above determinations, the atomic weight of tellurium is higher than that of iodine. Hence we are obliged to admit one of two things, — either that the atomic weight of pure elementary tellurium has been incorrectly determined, or that the periodic law of the elements, that grand natural generalization whose distinguished elaborator English chemists have recently been delighting to honor, breaks down in this particular case. In view of the overwhelming mass of experimental evidence which has now accumulated in support of this generalization, the latter assumption cannot for a moment be tolerated. The redetermination of Dr. Brauner becomes therefore of primary importance, and his results partake of the highest interest. The mode of procedure which afforded the most satisfactory results consisted in the analysis of tellurium tetrabromide (TeBr_4), purified in the most complete manner by means of silver nitrate prepared from pure silver. The mean atomic weight from these experiments was found to be 127.61; the maximum being 127.63, and the minimum 127.59; hence there can no longer be any doubt that the substance we term "tellurium" does possess a combining weight larger than that of iodine. Now comes the question, "Is this substance pure elementary tellurium?" If it is, then, as Dr. Brauner says, it is "the first element the properties of which are not a function of its atomic weight." Dr. Brauner, however, finds as the result of a process of fractionation that it is not pure tellurium, and that it consists of probably three elements, — pure tellurium mixed with smaller quantities of two other elements of higher atomic weights; and he is at present engaged in studying the nature of these foreign substances, and in the endeavor to isolate pure tellurium itself. A few of the as yet unpublished results obtained in these latter researches were communicated personally by Dr. Brauner at the meeting of the Chemical Society on June 6, and among them the interesting fact was stated that one of the new elements is probably identical with Professor Mendeleeff's recently predicted dwitellurium (of atomic weight 214), the other new constituent being an element closely allied to arsenic and antimony.

—"The principal business transacted at the Literary Congress at Paris, over which M. Jules Simon presided," says the *London Athenæum* of June 29, "has been the passing of the following resolutions, which it is to be hoped may be imported into the Convention of Berne, to which nearly every civilized nation, the United States of America excepted, adhered, and has legislated accordingly: 1. As an author's title to his work includes the sole right to translate it, or to authorize its translation, the author, his successors, and assigns enjoy the right of translation during the term of copyright, even though they may not have the sole right to reproduce the work in its original form; 2. There is no reason for an author notifying in any way that he reserves the right of translation; 3. There is no ground for limiting the period during which the author of a book or his representatives may translate it."

— Arrangements are being made by the local committee of the American Association at Toronto for an excursion, starting Sept. 3 or 4, to the Huronian district. Particulars will be given in a circular to be issued by the American Geological Society. Ar-

rangements are also being made for an excursion to the Pacific coast. During the week, two popular lectures, complimentary to the citizens of Toronto, will be given by prominent members of the association. The Canadian Railway companies have made the following concessions to members from the United States who may wish to make local excursions during or after the meeting: Return tickets at single fare from Toronto to any station in Canada. Montreal and return, going and returning all rail, \$8; going boat, returning rail, or *vice versa*, \$10; or rail to Ottawa, river to Montreal, returning rail, \$10. Quebec, going and returning all rail, \$10; going steamer, returning rail, or *vice versa*, \$12; rail to Ottawa, river to Quebec, returning rail, \$12. Niagara Falls, going and returning all rail, \$2.50; going rail and returning lake, or *vice versa*, \$2; going lake and returning lake, \$1.50.

— The Entomological Club of the American Association will meet at 9 A.M. on Wednesday, Aug. 28, in the room of Section F, University Buildings, Toronto, where members of the club will register and obtain the club badge. Members of the club intending to contribute papers will send titles to the president, Mr. James Fletcher, Government Experimental Farms, Ottawa, Can. The Botanical Club will hold a meeting as usual on Tuesday, Aug. 27, in the room of Section F, University Buildings. Communications should be sent to the president, Professor T. J. Burrill, Champaign, Ill., or to the secretary, Douglas H. Campbell, 91 Alfred Street, Detroit, Mich. During the week, members will be conducted by local botanists on excursions to points of interest in the neighborhood of Toronto. The Society for the Promotion of Agricultural Science will hold its tenth annual meeting in Toronto, beginning on Monday evening, Aug. 26, in the room assigned to Section I in the University Buildings, and continuing on Tuesday. For further information address Professor W. R. Lazenby, secretary, Ohio State University, Columbus, O. The American Geological Society will hold its meeting apart from Section E, in one of the halls of the university, on Aug. 28 and 29; Professor James Hall, Albany, N.Y., president, and Professor J. J. Stevenson, University of City of New York, secretary. For all matters pertaining to membership, papers, and business of the association, address the permanent secretary, at Salem, Mass., up to Aug. 20. From Aug. 20 until Sept. 9 his address will be A.A.A.S., Toronto, Ont.

— One of the most interesting features in the rapid approach of Cossack and Sepoy towards each other is the extensive planting of trees that is being carried on by the engineering branches of both countries, as reported in *Engineering*. Wherever stations are established in the Quetta district, trees, flowers, and vegetables are planted; and the same is the case with the new Russian settlements along the course of the Transcaspian Railway and the Oxus River. Of the two, the Russians have been more systematic than the English, and have spent considerably more money. This is due to the interest taken in the matter by Gen. Annenkoff, who is a born founder of colonies, and takes as much interest in all that appertains to the Transcaspian settlements as Robinson Crusoe did in his "desert island." At a recent meeting at St. Petersburg, Gen. Annenkoff gave an account of some of his operations in this direction. He admitted very frankly that the tree-planting of the last three years had not been altogether a success, many imported trees and shrubs having perished; but experience had shown what would and would not thrive, and seeds were being obtained from various parts of the world that would thrive in the sandy soil of the Kara Kum, exposed to the widest possible variations of heat and cold, or in the irrigated clayey expanses of the Merv, Tejend, and Atak oases. Meanwhile the Russian authorities are looking well after the local flora. Orders have been given that no bushes are to be cut down within ten miles of the line, and that the existing forests of saxaul are to be preserved. Saxaul is a kind of heavy, extremely knotted brier-wood, attaining a forest growth in places, and provides most of the fuel hitherto used in the country. It grows readily in sand, which it moreover serves to bind together by its long, trailing, clumsy roots. Plantations of this are to be made along the line, with camel thorn and other native bushes that thrive well, and it is expected that in time there will be a sufficient growth of vegetation not only to protect the line, but also to provide shelter for weaker trees and bushes of foreign origin. In the mean

while oil-refuse from Baku is being used as household fuel by the Russians, and, as soon as cheap suitable stoves are introduced, the population will probably become more and more accustomed to rely upon oil for fuel purposes. Every step in this direction is a boon, because it tends to save more and more the timber in Central Asia, and thereby contributes to a reforestation of a country once densely covered with trees, and at that period famous throughout Asia for its fertility. This fertility the Russian engineer is now attempting to gradually restore.

— The question of permeability of cements and mortars has been treated of by the board of experts appointed to report on the Washington Aqueduct Tunnel. In their report it is stated, that, even if the brick lining of the tunnel were carefully made and backed, still leakage could not be prevented, as bricks are themselves pervious under somewhat moderate heads. In some experiments made by Mr. Francis last year, about 13.8 gallons of water per square foot of surface passed through a thickness of nearly 16 inches cement in twenty-four hours, under a pressure of 77 pounds per square inch. Mr. Stauffer, another engineer, constructed a bulkhead of brick-work in cement in the Dorchester Bay Tunnel, which measures 10 feet by 10 feet. Under a pressure of 72 pounds per square inch, water percolated through at the rate of 96,000 gallons per day. Experience on the Boston main drainage work showed that it was not practicable to build a brick bulkhead which should be tight for pressures exceeding 64 pounds per square inch, and at the Croton Reservoir water under 36 feet head was found to percolate through 26 inches of brick-work and 4 feet of concrete. In some experiments made by the board of experts themselves, a good fair specimen brick was exposed to a pressure of 80 pounds per square inch on one of its faces; and, under these conditions, 23.4 cubic inches of water passed through the brick in the first hour, and 21.3 in the second hour. The mean of these figures is equivalent to 1.4 gallons per square foot of surface per hour. In the case of another brick under the same pressure, 46.8 cubic inches passed through in one hour. Blocks of cement mortar allowed to set for twenty-four hours in air, and afterwards hardened for five weeks in water, were also tested. Under 80 pounds pressure, water passed through these at the rate of 36.4 gallons of water per hour. The above figures have been reduced to English gallons of 10 pounds of water.

— The circular of the local committee for the meeting at Toronto, Ontario, Aug. 27 to Sept. 7, of the American Association for the Advancement of Science, states that arrangements have been made on the certificate plan for a very general reduction of railway-fares over the principal railways embraced in the territory of each of the different passenger agents' associations. Full fare for limited or unlimited tickets, as the case may be, will be paid going to Toronto, the purchaser receiving from the ticket-agent at the starting-point, or at the one nearest thereto in the association, a certificate giving the initials of the railways in the route to be traversed, and the amount of fare paid. A certificate must be taken covering the route in each passenger agent's association, if more than one is traversed. Conductors of trains and ticket-agents will be able to give full information as to the limits of each association's territory. Upon the presentation of such certificate, properly filled in and signed by the agent at the starting-point, and indorsed by the local secretary at Toronto, a return ticket will be sold, within three days after the meeting, for one-third the regular first-class fare. Return tickets will be sold at this price only over the route traversed in going to Toronto. Persons must obtain their blank certificates from the local secretary, Professor Loudon, at Toronto. These certificates will be mailed, with full instructions for their use, upon application to the local secretary. A separate certificate will be needed for each person coming to the meeting. Members and others making application for certificates will confer a favor upon the committee by enclosing an addressed envelope for the reply. The railway companies will adhere to the following rule: "No refund of fare will be made on any account whatever because of failure of the parties to obtain certificates." It will therefore be noticed that any person failing to obtain from the agent selling the ticket to Toronto, such a certificate as has been above described, will be obliged to pay full fare both ways.

Those who desire to secure rooms in advance should communicate either directly with the hotels or with William McCulloch, secretary of the Young Men's Christian Association. The morning and afternoon meetings of the association and of its sections will be held in the University Buildings, Queen's Park, where will also be the offices of the permanent and local secretaries during the meeting. Hotel headquarters will be at "The Queen's," and the local committee's office in the vicinity at 42 York Street, where application may be made for information. In order to enable members to attend the morning and afternoon sessions without being obliged to go to the hotels in the interval, a luncheon will be served daily in the dining-hall, University College. Through the courtesy of the post-office authorities, there will be a branch post-office at the university during the meeting. All mail matter should be addressed "Care of A.A.A.S." The Great North-Western Telegraph Company has liberally offered to transmit free the social messages of members when approved by the secretary. No concessions could be obtained over the United States lines. The Canadian Express Company has generously offered to carry free packages containing scientific articles intended for use at the meeting. Members will receive whatever additional favors the local committee or the association may be able to secure or give, if they will send such packages in care of the local secretary. By the courtesy of the minister of customs, all articles intended for use at the meeting will be admitted free; subject, however, to inspection by the customs officers. In case any difficulty arises at the frontier, members are recommended to ship the articles by express in bond to the local secretary. Full reports of the proceedings will be published in the Toronto daily papers. Authors will oblige by sending, in advance, abstracts of their papers (other than those sent to the permanent secretary) to James Hedley, *Monetary Times*, Toronto, who will withhold them from publication until the papers have been read in the sections. The council will meet at the Queen's Hotel at noon on Tuesday, Aug. 27. The association will be called to order in general session at 10 A.M., on Wednesday, Aug. 28, in the University Convocation Hall, by the president, Major J. W. Powell of Washington, who will resign the chair to the president-elect, Professor T. C. Mendenhall of Terre Haute, Ind. After the adjournment of the general session, the sections will organize in their respective halls. In the afternoon the sections will meet and the vice-presidents deliver their addresses. In the evening Major Powell will deliver the presidential address in the Pavilion, Horticultural Gardens. The meetings of the sections will be held on the following days (except Saturday and Sunday) until Tuesday night, when the concluding general session will take place. Saturday will be devoted to excursions complimentary to the association, including one to Niagara Falls and one to Muskoka.

— Thomas G. Farrell writes from Portland, Ore., to the *American Field*, that, the varieties of native song-birds in this country being rather limited, several German citizens some time since conceived the idea of importing a number of German song-birds. In a few days quite a respectable sum was raised for this purpose, and forwarded to Germany. Not long since, the birds arrived in charge of a competent keeper, and, after being placed on exhibition for a few days, were all turned loose to multiply and prosper. There were some three hundred birds in all, consisting mainly of chaffinches, goldfinches, greenfinches, bullfinches, starlings, nightingales, skylarks, German robins, linnets, thrushes, grossbeaks, and, last but not least, several specimens of the singing-quail. It is understood that many of them have been observed nesting, and it is very likely that they will form a valuable addition to our feathered family.

— At a recent meeting of the German Meteorological Society in Berlin, according to *Nature*, Dr. Lang of Munich read a paper on "The Velocity of Propagation of Thunder-Storms in South Germany in the Ten Years 1879-88." This is, on an average, 38.4 kilometres per hour; but it has varied considerably from year to year, increasing in the years to 1884, and thereafter decreasing. To this corresponds a curious variation of Van Bebbler's fourth and fifth depression-paths, which lay in the north at the beginning of the period, then moved south to South Germany till 1884, after which they retired northwards. Hail frequency has varied in an

opposite sense to the velocity; but the rapidly moving winter thunder-storms have most hail. The velocity is maximum in winter: it falls rapidly till May, slowly rising thereafter (with a second depression in September) till winter. The velocity is greatest in storms coming from the west. Dividing the region into four zones from north to south, there is a decrease in the velocity, at first slight, but getting very rapid on reaching the Alpine region. The velocity is greatest about midnight, least about midday. At the same meeting, thunder-storms and hail in Bavaria in 1880-88 were the subject of a paper by Dr. Horn. These phenomena in general correspond. Both have a maximum early in July; but the hail has a second maximum, nearly as great, in May. Both phenomena show a pronounced day maximum about 3 to 4 (in winter about 2 to 3), and a minimum in the morning from 7 to 8. Dr. Horn said hail never fell in Bavaria without electric discharge, but Dr. Assmann maintained it did sometimes in Prussia.

—The Transvaal Volksraad is reported to have placed \$100,000 on the estimates for the current year, for the purpose of endowing the first university of the Republic.

—The monograph prepared by Mr. C. Meriwether, A.B., Johns Hopkins University, and recently published by the United States Bureau of Education, is designed to trace the history of higher education in South Carolina, his native State, and to give a sketch of the development of the free or public school system. The earliest educational efforts are described, and instances are given illustrating the interest of South Carolina when yet a colony in providing the means for the intellectual improvement of her sons. Not only were schools founded and maintained in the province by the government and through private and charitable aid, but many youths were sent to England for their education. The influence of such men on their return was so great and lasting, that, even to the middle of the present century, schools in Charleston, modelled on the English plan, were very popular. The birth of colleges was late, and their growth slow: there was, therefore, chance for a good system of academies to develop. These were planted in all parts of the State, so that a good training-school was within the reach of all. The number continued to increase until the outbreak of the war. The most famous academy was that presided over by Dr. Moses Waddell, the Thomas Arnold of South Carolina. Although there is mention, in the House Journal of 1723, of a proposal to establish a college, and a bill was introduced into the colonial Legislature in 1769 for this purpose, yet no action was taken until the present century. An act was passed in 1785, establishing three colleges in the State, yet only one of them ever gave collegiate instruction. The College of Charleston, while its foundation can be traced to the legislative act of 1785, has given collegiate instruction only since the first quarter of the present century. It is supported very largely by income from vested funds, the result of endowment by public-spirited citizens in and near Charleston. Over half the three hundred thousand dollars endowment was given by Mr. Baynard, during the war, in 1864. The attendance has not been large, but the training in mathematics and ancient languages has always been thorough. Every denomination of any strength in the State has founded a college. In the main, they follow the average college course, but, owing to want of funds, they cannot offer very many electives. It is gratifying to state that the funds and attendance of nearly all of them are gradually increasing. The war was most disastrous to all these institutions in sweeping away their endowments. The first attempt made to establish a general system of free schools was in 1811. The act was passed after bitter opposition on the part of some of the up-country members, and provided free instruction for all children, but gave the preference to poor children; but although the annual appropriations were doubled in 1852, being made seventy-four thousand dollars, the universal testimony was that the schools were a failure. On the adoption of a new State constitution in 1868, the present public-school system was introduced. Its usefulness has been greatly increased by the efficient management since 1876. The attention paid by the State to the education of the colored citizens is well illustrated in Claflin University, supported largely by the State. It has seventeen teachers and six courses of instruction, and its students at the last session numbered nine hundred and

forty-six. The most important phases of advanced instruction in South Carolina are those connected with the State institutions. The Military Academy at Charleston was designed to furnish trained soldiers for South Carolina. Its course is modelled after that of West Point. The College of South Carolina is the best of all the institutions in the State. It was opened for students in 1804, and has ever since exercised a strong influence on the politics of South Carolina, except during the reconstruction period. Every politician of any note in the State, except John C. Calhoun, has been for a time connected with the institution.

—Since the perfection of the silo, maize or corn has come to have an increased importance in successful agriculture, especially in dairying and stock-growing. The value of corn for the silo and as a forage crop is a sufficient incentive for making a thorough and systematic study of the development of, and chemical changes in, maize during its period of growth. This work was begun last year in a preliminary way at the New York Agricultural Experiment Station, and is being continued in more detail the present season. When this season's work is completed, it is hoped the results may answer the question, "What is the proper stage of maturity for cutting corn for the silo?" To every farmer who is interested in the silo, three important questions present themselves for consideration: 1. What is the best variety of corn to grow for the silo? 2. What is the best method of planting? 3. What is the proper stage of maturity for cutting corn for the silo? As the result of experiment, the following conclusions are probable: 1. That the greatest weight of green fodder seems to have been at about the period of full silking of the ears; 2. That the total weight diminished after this date, but the total dry matter increased; 3. That the total nitrogen does not appear to increase after the ears silk; 4. That as the corn approaches maturity the per cent of amide nitrogen diminishes, while the albuminoid nitrogen increases, thus seemingly increasing the feeding-value of the crop; 5. That the sugars and starch increase rapidly during the latter period of growth and maturing of the corn-plant, and that these are the most valuable portion of the nitrogen-free extract; 6. That for the greatest amount of nutriment, considered from a chemical standpoint, corn should not be cut before it has reached the milk stage of the kernel; 7. That it remains for future investigation to determine whether it is better to be cut at the milky stage or at a later period for the greatest amount of digestible and available nutriment; 8. That the Burrell & Whitman corn cannot, in ordinary culture, be matured in this latitude.

—It is well known that plants of *Dictamnus fraxinella*, at the close of a dry, sunny day, are surrounded by a gas which is inflammable, and will ignite with a sudden flash of flame when a lighted match is applied to it. M. H. Correvon gives in *The Garden* the results of some investigations lately made with regard to this phenomenon. Certain plants, and very notably the *Rutaceæ* and *Labiata*, secrete various products, such as essential oils, resins, gums, balsams, etc. Secretory organs which are buried in the substance of the parenchyma elaborate these products, while hairs of various forms and textures conduct them to the surface, and there excrete them. The secretory organs are termed "internal glands," and the excretory hairs are known as "external glands." These latter glands are surrounded at the base by a part of the epidermis, which the hair has pushed up in issuing forth to make its appearance on the surface of the stem, and in the *fraxinella* this raised part of the epidermis covers a gland which is very richly provided with resin and essential oil. When this gland was examined with a microscope on a hot day, it was empty, its contents having been drawn out by the heat through the cells of the epidermis or through the hair that terminates the gland. It must be understood that the surrounding air has to be pretty strongly impregnated with the gas of the volatilized resin in order to take fire when a lighted match is applied to it. This experiment has also been carried out in France by placing a pot-plant of *fraxinella* in bloom under a bell-glass, and leaving it there for some time, when the air in the bell-glass was found to be so highly charged with the resinous gas that it ignited the moment a lighted match was applied to it, and, it may be added, without doing the slightest injury to the plant.

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THE WORLD'S-FAIR PROJECT is moving on favorably. A meeting of prominent representatives of American industries was held at the office of the mayor of New York, where it appeared that the proposition was well received by this class, upon whose efforts success will depend. At this season many of New York's prominent men are out of town, but there is no evidence that this will interfere with the preliminaries of organization. Among the suggestions floating in the air is that there should be minor exhibitions in some of the other large cities of the United States, but it does not appear that this side-show business will meet with acceptance. At the mayor's meeting the appointment of four preliminary committees was decided on; and the mayor is using due effort to secure the right material for these, having invited the various commercial and industrial organizations for suggestions. The finance committee will be called on to secure a guaranty of something like \$15,000,000. The committee on the site will have necessarily a delicate task, in view of the enormous interests which will be affected; but, with the many points in New York which can be reached by land and water, there will be ample opportunity for a good choice. The matter of legislation will call for due attention, and, the more rapidly some results of the organization are to be shown, the better will be the prospect of recognition at the hands of Congress and the Legislature. What can be said now is that the scheme takes with those who will carry it through.

WE WOULD CALL ATTENTION to the letter by Dr. Lamborn in this issue. We think all will agree that scientific methods should be sought to lessen the number of mosquitoes, and that, where even a glimmer of light is seen promising that consumption, it should be followed by scientific men with the utmost vigor. New Jersey alone could afford to spend a million dollars a year on any plan that would largely lessen her mosquito-product. The life-history of any dragon-fly is yet but little known, and the characteristics as destroyers of small insects of many of the scores of species of dragon-flies is even less known. This attempt to get at facts to reason upon we hope will meet with the aid of scientific persons throughout the country, and that, with the results of this season's work before us, we may be able to conclude how far the dragon-fly may be used for the ends mentioned in Dr. Lamborn's letter.

CONSIDERATIONS CONCERNING SOME EXTERNAL SOURCES OF INFECTION IN THEIR BEARING ON PREVENTIVE MEDICINE.

(Continued from p. 73.)

As regards anthrax bacilli, it has been determined that in ordinary garden or field earth they do not multiply, but in earth contaminated by blood, urine, or fæces, their reproduction can occur. They can grow on various vegetable substrata. There is no reason to doubt, therefore, that the anthrax bacilli can find in or on the ground suitable conditions for their multiplication, although such conditions are not everywhere present. For durable infection of the soil with anthrax bacilli, it is, however, more important that these bacilli should find there suitable conditions for the formation of spores than that they should be able simply to multiply. The vegetative forms of anthrax bacilli would not, as a rule, be able to survive for a great length of time the hostile influences which they are likely to encounter in the ground; such as insufficient or exhausted nutriment, absence of sufficient moisture, and the attacks of saprophytic organisms. On the other hand, against these injurious influences the anthrax spores have great resistance. In the superficial layers of the ground the anthrax bacilli may often find those conditions of moisture, of temperature, of oxygen-supply, and of insufficient food, which we know are most favorable for the development of their spores; indeed, Soyka has shown that the ground presents often these conditions better than our culture media. A circumstance discovered by Feltz, which, however, needs confirmation, is, if true, of not little significance. He finds that anthrax bacilli may undergo a progressive diminution in virulence in the soil. If this should be true likewise of other infectious micro-organisms, we should be able to account in some instances for the variable degree of virulence which clinical observation indicates that certain agents of infection acquire. So far as anthrax bacilli are concerned, we may conclude, therefore, that the ground occasionally offers suitable conditions for their reproduction; but, what is of greater importance, it offers especially favorable conditions for their long-continued preservation in the form of spores. I must forego here the further consideration of the special circumstances inherent in the soil which control the origin and spread of epidemics of anthrax in cattle, although many interesting investigations have been directed to this subject.

Of greater interest to physicians is the behavior of typhoid and of cholera bacteria in the ground. As has already been intimated, the ground is regarded by Pettenkofer and his school as the principal breeding-place of these micro-organisms outside of the body. This view, however, is not supported by bacteriological investigations. Inasmuch as the cholera and typhoid bacilli may multiply on various vegetable substrata and substances derived from animals at temperatures often present in the ground, it is evident that here and there conditions may be present for their growth in the ground; but this growth is likely to be soon interrupted by the invasion of ordinary saprophytic organisms and other harmful influences. The typhoid bacilli are more hardy in resisting these invaders than are the cholera bacteria, which easily succumb; but even for the for-

mer, so far as our present knowledge extends, the ground can rarely serve as a favorable breeding-place.

It is not, however, necessary that these organisms should multiply in order to infect for a considerable time the ground; it is sufficient if their vitality is preserved. As to this latter point, the reports of different investigators are not altogether concordant. Such excellent observers as Koch, Kitasato, and Uffelmann found that the cholera bacteria, when added to fæces, or a mixture of fæces and urine, rapidly diminished in number, and at the end of three or four days, at the most, had wholly disappeared. In a mixture of the intestinal contents from a cholera corpse with earth and water, Koch found numerous cholera bacteria at the end of three days, but none at the end of five days. On the other hand, Gruber reports the detection of cholera bacteria in cholera dejecta fifteen days old. The weight of bacteriological evidence, therefore, is opposed to the supposition that the bacteria of Asiatic cholera preserve their vitality for any considerable time in the ground or in the excreta.

With respect to the bacilli which cause typhoid-fever, it has been shown by Uffelmann that these may live in fæces, a mixture of fæces and urine, and a mixture of garden earth, fæces, and urine, for at least four and five months, and doubtless longer, although they may die at the end of a shorter period. He also finds that under these apparently unfavorable conditions some multiplication of the bacilli may occur, although not to any considerable extent. Grancher and Deschamps found that typhoid bacilli may live in the soil for at least five months and a half. Unlike the cholera bacteria, therefore, the typhoid bacilli may exist for months at least in the ground and in faecal matter, holding their own against the growth of multitudes of saprophytes. This difference in the behavior of cholera and of typhoid germs is in harmony with clinical experience.

As regards other infectious bacteria than those which have been considered, I shall only mention that tubercle bacilli, although incapable of multiplication under the ordinary conditions of nature outside of the body, may preserve their vitality for a long period in the ground, on account of their resistant character, and, furthermore, that the pyogenic cocci, on account of their considerably resistant nature and their modest demands in the way of nutriment, can be preserved and sometimes probably grow in the ground. Indeed, the *Staphylococcus pyogenes aureus* has been found in the earth by Lübbert.

The conclusion which we may draw from the observations mentioned, is that in general the soil is not a good breeding-place for most of the infectious bacteria with which we are acquainted, but that it can retain for a long time with unimpaired vitality those which produce spores or which offer considerable resistance to injurious agencies, such as anthrax bacilli, typhoid bacilli, tubercle bacilli, and the pyogenic cocci.

In order to become infected with bacteria in or on the ground, these bacteria must in some way be introduced into the body; and we must therefore now attempt to determine how bacteria may be transported to us from the ground. So various and intricate are the possibilities for this transportation, that it is hopeless to attempt to specify them all.

There occurs to us first the possibility of the conveyance of infectious micro-organisms from the soil by means of currents of air, — a mode of carrying infection which has already been considered. Here I shall only repeat that the wind can remove bacteria from the ground only when the surface is dry and presents particles of dust, and that the sole, perhaps the chief, danger is not that we may inhale the infected dust.

Manifold are the ways in which we may be brought into contact with infectious bacteria in the ground, either directly or by means of vegetables to which particles of earth are attached, by the intervention of domestic animals, by the medium of flies or other insects, and in a variety of other ways more or less apparent.

* An important, doubtless for some diseases the most important, medium of transportation of bacteria from an infected soil is the water which we drink or use for domestic purposes. From what has been said, it is evidently not the subsoil-water which is dangerous, for infectious, like other bacteria, cannot generally reach this in a living state; but the danger is from the surface-water, and

from that which trickles through the upper layers of the ground, as well as from that which escapes from defective drains, gutters, cesspools, privy-vaults, and wrongly constructed sewers or improper disposal of sewage. I shall have something to say presently of water as a source of infection, and shall not further elaborate here the dangers of infection of drinking-water through contaminated soil, — dangers which, especially as regards typhoid-fever, are widely appreciated in this country, even if often imperfectly counteracted.

A point which has been much discussed, and one of interest, is whether bacteria which are in the depth of the ground can come to the surface. Two agencies, especially, have been considered by some as capable of transporting bacteria from the depth to the surface. One is ascending currents of air in the ground, and the other is the capillarity of fluids in the minute pores of the ground. The first of these suspected agencies must be unquestionably rejected, in view of the fact that even a few inches of sand is sufficient to filter all of the bacteria out of the air, even when it is in much more rapid motion than can occur within the ground. Moreover, that degree of dryness which is essential for the detachment of bacteria by air-currents is not likely to be present much below the surface of the ground. The experiments which have been made to determine to what extent bacteria may be carried upward by the capillarity of fluids in the ground have not yielded harmonious results, but the weight of evidence is opposed to the belief that this is a factor of any considerable importance for this purpose.

From what has been said concerning the growth of pathogenic bacteria in the soil, we shall not be inclined to attribute to the multiplication and the motility of these organisms much influence in changing their place in the ground.

The somewhat sensational rôle assigned by Pasteur to earth-worms, of bringing bacteria to the surface, cannot be wholly ignored, and has received support from observations of Bollinger regarding anthrax; but it is questionable whether much importance is to be attached to this agency.

Regarding the depth to which typhoid bacilli may penetrate in the soil, the experiments of Grancher and Deschamps show that at the end of five weeks they may reach a depth of sixteen to twenty inches below the surface. As Hoffmann has demonstrated the extraordinary slowness with which fluids and fine particles penetrate the soil, it is probable that in the course of time a greater depth than this may be reached. Indeed, Macé claims to have found, in the neighborhood of a well suspected of infection, typhoid bacilli, together with ordinary intestinal bacteria, at a depth of at least six and a half feet below the surface. There are a number of instances recorded in which there is good reason to believe that turning up the soil, and cleaning out privies or dung-heaps in which typhoid stools have been thrown, have given rise to typhoid-fever, even after the infectious excreta have remained there a year and more.

It cannot be said that bacteriological investigations have as yet shed much light upon a factor which plays a great rôle in epidemiology, namely, predisposition to infection from the ground, according to locality and time; and this deficiency receives constant and vehement emphasis from the localistic school of epidemiologists. We can, however, readily understand that varying conditions, such as temperature, moisture, porosity, quality of soil, may exert a controlling influence in determining the behavior of infectious germs in the soil, and the facility of their transportation to human beings or animals. As regards that much-discussed question, the significance of variations in the height of the subsoil-water in relation to the prevalence of certain epidemic diseases, particularly cholera and typhoid-fever, we now know that this cannot depend upon the presence of bacteria in the subsoil-water itself, or in the capillary layers immediately above it. It has been plausibly suggested, that, with the sinking of the subsoil-water, fluids from infected cesspools, privy-vaults, and other localities, may more readily be drawn into wells or other sources of water-supply, and that by the same cause the surface of the ground becomes dry, so that dust-particles may be lifted by the wind. Other more or less plausible explanations have also been offered, but it must be confessed that our positive information on this point is meagre. There can, how-

ever, be little doubt that this significance of the variations in subsoil-water is apparent only for certain localities, and has been considerably exaggerated and often misunderstood. It is not, however, pertinent to my theme to discuss this or other purely epidemiological observations concerning the relations of the ground to the spread of epidemic diseases, interesting and important as are many of these observations.

Before leaving the subject of the ground as a source of infection, permit me to indicate briefly some conclusions which may be drawn from what has been said, as to the principles which should guide us in preventing infection, directly or indirectly, from the ground.

First in importance is to keep infectious substances as far as possible from the ground. This implies the early disinfection or destruction of such substances as typhoid and cholera excreta and tuberculous sputum.

Second, the ground should be rendered, so far as practicable, unsuitable for the continued existence of infectious germs. This, at least for some diseases, is accomplished by a proper system of drainage; which, moreover, for other reasons, possesses hygienic importance.

Third, means should be provided to prevent waste products from getting into the ground around human habitations, or from gaining access to water used for drinking or domestic purposes. In cities this can be accomplished only by a properly constructed system of sewers. The system of storing waste products in cesspools, whence they are to be occasionally removed, cannot be approved on hygienic grounds. There are conditions in which the disposal of waste products in deep wells only used for this purpose, and whence these products can filter into the deep layers of the ground, may be permissible; but this can never be considered an ideal method of getting rid of excrementitious substances, and is wholly wrong in regions where wells are used for drinking-water. But I am trespassing with these remarks upon a province which does not belong to me, but rather to practical sanitarians and engineers. I shall only add that the advantage gained by preventing organic waste from soaking into the ground is not so much that the ground is thereby rendered better adapted for the existence of infectious micro-organisms, but is due rather to the fact that this waste is likely to contain infectious germs.

Finally, in cities, good pavements, absence of unnecessary disturbance of the soil, cleanliness of the streets, and laying of dust by sprinkling, are not only conducive to comfort, but are sometimes hygienically important in preventing infection from the ground and dust.

In passing from the consideration of the ground to that of water, one feels that he now has to do with a possible source of infection against which, in this country and in England, he is at liberty to make any accusation he chooses without fear of contradiction. There is reason to believe that such accusation has been repeatedly made, without any proof of misdemeanor on the part of the water. It is not, therefore, with any desire to awaken further the medical or the public conscience that I wish to say a few words concerning the behavior of bacteria in water, and the dangers of infection from this source. That such dangers are very real must be apparent when we consider the universal employment of water, and its exposure to contamination from all kinds of sources.

Ordinary water, as is well known, contains bacteria in large number. Not a few species of bacteria can multiply rapidly, and to a large amount, even in distilled water. These are the so-called water bacteria, and, like most of the micro-organisms found in ordinary drinking-water, are perfectly harmless saprophytes. What we wish to know is, how pathogenic micro-organisms conduct themselves in water. Can they grow, or be preserved for any length of time in a living condition, in water? As regards the multiplication of pathogenic bacteria in water, the results of different experimenters do not altogether agree. Whereas Bolton failed to find any growth, but rather a progressive diminution, in number of pathogenic bacteria planted in sterilized water, Wolfhügel and Riedel observed a limited reproduction of such bacteria, including those of typhoid-fever and of cholera. This difference is due probably to the methods of experimentation employed. According to Kraus, these latter bacteria diminish rapidly in number in

unsterilized spring or well water kept at a low temperature. These experiments indicate that water, even when contaminated with more organic impurities than are likely ever to be present in drinking-water, is not a favorable breeding-place for pathogenic bacteria. Still it is to be remembered that these laboratory experiments do not reproduce exactly all of the conditions in nature; and it may happen that in some nook or cranny, or vegetable deposit at the side of a well or stream, some pathogenic bacteria may find suitable conditions for their multiplication.

But, as has been repeatedly emphasized in this address, it is not necessary that pathogenic bacteria should actually multiply in a medium in order to render it infectious. It is sufficient if their life and virulence are not destroyed in a very short time. As to this important point, Bolton found that in sterilized water typhoid bacilli may preserve their vitality for over three months, and cholera bacteria for eight to fourteen days, while Wolfhügel and Riedel preserved the latter in water for about eighty days. Under natural conditions, however, these organisms are exposed to the overgrowth of the water bacteria; so that Kraus found in unsterilized water kept at a temperature of 10.5° C. the typhoid bacilli no longer demonstrable after seven days, and the cholera bacteria after two days. The conditions in Kraus's experiments were as unfavorable as possible for the continued existence of these pathogenic bacteria, more unfavorable than those often present at the season of prevalence of cholera and typhoid-fever; nevertheless I do not see that they justify the conclusions of Kraus as to the slight probability of drinking-water ever conveying infection with the germs of typhoid-fever and of cholera. To render such a conclusion probable, it would be necessary to demonstrate a much shorter preservation than even Kraus himself found. In judging this question, it should not be overlooked that infection of drinking-water with the typhoid or the cholera germs is not so often the result of throwing typhoid or cholera stools directly into the source of water-supply as it is the consequence of leaky drains, cesspools, privy-vaults, or infected soil; so that there may be continued or repeated accessions of infected material to the water.

In view of the facts presented, there is no sufficient reason, therefore, from a bacteriological point of view, for rejecting the transmissibility of typhoid-fever and cholera by the medium of the drinking-water. This conclusion seems irresistible when we call to mind that Koch once found the cholera bacteria in large numbers in the water of a tank of India, and that the typhoid bacilli had been repeatedly found in drinking-water of localities where typhoid-fever existed. Nor do I see how it is possible to interpret certain epidemiological facts in any other way than by assuming that these diseases can be contracted from infected drinking-water, although I know that there are still high authorities who obstinately refuse to accept this interpretation of the facts.

In this connection it may be mentioned that pathogenic bacteria may preserve their vitality longer in ice than in unsterilized drinking-water. Thus Prudden found typhoid bacilli still alive which had been contained in ice for one hundred and three days.

When we come to consider the ways in which water may become infected with pathogenic micro-organisms, we recognize at once a distinction in this respect between surface-water and subsoil-water. Whereas the subsoil-water may be regarded under ordinary circumstances and in most places as germ-free, the surface-water, such as that in rivers and streams, is exposed to all manner of infection from the ground, the air, and the direct admission of waste substances. Unfortunately, in the ordinary way of obtaining subsoil-water for drinking purposes by means of dug wells, this distinction is obliterated; for the water which enters these wells free from bacteria is converted into a surface-water often exposed, by the situation of the well, to more dangerous contamination than other surface-waters used for drinking purposes.

Now let us turn our attention, as we have done with other sources of infection, to a brief outline of certain general principles which may help us in avoiding infection from the water.

We shall, in the first place, avoid, so far as possible, the use of water suspected of infection, especially with the germs of such diseases as typhoid-fever and cholera. When it is necessary to use this suspected water, it should be boiled.

As regards the vital question of water-supply, it may be stated as a general principle that no hygienic guaranty can be given for the purity of surface-water which has not been subjected to a proper system of filtration, or for the purity of spring or well water fed from the subsoil, unless such water is protected from the possibility of infection through the upper layers of the soil or from the air. This is not saying that water which meets certain chemical and biological tests, and which is so situated that the opportunities for its contamination appear to be absent or reduced to a minimum, is not admissible for the supply of drinking-water; but the possibility of infection can be removed only by the fulfilment of the conditions just named, and upon these conditions the hygienic purist will always insist.

Unfortunately we have at present no domestic filters which are satisfactory; and most of those in common use are worse than none, as they soon furnish a filtrate richer in bacteria than the original water. The only effective method of water-filtration for the general supply is by means of large sand-filters, such as are in use, with excellent results, in Berlin and some other cities. These require skilled attention. I cannot on this occasion discuss the construction or working of these filters, but would refer those who are interested to the full and careful investigations of the Berlin filters by Wolffhügel and by Plagge and Proskauer.

What is accomplished by these artificial sand-filters is accomplished under natural conditions also by the ground, which furnishes a subsoil-water free from micro-organisms; and to obtain pure water we have only to devise means by which this subsoil-water may be secured without the chance of contamination. Just as the water which has passed through the sand-filters is collected in suitable reservoirs, and is distributed in pipes which do not admit contamination from without, so, by means of properly constructed artesian or driven wells, we may secure the naturally filtered subsoil-water with the same freedom from the chances of infection.

It is well to bear in mind that no biological or chemical tests of water can replace those measures which have been mentioned as necessary to secure purity of water-supply. These tests are of value only when applied with proper precautions, and with due consideration of the special circumstances of each case for which they are employed. There has been much profitless discussion as to whether greater significance is to be attached to the chemical or to the bacteriological examination of water. Each has its own special field of application, and in this the one cannot replace the other method. The bacteriological examination has for hygienic purposes the advantage that it may enable us to detect the specific agents of infection in the form of micro-organisms, as has already been done for cholera bacteria and typhoid bacilli; but this is a comparatively rare result, and does not at present afford a wide field of application for this method. The significance of the bacteriological test is to be based more frequently upon the fact that it concerns itself with the same class of micro-organisms to which some of the recognized, and doubtless many of the undiscovered, infectious agents belong, and from the behavior of which, in some respects, conclusions can be drawn as to the behavior of the pathogenic organisms. Thus the bacteriological test is the only one which enables us to judge correctly of the efficacy of those methods of filtration of surface-water and of construction of wells which insure purity of water-supply. The points of view from which we can estimate correctly, according to our present knowledge, the relative merits and fields of application of the chemical and of the bacteriological methods of water-examination, have been clearly indicated by Plagge and Proskauer, and by Wolffhügel. The theme is one beyond the limits or the scope of this discourse; and I have referred to it chiefly to emphasize the fact that we cannot rely upon chemical or bacteriological tests of water to the exclusion of those protective measures which have been mentioned although I do not intend to imply that each of these tests, when properly employed, does not afford important information and is not of great value in many cases.

I have already taxed so largely your time and patience, that I must pass over with brief mention the food as a source of infection. Unlike those external sources of infection which we have hitherto considered, many articles of food afford an excellent nutritive

medium for the growth of a number of species of pathogenic micro-organisms, and in many instances this growth may be abundant without appreciable change in the appearance or taste of the food.

When we consider in how large a degree the certainty and the severity of infection with many kinds of pathogenic micro-organisms depend upon the number of such organisms received into the body, we can appreciate that the danger of infection from food which contains a mass of growing pathogenic bacteria may be much greater than that resulting from the reception of infected water or air,—media in which infectious organisms are rarely present in other than a very dilute condition. The entrance into the body of a single infectious bacterium with the inspired air is, at least in the case of many diseases, not likely to cause infection; but let this bacterium fall upon some article of food, as, for instance, milk, where it can multiply in a short time at a favorable temperature many thousand-fold, and evidently the chances of infection become vastly increased.

Among the various agencies by which infectious organisms may gain access to the food may be mentioned the deposition of dust conveyed by the air; earth adhering to vegetables; water used in mixing with or in the preparation of food, in cleansing dishes, cloths, etc.; and contact in manifold other ways with infected substances.

Fortunately a very large part of our food is sterilized in the process of cooking shortly before it is partaken, so that the danger of infection from this source is greatly diminished, and comes into consideration only for uncooked or partly cooked food, and for food which, although it may have been thoroughly sterilized by heat, is allowed to stand for some time before it is used. Milk, in consequence of its extensive use in an unsterilized state, and of the excellent nutritive conditions which it presents to many pathogenic bacteria, should be emphasized as especially liable to convey certain kinds of infection,—a fact supported not less by bacteriological than by clinical observations. Hesse found that also a large number of ordinary articles of food, prepared in the kitchen in the usual way for the table, and then sterilized, afford a good medium for the growth and preservation of typhoid and cholera bacteria, frequently without appreciable change in the appearance of the food.

Upon solid articles of food, bacteria may multiply in separate colonies, so that it may readily happen that only one or two of those who partake of the food eat the infected part; whereas with infected liquids, such as milk, the infection is more likely to be transmitted to a larger number of those who are exposed.

In another important particular the food differs from the other sources of infection which we have considered. Not only the growth of infectious bacteria, but also that of bacteria incapable of multiplication within the body, may give rise in milk and other kinds of food to various ptomaines, products of fermentation, and other injurious substances, which, when ingested, are likely to cause more or less severe intoxication, or to render the alimentary tract more susceptible to the invasion and multiplication of genuinely infectious organisms.

It is plain that the liability to infection from food will vary according to locality and season. In some places and among some races the proportion of uncooked food used is much greater than in other places and among other races. In general, in summer and in autumn the quantity of fruit and food ingested in the raw state is greater than at other seasons; and during the summer and autumn there is also greater danger from the transportation of disease-germs from the ground in the form of dust, and the amount of liquids imbibed is greater. The elements of predisposition, according to place and time, upon which epidemiologists are so fond of laying stress, are not, therefore, absent from the source of infection now under consideration.

I have thus far spoken only of the secondary infection of food by pathogenic micro-organisms; but, as is well known, the substances used for food may be primarily infected. Chief in importance in the latter category are the various entozoa and other parasites which infest animals slaughtered for food. The dangers to mankind resulting from the diseases of animals form a separate theme, which would require more time and space than this address affords for their proper consideration. I shall content myself on

this occasion with only a brief reference to infection from the milk and flesh of tuberculous cattle.

It has been abundantly demonstrated by numerous experiments that the milk from tuberculous cows is capable, when ingested, of causing tuberculosis. How serious is this danger may be seen from the statistics of Bollinger, who found, with cows affected with extensive tuberculosis, the milk infectious in eighty per cent of the cases; in cows with moderate tuberculosis, the milk infectious in sixty-six per cent of the cases; and in cows with slight tuberculosis, the milk infectious in thirty-three per cent of the cases. Dilution of the infected milk with other milk or with water diminished, or in sufficient degree removed, the danger of infection. Bollinger estimates that at least five per cent of the cows are tuberculous. From statistics furnished me by Mr. A. W. Clement, V.S., it appears that the number of tuberculous cows in Baltimore which are slaughtered is not less than three to four per cent. Among some breeds of cattle, tuberculosis is known to be much more prevalent than this.

There is no evidence that the meat of tuberculous cattle contains tubercle bacilli in sufficient number to convey infection, unless it be very exceptionally. Nevertheless one will not willingly consume meat from an animal known to be tuberculous. This instinctive repugnance, as well as the possibility of post-mortem infection of the meat in dressing the animal, seems to be good ground for discarding such meat. The question, however, as to the rejection of meat of tuberculous animals, has important economic bearings, and has not been entirely settled. As to the rejection of the milk from such animals, however, there can be no difference of opinion, although this is a point not easily controlled.

The practical measures to adopt in order to avoid infection from the food, are, for the most part, sufficiently obvious; still it is not to be expected that every possibility of infection from this source will be avoided. It is difficult to discuss the matters considered in this address without seeming to pose as an alarmist; but it is the superficial and half knowledge of these subjects which is most likely to exaggerate the dangers. While one will not, under ordinary circumstances, refrain from eating raw fruit or food which has not been thoroughly sterilized, or from using unboiled or natural waters in the fear that he may swallow typhoid or cholera bacteria, still, in a locality infected with cholera or typhoid-fever, he will, if wise, not allow himself the same freedom in these respects. Cow's milk, unless its source can be carefully controlled, should, when used as an habitual article of diet, as with infants, be boiled, or the mixed milk of a number of cows should be selected; but this latter precaution offers less protection than the former.

In most places in this country we are sadly lacking in good sanitary inspection of the food, especially of the animal food, offered for sale. One cannot visit the slaughter-house in Berlin or in Munich (and doubtless similar ones are to be found elsewhere), and watch the intelligent and skilled inspection of the slaughtered animals, without being impressed with our deficiency in this respect. In large cities an essential condition for the efficient sanitary inspection of animal food is that there should be only a few places, and preferably only one place, where animals are permitted to be slaughtered. Skilled veterinarians should be selected for much of the work of inspection.

It may reasonably be asked that the national government, which has already spent so much money for the extermination of such diseases as pleuro-pneumonia of cattle and hog-cholera, which are not known to endanger the health of mankind, should turn its energies also to means for eradicating tuberculosis from cattle, which is a scourge not only to the economic interests of farmers and dairymen, but also to the health of human beings.

Without any pretension to having done more in this address than to sketch here and there a few principles derived from bacteriological researches concerning only some of the most widely distributed external sources of infection, I trust that enough has been said to show the folly of any exclusive dogma as to modes of infection. The ways of infection even in one and the same disease are manifold and various, and can never be resolved into exclusive hypotheses, such as the drinking-water hypothesis, the ground hypothesis, etc.

It follows, therefore, that it is not by sanitary improvements in one direction only that we can control the spread of preventable epidemic diseases. In one situation improvements in the supply of drinking-water check the prevalence of typhoid-fever, in another place similar measures show no such influence; or, again, in one city the introduction of a good system of sewerage diminishes epidemic diseases, and in another no similar result follows. We should therefore aim to secure, as far as possible, good sanitary arrangements in all directions and in all respects.

It has also been rendered evident, in what has been said, that infectious agents differ markedly from each other in their behavior; so that, while public sanitation aims at those measures which are found to be most widely beneficial, it should not forget that each infectious disease is as much a separate problem in its prophylaxis as in its symptomatology, etiology, and treatment. It will not aim to combat cholera with the means found best adapted to scarlet-fever, but it will adapt preventive measures as directly to the specific end in view as possible. In presenting to you the results of researches chiefly bacteriological concerning the scientific basis of preventive medicine, I hope to escape the accusation of one-sidedness and narrowness by the statement that I do not for a moment intend to imply that the bacteriological method is our only source of accurate knowledge on the subjects which have been considered. My aim is accomplished if I have succeeded in making clear that this method has established facts which aid in a clearer conception of the causes of some important infectious diseases, in a better understanding of the sources and dangers of infection, and in a more efficient selection and application of sanitary measures.

If this science of only a few years' growth has furnished already acquisitions to knowledge so important, so far reaching, may we not look forward with assurance to the solution of many dark problems in the domain of infectious diseases,—problems the solution of which may yield to preventive medicine a future of usefulness and success which we cannot now foresee?

LUCERNE OR ALFALFA.

DURING the past two years considerable has been written concerning the value of alfalfa as a forage-plant and for hay. Experiments in a limited way have been made at the Agricultural Station at Geneva, N.Y., of which Mr. Peter Collier is the director, since 1882.

Alfalfa or lucerne is botanically the same plant (*Medicago sativa*, Lin.), and one of the clover or leguminous family. Alfalfa has been grown in Greece for nearly three thousand years as a forage-plant. The Romans esteemed it very highly, and Columella writes that it yielded four to six crops a year. In France the plant is known as lucerne, and in Spain as alfalfa. It is grown quite extensively in southern Europe. From Spain alfalfa was introduced into South America, and thence by way of Mexico to California, where it still retains the Spanish name, alfalfa. While in California and many of the Western and Southern States it is grown quite extensively, it has never been much cultivated in the Northern States. In the Eastern States it was introduced from Europe, and is generally known as lucerne. The alfalfa from California is said to withstand drought far better than the lucerne of Europe, while the lucerne withstands cold winters better than the alfalfa.

It seems to be the prevalent opinion that lucerne does not flourish well so far north as New York State, but seven years' experience with it at the Geneva station proves that it can and will thrive well in this latitude. Chancellor Livingston experimented with it with good results on his estate in Columbia County nearly ninety years ago. It has been generally conceded, that, in order to succeed, lucerne must have a deep, sandy, or light loam soil. The experience of the station has been upon heavy clay loam, some of it of a cold retentive nature. This indicates that alfalfa will thrive well upon other than sandy or light loamy soils. Two acres and a half of lucerne now growing at the station, on three parts of the farm, show well the capabilities of the plant to withstand the drought and northern winters. In 1882 two plats were put down to lucerne and alfalfa. These plats have yielded several crops each season since. In 1888 they were cut three times, and yielded an average

of about fifteen tons per acre of green fodder, after having been down to grass from the original seeding six years.

From the analysis of alfalfa for different years as grown at the station, at the period of full bloom it was found to contain 67.46 per cent of water. With the figures of the analysis as the basis, it is found, that if the fifteen tons of green fodder, having a composition like the above, were converted into hay, they would be equal to 5.6 tons of hay per acre. The chemical composition of this hay is shown by analysis to be much like red-clover hay, and to contain nearly as much albuminoids as does wheat-bran. The total amount of fertilizing matter removed from one acre by the crop for the year was very large. Especially is this true of the nitrogen, potash, and lime. Alfalfa is pre-eminently a lime-loving plant, and it is generally recommended to apply a good dressing of lime to the soil before putting down to alfalfa.

In a feeding trial made at the station during the past winter, the digestibility of alfalfa hay was determined. The subject for experimentation was a four-year-old Jersey cow, in milk about two months when the trial was made. Feb. 23 the feeding of alfalfa hay was begun. Twenty-five pounds per day were offered, and, during the five days on which the dung was saved, an average of 24.31 pounds, or 389 ounces, per day were eaten. The amount of dry matter consumed per day was 322.7 ounces.

By comparison of the results with those for the digestibility of clover hay as found by Armsby, it is found that alfalfa is considerably more digestible than red clover. Especially is this true for the albuminoids and nitrogen-free extract.

Some notes from station experience, on the method of preparing the soil for planting out lucerne-seed and for curing the hay, may be of interest to those who contemplate making a trial of this crop.

Perhaps the best time to sow alfalfa is in the spring. The earliness will depend on the condition of the soil, moisture, and warmth. A crop that is to hold the ground, so long as we expect alfalfa to produce profitably, should have a faultless seed-bed prepared for it to start on. This is especially desirable where the first year's growth may be expected to be small, and may be overcome by weeds if any exist with it, and care is not taken to reduce them to a minimum. It would be well to specially prepare a suitable piece of land with a late summer fallow, or some crop which can be kept hoed free from weeds. Then, when the land is in good condition to work in spring, make a nice bed, and, if there is likelihood of many weeds starting on it, wait a week for them to germinate, harrow up well, and at once sow the alfalfa-seed if it is to be broadcasted. If it is to be drilled and cultivated the first season, the harrowing before seeding may be omitted. Roll the soil with a moderately heavy roller after sowing the seed. This will compact the soil about the seed, and hasten germination.

Having the crop started, one has only to watch the growth, and, if vigorous enough, it may be cut the first season. If allowed to stand too long, alfalfa becomes hard and woody in the stalk: hence a part will be wasted. It will also draw too largely from the roots for the good of the succeeding crops: so it seems best to cut it during the first period of good weather after the blossoms begin to appear. If designed for soiling, it should be wilted before feeding, to be sure that animals will not eat enough to cause hoven. This can be done by cutting feed one day ahead in fair weather, or longer if there is an appearance of storm.

If designed for hay, it must be very carefully handled, for like all the clovers, and to a greater extent perhaps, its leaves will drop off during the curing and housing, and leave only a mass of bare stalks instead of the bright green leaves and blue blossoms which ought to stay on for the best hay.

A good time to mow is in the afternoon, so it will wilt but not dry much before night. The next forenoon or toward evening, after the leaves become tough, pitch together into small cocks from the machine-swath.

Two active men can pitch from three to five swaths together quite fast, and, if wide barley-straw forks are used, there will be little use for a rake. After the cocks are made, they should stand two or three days before pitching over; then put two or three into one, if making well, and observe to turn every forkful bottom up, and spread out the thick green bunches so they will be brought

into contact with the dry portions. All the work of pitching, from the first to the final mowing away, must be done when the alfalfa is tough, but not wet from dew in the morning or evening. Never handle clover when it rattles, for the leaves will be broken and wasted. A second or third handling will be needed before the hay will be fit to store. The drawing should be done early in the forenoon; and, if the bottom layers of hay are wet, the cocks can be overturned from the sun, and, after a few minutes' exposure, will be dry enough to load. Alfalfa or other clover hay made in this way comes out fresh and bright, and retains its leaves and flowers to an extent beyond the belief of those who are accustomed to rake clover with a horse, open out the hay to the sun, and pitch it in the heat of the day. The value saved will be worth all the extra time, if any is required.

The result of the station experience with lucerne or alfalfa may be summarized as follows: 1. That lucerne or alfalfa may be successfully grown in New York State; 2. That when once established, it thrives well upon clay land, but will probably do better upon good light loam; 3. That seed two years old loses its vitality, and fails to germinate (undoubtedly many of the failures to secure a stand of plants may be traced to poor seed); 4. That the seed-bed must be well prepared, and in this latitude it seems best to plant out the seed in the spring, and with no other crop (the seed should be but lightly covered by rolling the ground); 5. That for seven successive years at the station three and four cuttings per year have been taken from the plats; 6. That last year, the sixth in succession, the plats yielded more than fifteen tons per acre of green forage, equal to 5.6 tons of alfalfa hay; 7. That alfalfa should be cut in early bloom, before the plants become woody; 8. That it should be cured largely in the cock to produce the best quality of hay; 9. That by chemical analysis the hay was found to be more nitrogenous than good red clover; 10. That cattle, sheep, and horses all relished the hay, and seemed to do well; 11. That it was found to be more digestible than red-clover hay; 12. That if farmers would try this crop, it is advisable to begin with a small piece of well-prepared land, in order to see whether alfalfa does as well with them as it has at the station; 13. That probably success with alfalfa will depend largely upon having fresh seed, a good, carefully prepared seed-bed, and in covering the seed lightly with soil.

HEALTH MATTERS.

PNEUMONIA. — Drs. C. W. Townsend and A. Coolidge, jun., of Boston, from a study, published in *The Medical News*, of all the cases of lobar pneumonia treated at the Massachusetts General Hospital, from the first case, in 1822, up to the present day, find that (1) in the thousand cases of this disease treated between those dates there was a mortality of 25 per cent; (2) the mortality has gradually increased from 10 per cent in the first decade, to 28 per cent in the present decade; (3) this increase is deceptive for the following reasons, all of which were shown to be a cause of a large mortality, — (a) the average age of the patients has been increasing from the first to the last decade, (b) the relative number of complicated and delicate cases has increased, (c) the relative number of intemperate cases has increased, (d) the relative number of foreigners has increased; (4) these causes are sufficient to explain the entire rise in the mortality; (5) treatment which was heroic before 1850, transitional between 1850 and 1860, and expectant and sustaining since 1860, has not, therefore, influenced the mortality rate; (6) treatment has not influenced the duration of the disease or of its convalescence. It must, however, be admitted that the present treatment of expectancy — a treatment which makes the patient as comfortable as possible, preserves his strength, and avoids every thing harsh — is certainly far more agreeable to the patient than the former heroic method. After these studies, we cannot but admire the regular and uniform manner in which pneumonia — that type of self-limited diseases — has run its course in all these years, uninfluenced by the varying treatment it has received.

DR. BROWN-SEQUARD'S HYPODERMIC FLUID. — The extraordinary statements made by Professor Brown-Séquard as to the efficiency of hypodermic injections of fluid expressed from certain tissues of young animals in senile debility have been to a certain

extent confirmed by M. Variot, who made a communication to the Société de Biologie on June 29. The patients chosen were debilitated men, aged fifty-four, fifty-six, and sixty-eight years respectively, and they were not informed of the nature of the treatment adopted. In all three cases the injections were followed by general nervous excitement, increased muscular power, and stimulation and regulation of digestion. M. Brown-Séquard said that M. Variot's observations disposed of the objection that the results he had observed in himself were due to "suggestion."

THE HEREDITY OF MYOPIA. — If the opinions of various ophthalmologists concerning the heredity of myopia were recorded here, the result would be an accumulation of vastly conflicting statements. This, however, would be largely due to lack of precision in investigating the subject. Lately Dr. Motais has carefully studied both the history and course of disease in 330 cases of myopia occurring in young people, and has arrived at the following conclusions, which are given in *The Medical News*: 1. The hereditary influence of myopia is manifest; 2. Out of 330 cases, the families of 219 were afflicted with the same disease (this shows a percentage of 65 per cent); 3. Hereditary myopia is distinguished from acquired myopia by (a) its more early appearance, (b) its more rapid development, (c) its greater severity, (d) its being more frequently followed by other complications (in short, hereditary myopia is far more serious than the acquired form of the disease); 4. Myopia is usually transmitted from the father to the daughter (86 per cent), and from the mother to the son (79 per cent); 5. The principal conditions which favor the transmission of hereditary myopia are, (a) use of the eyesight under bad hygienic surroundings (whether in school or at home), (b) Astigmatism (14 per cent), (c) Microsæmia (diminution of the orbital arch), 16 per cent; 6. The increase of the disease in hereditary cases was, in 6 per cent of the cases, found to be mainly the fault of those who had charge of the child's education. If care is not taken, acquired myopia will not restrict itself to the individual, but may also be transmitted unto their children.

ELECTRICAL NEWS.

WIRING OF SHIPS. — In order to avoid any disturbance of the magnetism of the compass of a vessel by the powerful currents used in electric lighting, Sir William Thomson recommends the exclusive employment of a two-wire system, the positive and negative mains being not far apart save in those cases, of rare occurrence at present, in which alternating currents are employed. A galvanometer of simple construction should also be made use of, for the purpose of ascertaining that the outgoing and return currents are of the same strength, or, in other words, that no leakage is occurring. Further, the magnetic leakage from the dynamo should not be sufficient to cause any appreciable disturbance of the compass-needle, which may be tested by observing this needle at the moments of starting and stopping the dynamo. In opposition to Sir William, says *Engineering*, Mr. Alexander Siemens, whose firm have fitted up a large number of vessels with the electric light, has not found any special precautions necessary, the single-wire system being employed in every case. As for the dynamo, he has never found any disturbance from this cause, provided that there was a distance of fifty feet between the dynamo and the binnacle.

BOOK-REVIEWS.

Autobiography of Friedrich Froebel. Tr. by EMILIE MICHAELIS and H. KEATLEY MOORE. Syracuse, C. W. Barden. 12°. \$1.50.

THE bulk of this volume consists of a letter from Froebel to the Duke of Meiningen, to which is added an extract from another of his letters, and several notes by the translators. The letter to the duke relates to the early part of the author's life, from his birth to the establishment of his school at Keilhau, where his system of education, since known as the kindergarten system, was first definitely carried into practice. The letter to the duke of Meiningen is unfinished, and whether it was ever delivered to the duke at all is uncertain. But, however that may be, the letter gives a full ac-

count, not only of the writer's early life and education, but also of his theory of education in general. His practical method, unfortunately, receives but scant mention; and, if we had no other sources of information than this book contains, we should be at a loss to know what his improvements in education really were. His theories however, and the pantheistic philosophy on which they are based, are expounded superabundantly, page after page being filled with what is little better than vapor. He is forever talking about the "unity and inner connection" of things, "the inner law and order embracing all things." Whenever he studied any subject, he always sought for this "inner connection," and he complains of Pestalozzi's school, which he visited, as lacking in inner harmony and unity. Precisely what he meant by these phrases it is sometimes difficult to ascertain; but they are repeated till the reader is weary of them. He had, as even his translators admit, an absurdly exaggerated sense of the importance of his educational methods. He seems to have thought that the wisdom of ages and the accumulated experience of mankind were worthless, and declared that he wanted "the exact opposite of what now serves as educational method and as teaching-system in general." Indeed, he seems to have thought that he was going to revolutionize the culture and life of humanity, whereas all he has accomplished is some slight improvements in the education of children. Of his ardent devotion and spirit of sacrifice for the good of others, this book bears abundant evidence. He was often in pecuniary difficulties, yet, amid them all, he steadfastly pursued his course after he had once learned his true vocation as an educator. It is to be regretted that the translators have not given a fuller account of Froebel's more elaborate experiments in teaching, to which he really owes his influence and fame, and which are scarcely touched upon in his autobiographical letter. As it is, we get from this book an interesting account of his early life, and of his theories and aspirations, but very little information as to the inception and introduction of those practical methods in which his real life-work consisted. However, we must be thankful to the translators for giving us the autobiography in English, and, as they themselves remark, wait till some adequate biography appears for the fuller information we desire.

AMONG THE PUBLISHERS.

"THE Life of Harriet Beecher Stowe," by her son, Rev. Charles E. Stowe, is now passing through the Riverside Press, and will be given to the public early in the autumn. It will be a book of peculiar personal and literary interest, and will appeal to a host of readers on both sides of the Atlantic. It is to be a handsome volume, embellished with fine portraits and other illustrations, and will be sold by Houghton, Mifflin, & Co. by subscriptions.

— Messrs. Ginn & Co. announce for publication in August "Myers's General History," by P. V. N. Myers, president of Belmont College. This book is based upon the author's "Ancient History" and "Medieval and Modern History," and is characterized by the same qualities as mark the earlier works. It is believed that the difficult task which the author set for himself, of compressing the fourteen hundred or more pages comprising the two text-books mentioned into a single volume of about seven hundred pages, has been accomplished without impairment either of the interest or of the easy flow of the narration. The greatest care has been taken to verify every statement, and to give the latest results of discovery and criticism. The book is provided with between twenty and thirty colored maps, besides nearly two hundred sketch-maps, woodcuts, and photogravures. The illustrations have been drawn from the most authentic sources, and nothing has been admitted save what is illustrative and truthful.

— Sampson Low & Co. have published a work entitled "Englishmen in the French Revolution," by Mr. J. G. Alger, which is based upon much personal research among unpublished documents both at the Record Office and in Paris. Besides incorporating two articles that originally appeared in the *Edinburgh Review*, dealing with the early days of the Revolution and the Terror, chapters are added about the prisoners of war, the opening of Paris by the peace of Amiens, and the subsequent imprisonment

of visitors in France by Napoleon. Attention has been given not only to spectators, deputations, and victims, but also to those writers who sympathized with the downfall of the *ancien régime*.

— Dr. Nansen, the Arctic explorer, has made arrangements with Longmans, Green, & Co. for the publication of an account of his recent Greenland expedition. The book will be ready early next spring, and will be illustrated with maps and plates.

— Kegan Paul, Trench, & Co. will shortly publish the first number of a new serial devoted to the reproduction of selected works of the foremost photographers of the day. It is proposed to issue quarterly a portfolio of four photogravure pictures from the negatives of "Sun Artists," such as will tend to advance photography in the estimation of the art-loving public, and obtain for it the position which it now claims. The first number of "Sun Artists" will consist of four studies by Mr. J. Gale, on imperial quarto paper, with letterpress.

— Funk & Wagnalls have just issued a practical little book, entitled "Emergency Notes," in which Dr. Glentworth R. Butler tells in a clear, easily understood way what to do in the emergencies that are ever arising in this world of multiplied diseases and accidents.

— A. C. Armstrong & Son have, by arrangements with Rev. C. H. Spurgeon and his English publisher, issued the first volume of his new work entitled "The Salt Cellars," being proverbs and quaint sayings, together with homely notes thereon. It is alphabetical in arrangement, and brings the proverbs down to the letter M.

— D. Appleton & Co. will publish immediately "Christianity and Agnosticism," a controversy consisting of the papers by Henry Wace, Professor Huxley, W. H. Mallock, the Bishop of Peterborough, and Mrs. Humphry Ward, which have been appearing in different periodicals, and which many persons desiring to get at the complete discussion will be glad to have in one volume.

— George O. Seilhamer, 112 North 12th Street, Philadelphia, has nearly ready the second volume of his "History of the American Theatre," treating of the period during the Revolution and after. The last volume, which is in preparation, will treat the subject in the "Last Years of the Eighteenth Century."

— Little, Brown, & Co. have in preparation "Myth and Folk-Lore of Ireland," by Jeremiah Curtin, an original and fresh contribution to the already rich store of the folk-lore of the "Emerald Isle," extracted by the author from Gaelic sources.

— Messrs. Ginn & Co. announce for publication about Oct. 1, "History of the Roman People," by Professor W. F. Allen of the University of Wisconsin. This will replace the second part of Myers's "Outlines of Ancient History." This sketch of Roman history will place especial emphasis upon two series of events, — first, the policy and process by which the Roman Dominion was secured and organized during the republic, its re-organization under the empire, and final disruption at the time of the German migrations; second, the social and economical causes of the failure of self-government among the Romans, and the working of the same forces under the empire (in this point of view, the history of religion among the Romans will be carefully traced).

— Hereafter the *American Journal of Psychology* will be published from Clark University, Worcester, instead of from Johns Hopkins University, Baltimore. Remittances and business communications should be addressed to the clerk of Clark University, Worcester, Mass., and scientific and editorial communications to G. Stanley Hall, editor, Clark University, Worcester, Mass.

— G. P. Putnam's Sons announce among their first autumn publications, "The Industrial Progress of the Nation, Consumption Limited, Production Unlimited," by Edward Atkinson, author of "The Distribution of Products," etc.; "A Race with the Sun," a sixteen-months' trip around the world, by Hon. Carter H. Harrison of Chicago, illustrated by many full-page plates; "The Modern Chess Instructor," by W. Steinitz; "Christian Theism, its Claims and Sanctions," by D. B. Purinton, LL.D., vice-president of West

Virginia University, and professor of metaphysics; "To the Lions," by Alfred Church; "A Woman's War Record, 1861-1865," by Mrs. Gen. Charles H. T. Collis; "Lectures on Russian Literature," by Ivan Panin; "The Practical Pocket Dictionary in Four Languages, — English, French, German, and Italian;" and "Tales from the Korea," collected and translated by Henry N. Allen, secretary of the Korean Legation. In the Story of the Nations Series they will publish "The Story of the Hansa Towns," by Helen Zimmern; and in the Knickerbocker Nuggets, "Sesame and Lilies," by John Ruskin; "The Autobiography of Benjamin Franklin;" "Tales by Heinrich Zschokke;" and "Great Words from Great Americans," the last comprising the Declaration of Independence, the Constitution of the United States, Washington's Inaugural Addresses, Lincoln's Inaugural Addresses, Lincoln's Gettysburg Address.

LETTERS TO THE EDITOR.

*.*Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

The editor will be glad to publish any queries consonant with the character of the journal.

Twenty copies of the number containing his communication will be furnished free to any correspondent on request.

A Circular Note to Working Entomologists.

MOSQUITOES and house-flies are perhaps the most numerous, widely distributed, and persistent of the creatures that attack the health and comfort of human beings. Of their attacks upon our comfort every one is aware. Scientific investigation favors the belief that tuberculosis and ophthalmia are carried from diseased persons to healthy ones by the house-fly, and German experimenters have shown that serious blood maladies may be transmitted by the mosquito.

Certainly, therefore, any suggestion, however remote, of a means of decreasing the numbers of or exterminating these pests, should be followed with all possible skill and patience.

I have observed dragon-flies gathering in scores around my camp in Minnesota to feed on the mosquitoes. I recently saw a dragon-fly that had devoured over thirty house-flies still voracious for more. Entomologists have observed the larvæ of the dragon-fly swallowing undeveloped mosquitoes in large numbers.

Now, may we not have in the active, voracious, harmless "mosquito-hawk," an agency for greatly diminishing the numbers of the smaller insects?

Professor Baird's success in producing millions of healthy fish in a few laboratory boxes and jars, the propagation of silkworms by scores of millions from eggs carried half around the world to Italy, the success of the plan for breeding foreign humble-bees in Australasia to fertilize the red clover, — these and many other similar facts seem to show that scientific methods have reached a stage where it is reasonable to hope that a plan may be devised whereby whole tribes of noxious insects may be exterminated by the artificial multiplication of their innoxious enemies.

Not being an entomologist, I have consulted with several distinguished students of that science as to the best means of reaching some practical result in the direction above indicated, and they agree with me that the following preliminary step may be usefully taken: —

For the purpose of drawing the attention of entomologists to the subject mentioned, I have placed in the hands of Morris K. Jesup, Esq., president of the American Museum of Natural History, New York City, \$200, to be paid by him in three prizes of \$150, \$30, and \$20, for the three best essays, based on original observations and experiments, on the destruction of mosquitoes and flies by other insects.

The following suggestions are made as to the direction in which the investigation should be carried and the essay formulated: 1. Observations and experiments upon various insects that destroy mosquitoes and house-flies, stating the method of and capacity of destruction; 2. Observations and experiments to determine the best dragon-flies to be artificially multiplied for the two above-named objects, — probably species of *Æschna*, *Libellula*, or *Di-*

plax; 3. Give detailed statements of the habits and life-history of the species chosen, based on original and careful experiments and observations; 4. Suggest a plan for breeding the insects in large numbers, with a sketch of apparatus, and estimated cost of producing them per thousand; 5. Formulate a plan for using the insects in the larva, pupa, or perfect state for the destruction of mosquitoes and flies, (a) in houses, (b) in cities, (c) in neighborhoods.

The prizes will be awarded after careful consideration by Dr. Henry C. McCook, vice-president of the Academy of Natural Science of Philadelphia, and vice-president of the American Society of Entomologists, and Dr. J. S. Newberry, president of the New York Academy of Sciences, professor of geology of Columbia College, and late chief of the Geological Survey of Ohio.

In awarding the prizes, clearness of statement obtained by accompanying sketches, and new and purely scientific facts in the life-history of the *Libellulide*, of which so little is known, will be duly considered.

All the essays received may be published wholly or in part, at the discretion of the judges, and full credit will in all cases be given to each observer.

The essays should be forwarded by Dec. 1, 1889, to Mr. J. H. Winsor, at the American Museum of Natural History, 77th Street and 8th Avenue, New York, to whom all communications should be addressed.

ROBERT H. LAMBORN.

37 Nassau Street, New York, July 15.

Are Beech-Trees ever struck by Lightning?

REFERRING to note on p. 7 of *Science* for July 5, and letter on p. 50, July 19, I here record some observations on the same subject. During a prolonged summer drought, about one o'clock P.M., the sun was shining brightly, but a small cloud came from the south-east; and while two other gentlemen and I were seated in my parlor, conversing, a flash was seen, and a sharp explosion heard. In a few moments a man came in, announcing that he had been thrown from the wagon, the driver knocked down, also five of the six oxen, "three of which were killed by lightning." Hastening to the spot, about two hundred feet from the parlor, we found the wagon under the branches of a large beech-tree a few feet from the trunk, the wheels in contact with roots, the fore-wheels having passed the trunk; the oxen all recovered and standing, save the farthest one from the tree. He was dead, and never moved a muscle. The messenger was seated on the hinder part of the wagon when struck and knocked down. The driver walking on the opposite side of the tree, perhaps ten feet from the trunk, but some of the spreading branches almost touching his head, was knocked down, somewhat stunned, and, although standing on our arrival, had not fully regained his wits, nor his hat.

The tree was tall, and thickly branched to the top. On careful and minute examination, we found no mark of electricity on trunk, root, or branch; but later we discovered, perhaps twelve or more feet from the top, a space about three inches wide and six or eight feet long, as we guessed, from which the bark was torn and the wood grooved. Some days later we discovered that a strip of bark extending from the rent above mentioned to the earth was dead and peeling off, and the wood grooved. Our conclusion was that the electricity mostly passed between the bark and the wood, there being most moisture at plane of contact. Not a drop of rain fell during the day, nor during many weeks before and after the above incidents.

This is by no means the only instance in which I have known the beech-tree struck by lightning, nor the only one in which the electricity seemed, at least, to pass between bark and wood of beech, oak, tulip-tree, black gum, *Magnolia grandiflora*, etc.

Why was neither man killed in this instance, and only the ox farthest from the stricken tree? The explanation is simple enough. Here was a ridge gently sloping to the east, west, and south. The stricken tree was perhaps twenty feet from the lowest western level. One ox had placed one foot on the lowest spot of ground which it is presumed was near moisture beneath (the rest of the land being dried, and on the crest of the ridge to such a depth as to cause the death of several trees): the circle from moist earth through the ox, the chains, and iron of the wagon, was completed to the tree. One of the two oxen nearest the tree did not fall. All the phenomena caused me to think that the discharge was *from* the earth.

Having had many extraordinary, very undesirable, and extremely dangerous opportunities of witnessing phenomena of natural electricity, other facts may possibly be given later. D. L. PHARES.

Madison Station, Miss., July 24.

Breathing.

My attention has recently been called to your editorial comments on my observations made on the chest-movements of some eighty Indian females about two years ago, from which I felt justified in concluding that the abdominal was the original type of respiration in woman, and that the costal type has been acquired through the influence of abdominal constriction. Now, although this observation and conclusion was confirmed more recently by the experiments of Dr. Kellogg, who measured the chest-movements of a number of Chinese women in the Far West whose abdomens were never constricted by artificial appliances, you incline to the belief that "the question of what is the natural type of respiration may still be regarded as *sub judice*, unless (which perhaps may be the truth) both types are natural under varying conditions independent of dress," because "other observers, notably Hutchinson in his examination of twenty-four girls whose waists had never been constricted by corsets or other appliances, found the costal type present."

With the highest regard for your opinion, I beg to say that such a deduction is scarcely allowable from the premises of my researches. These show, in all probability, that Dr. Hutchinson's girls were not entirely free from the influence of abdominal constriction, even though they never wore corsets: for in the Indian the abdominal type obtains the highest form of development in the full-blooded girl, whose body, as well as the bodies of her ancestors, has never been subjected to the influence of abdominal constriction; and this type seems to disappear from the Indian girl in the proportion of the admixture of white blood in her veins. It is very probable, therefore, that heredity is an important factor in the maintenance of women's breathing; and any experiment or deduction which fails to give this due consideration will naturally lead to final disappointment.

So far as I know, Dr. Kellogg's and my own experiments are the only efforts which have been made to solve this problem by studying the respiratory movements in their most primitive condition in woman, and, until they are disproved by experiments based on identical conditions, I think they must be taken as conclusive.

THOS. J. MAYES.

Philadelphia, July 29.

Exchanges.

[Exchanges are inserted for subscribers free of charge. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

Lead, zinc, mudic, and calcite.—Lulu Hay, secretary Chapter 350, Carthage, Mo.

I will sell to chapters or individual members of the Agassiz Association, 25 fine specimens of fossil plants from the Dakota group (cretaceous), correctly named, for \$2.50. Send post-office order to Charles H. Sternberg (author "Young Fossil-Hunters"), 1033 Kentucky Street, Lawrence, Kan.

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"new model" double dry-plate holder (4" × 5"), for fine geological or mineralogical specimens, properly classified.—Charles E. Frick, 1042 West Lehigh Avenue, Philadelphia, Penn.

Drawings from nature—animals, birds, insects, and plants—to exchange for insects for cabinet; or I will send them in sets of ten each, for ten cents in stamps. My drawings in botany are in detail, showing plant, leaves, flowers, seed, stamens, pistils, etc.—Aida M. Sharp, Gladbrook, Io.

The undersigned wishes to make arrangements for the exchange of *Lepidoptera* of eastern Pennsylvania for those from other localities. All my specimens are named and in good condition.—Charles S. Westcott, 613 North 17th Street, Philadelphia, Penn.

California onyx, for minerals and coins not in my col-

lection.—W. C. Thompson, 612 East 142d Street, New York, N. Y.

Will such members of the Agassiz Association as botanize this summer, and can afford time, please observe for me any case of doubling in any flower and in any locality, stating name of flower (Gray), the abnormal change, the time and place found, and whether monstrosity is abundant or otherwise? Please address communications to Will G. Cole, 3643 Prairie Avenue, Chicago, Ill.

Any one who has a botanical box in good condition will please write. I will offer about 30 specimens in exchange.—C. B. Haskell, Box 826, Kanebunk, Me.

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The Committee has recently returned and has made a very interesting Report upon the general development of Kansas and Nebraska as well as the business of the Company. The Company will be glad to send this Report to any address.

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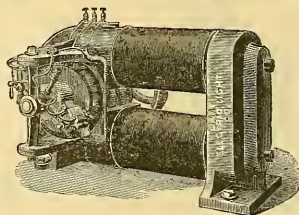
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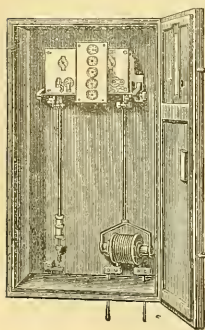
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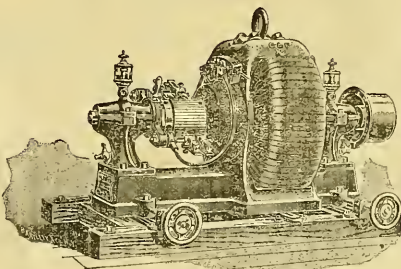
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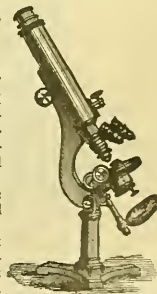
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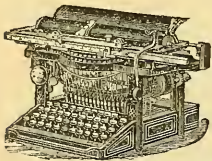
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ELECTRICAL DEVICES OF THE MUTUAL ELECTRIC COMPANY'S SYSTEM.

In last week's issue we presented illustrations of the Knowles dynamo and storage-battery as used by the Mutual Electric Company of Brooklyn. Several other electrical devices used by the same company are shown in the accompanying illustrations.

The Knowles meter is shown in Fig. 1. It is inserted in the main discharge circuit, and is arranged to record in lamp-hours, or, when preferred, directly in dollars and cents; so that a simple inspection will show the exact amount of current used, or its cost

potential to suit the requirements is secured by means of the switch at the head of the board, which throws in resistance sufficient to make the potential, as measured by a voltmeter in the charging circuit, the same as that previously found to exist between the terminals of the battery.

The Knowles current-indicator, as supplied with each dynamo, is shown at Fig. 3. It is arranged either with or without bell attachment for calling attention to excessive variation of the current. A safety cut-out, for use at the entrance of the circuit to buildings, or for loop circuits, is shown at Fig. 4. The Knowles

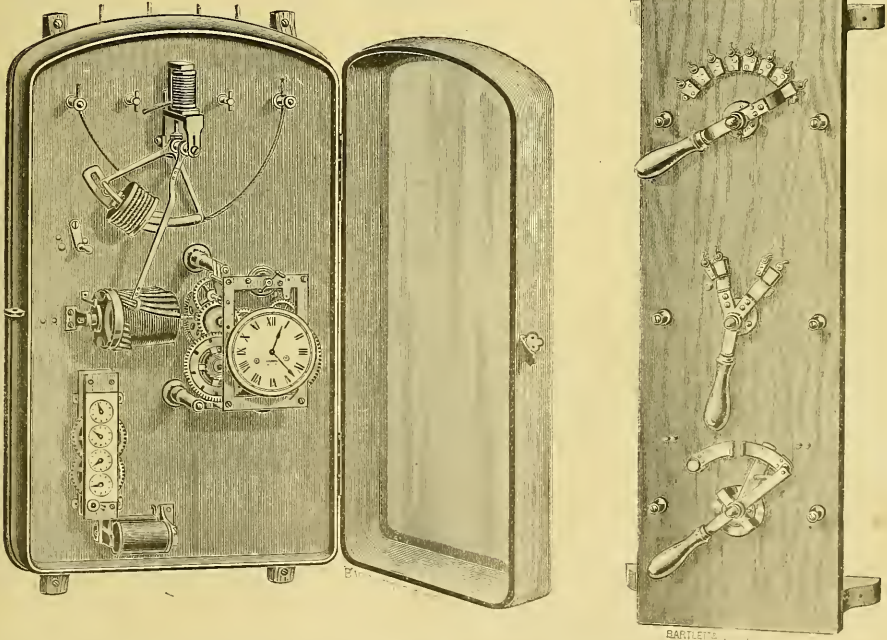


FIG. 1 AND 2.—METER AND BATTERY-CHARGING BOARD.

to the consumer. The meter is simple in construction, combining a varying electric device with a constant time device, and is not liable to get out of order under ordinary usage. It has a large range, and records equally well with low or high current strength.

A battery-charging board is shown in Fig. 2. Upon the board, as will be seen, are three switches, each between a pair of binding-posts. In operation, the 30-cell battery is connected to the binding-posts at the middle of the board, the lighting circuit to the upper pair of binding-posts, and the charging circuit to the lower pair. In charging the battery, a current of exactly the right po-

arc-lamps, single and double, are of simple construction, and steady and positive in action. A double lamp and its mechanism are shown in Figs. 5 and 7. The form of voltmeter and ammeter manufactured and used by the Mutual Electric Company is shown at Fig. 6.

This company now claims to have ready for the public a complete storage-battery system, an incandescent-light system, a traction system for street-cars, a car-lighting system, an arc-light system, a combination system, and a fire-alarm system,—all worked out by Mr. Knowles, electrical engineer of the company.

THE SPROUTING OF SEEDS.

It is well known that the germination of seeds is more or less influenced by many comparatively trivial circumstances and conditions; yet there have been no general inquiries in this country into the exact effects of these conditions, or their importance to the cultivator. Their relations to seed-testing have always seemed to Professor L. H. Bailey of the Cornell Agricultural Station to be of special importance, and it is in this direction that the investigation here referred to has been undertaken. Most of the published records of seed tests are obviously nearly valueless, because they

Seed-tests are of two sorts, — the determination of the purity of the sample as regards foreign material, as weed-seeds, chaff, dirt, and the like; and the determination of the germinative vitality. The former series of tests require a simple mechanical separation of the ingredients of the sample.

Germinative vitality is commonly estimated by per cent and rapidity of sprouting.¹ Rapidity of sprouting is held to indicate vigor or strength of seed, yet the results of many tests show that it is even more influenced by conditions than is the ultimate percentage of sprouting. Causes which determine the viability and vigor of seeds are either congenital, or due to the conditions of harvesting or

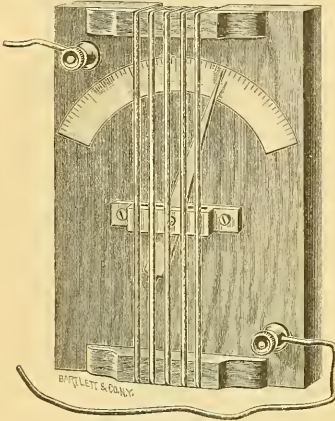


FIG. 4.

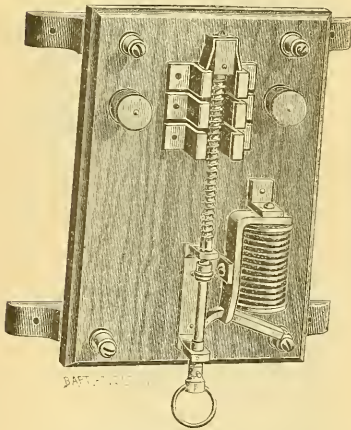


FIG. 4.

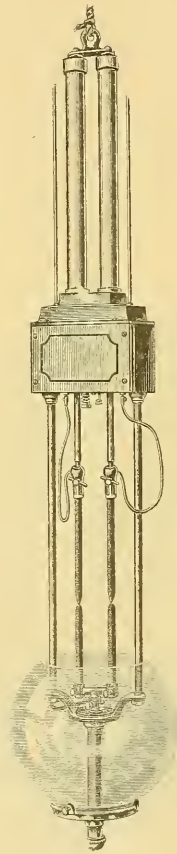


FIG. 5.

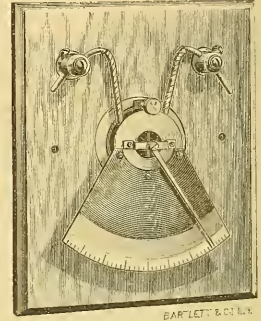


FIG. 6.

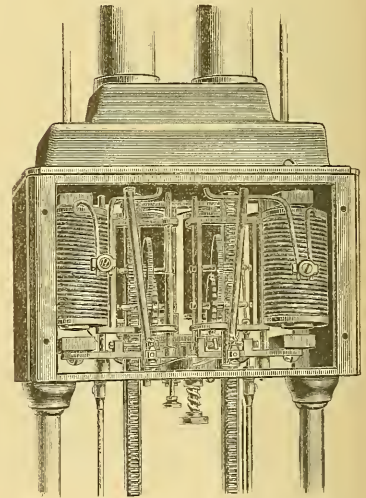


FIG. 7.

KNOWLES SYSTEM OF ELECTRICAL DISTRIBUTION.

take no account of the conditions of test. This is particularly true of those cases in which germinative vitality is recorded as low, for no assurance is given that other or more careful management might not have increased the percentages. It has been found repeatedly that a sample which gives very poor results under one treatment may give good results under another. The notes of experiments which follow may serve as suggestions to those who test: at all events, it is not too much to expect that the importance of care and uniformity in seed-testing will be emphasized. It is not to be expected that laws can be announced as the results of these somewhat discursive tests, but indications may be safely drawn in some instances.

The expression or measure of this viability and vigor is again determined by the conditions of germination. In the present investigation, with the exception of studies of the relations of weight and color to sprouting, only the conditions of germination have received attention. Seeds can be so readily selected in reference to weight and color, that it was thought advisable to study these phases of the subject in connection with conditions which may be fully controlled by the operator.

The importance of seed-testing is obvious, yet its value is ap-

¹ The verb "sprout" is used in preference to "germinate," as germination is complete only when the plantlet has assumed its true leaves, and has begun to assimilate. In seed-testing, the process is rarely carried to full germination.

parently commonly misapprehended. Its primary value is the determination of the vitality of a given sample. This testing, except in rare instances, should be conducted by the grower himself. The proper work for the experiment station is that of determining the best methods and conditions of testing each species and variety: in other words, it seems that the sphere of the stations is to discover and announce laws and rules, rather than to perform the petty tests for the multitude. Merely testing seeds for the purpose of determining how many will grow, is surely not experiment, and the publication of disconnected tests seems to be entirely unprofitable. The endeavor to determine the relative merits and honesty of seedsmen, by means of testing their seeds, is the merest folly.

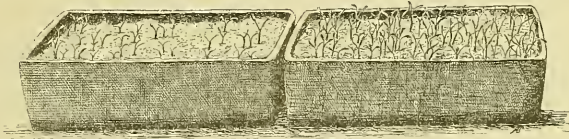
There appears to be no necessity for seed-control stations in this country, certainly not for such seeds as fall to the hands of the horticulturist. The control stations of the Old World have suffi-



FIG. 1.

ciently exposed the tricks of seedsmen, and have rendered open dishonesty unprofitable. There is now such sharp competition in the seed-business, that seedsmen themselves must exercise every caution in order to demand trade. Improved methods and apparatus for harvesting and cleaning are giving us clean samples. The greatest risk in the purchase of seeds is the possibility that inferior strains or varieties may be procured; but this is a risk which the control station could not assume to govern, inasmuch as the substitution becomes apparent only when the crop is grown. The experiment stations may be expected to influence sufficient control in the seed-business, as occasion shall require.

The tests enumerated in this article have been conducted with the greatest care. Unless otherwise recorded, they have been made in a steam-heated forcing-house. As a rule, they have been made in earth, in shallow earthen seed-pans. These pans are exceedingly convenient, and they afford good drainage. In some cases, lily-pans have been used, but they differ from the seed-pans only in their circular outline and somewhat greater depth. Illustrations of seed-pans may be seen in Figs. 3 to 7. For sowing seeds at uniform depths, two devices have been used. The simpler of these (Fig. 1) is nothing more than a block of half-inch stuff,



Wet Pan.

FIG. 3.

Dry Pan.

two inches wide, of the required length, upon which is nailed a cleat equal in thickness to the depth of sowing. The cleat is pressed into the soil evenly, and the seeds are dropped into the furrow it makes. The other device (Fig. 2) may be called the Tracy planter. It consists of two strips of heavy tin plate nearly three inches wide, hung upon two wire pivots or hinges some two inches long. At their upper edges, and equidistant from either end, the plates are joined by a firm spiral spring, which serves to throw the upper edges apart, and to cause the lower edges to join. This trough is filled with the required number of seeds, and is then inserted into the earth to a given depth, when the fingers push inward on the spring, and the trough opens and delivers the seeds.

ences of Constant and Variable Temperatures.

The tests here enumerated were made in an incubator of which the temperature was controlled by a galvanic current communicating with clock-work, and in a steam-heated forcing-house. In the incubator the temperature rarely varied three degrees, while the position of the seed-table in the forcing-house was such that variation sometimes amounted to sixty-five degrees. In some

cases, duplicate tests were made in an out-door cellar which was used for the storing of nursery stock.

The conclusions from the tests—seven with beans (Green Flageolet), one with peas (White Garden Marrowfat), one with radishes (Half-Long Early Scarlet), two with turnips (Red-Top Strap Leaf), and four with onions (Giant Yellow Globe Rocca)—were as follows:—

1. Different results are obtained from the same sample of seeds under different variations of temperature, of which the daily mean is essentially the same.

2. Sprouting takes place more quickly under essentially constant temperature of about 74° than under a temperature ordinarily variable, which gives about the same mean.



FIG. 2.

3. Rapidity of sprouting is particularly marked in beans and peas.

4. As the mean temperature becomes lower, rapidity of sprouting becomes slower.

5. Greater rapidity of sprouting does not appear to be correlated with greater per cent of total sprouting.

6. Constant temperature, of the degree here mentioned, does not appear to give greater percentages of sprouting: at least, the variation in this respect between the constant and variable temperatures is no greater than that which is usually obtained from tests conducted under identical conditions. In the seven tests with beans, however, there is an average gain of 5 per cent in favor of those under constant temperature.

II. Influences of Different Quantities of Water.

Mr. W. W. Tracy of Detroit, well known as an expert in the handling and testing of seeds, once said that he rarely obtained the same results from different tests of the same sample, if made in houses under the care of different men. He attributed this variation mostly to the various amounts of water habitually used by the different men. Acting upon this suggestion, a number of very

careful tests have been made in weighing the amounts of water used. The results have been the most marked of any which have ever come under Professor Bailey's notice in the testing of seeds.

The tests were all made side by side in a forcing-house, unless otherwise recorded, in earthen pans. The soil, with one exception, was a good quality of light potting earth, containing a good admixture of field-sand. Although the pans were very shallow, extra drainage was given by the use of broken pots. The samples which received the most water were rarely wet enough to drip: in fact, they had no more water than is given in many houses. The pans sparingly watered were dryer than they would be kept in most houses. The 8-inch round lily-pans are 4½ inches deep. The 10-inch seed-pans are 2½ inches deep, and the 12-inch pans 3 inches deep.

The conclusions drawn from the tests—two with tomatoes (Green Gage), two with cucumbers (Nichol's Medium Green), one with lettuce (Boston Market), two with carrots (Vermont Butter and Early Forcing), one with celery (White Plume), one with turnips (Early Six Weeks), one with pepper (Golden Dawn), two with Lima beans (Large White), and two with *Cobara scandens*

(Vaughan) — were, that (1) the quantity of water applied to seeds under test may make a remarkable difference in the results; (2) that sprouting is decidedly more rapid in tests which receive less than the usual amounts of water given in greenhouses (this is markedly the case in all the tests, with the exception of three indifferent and comparatively unimportant instances); (3) that the per cent of sprouting is much greater, as a rule, in the dryer tests; (4) that the addition of water above the amount to keep the earth simply moist is injurious; and (5) that the wide differences between the results of the wet and moist tests are not necessarily due to the rotting of the seeds in the wet tests (this is shown in the two tests with cucumber-seeds in which the dryer tests gave similar or even smaller totals than the wet tests).

In the tests with carrot, sprouting was remarkably more rapid in the dryer pan, and the per cent of sprouting was also very much greater, amounting to 47 per cent. Fig. 3, from a photograph, represents this test at its conclusion.

With the Lima bean, the per cent of sprouting was over 70 per cent greater in the dryer pan. This was due to the fact that more of the beans rotted in the wet pan. On May 22, twenty-six of the beans sown May 4 were rotten in the wet pan. Only six were rotten in the dryer pan, and ten were sprouting. It is known that seeds with a slight surface abrasion often germinate better than those which are uninjured; but this test indicates that great care must be exercised to water such seeds sparingly, as they are more

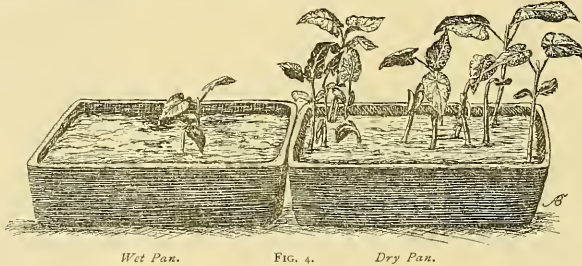
soaked seeds are sown earlier than the dry ones. If this advance in period of sowing is added to the date of sowing of the dry seeds it will be found that dry seeds as a rule sprout fully as early as soaked seeds, and many times much earlier.

3. The total amount of sprouting does not appear to be influenced by soaking.

4. Similar results are not to be expected from all species of plants.

IV. Influences of Character of Soil.

It is well known that texture of soil often has much to do with the germination of seeds in the field. Soils which bake, which become very dry, or which hold too much moisture, always tend to give a poor "stand" of crop. But the soils used in houses are such as to occasion no thought of their influence upon germination; yet there are cases in which such soils cause variation in seed-tests. This was particularly marked in a lot of beans tested this spring. Samples happened to be sown at the same time in potting soil on a bench, and under a cloth on the surface sand. Those in soil gave much poorer germinations than the others. Other sowings were therefore made from the same lot at given depths in sand for purposes of comparison. The figures cannot be presented in the limited space of this article, but it was found that sproutings were in some cases nearly twice as many in sand as in potting soil. More beans rotted in the soil than in the sand. The soil had not been sifted, and it contained some manure; yet it was only four



likely to rot. Fig. 4, from a photograph, represents this test on May 20.

III. Influences of the Soaking of Seeds before Sowing.

It is a common practice in both field operations and seed-testing to soak seeds in water before sowing. Several tests made indicate very clearly the leading results of this custom. In this connection it is interesting to study results with the Geneva seed-tester, which tests seeds by soaking them. A number of tests were made with the Geneva tester in comparison with sowing in potting soil in forcing-house. The results, which are too extended to be detailed here, indicate that higher sprouting tests are given by the Geneva tester than by planting under known conditions. Ten tests in each case with Marblehead Mammoth cabbage-seeds gave an average germination of 88 per cent in the tester, against 77.6 per cent in the soil. The earliness at which the sprouting is visible in the tester renders testing expeditious; but it must be remembered that full germination cannot often be secured in the apparatus. (Cf. § IX.)

The conclusions drawn from the tests — two with carrots (Early Forcing and Vermont Butter), four with tomatoes (one Green Gage, three Belle), one with turnips (Early Six Weeks), two with radishes (Early Scarlet Globe), and one with onions (Giant Yellow Globe Rocca) — were as follows: —

1. Great gain in rapidity of sprouting, counting from the time of planting, may be expected as a rule, if seeds are previously soaked in water; and the longer the seeds are soaked, within reasonable limits, the greater is usually the gain in rapidity of sprouting. This fact is interesting, in face of the experience that very profuse watering after sowing gives an opposite result. (Cf. § II.)

2. This gain in rapidity of sprouting in soaked samples is really fictitious, however, inasmuch as germination actually begins in the soaked seeds before the dry samples are sown. In truth, the

inches deep on the bench, and it would seem that the drainage was good. Tests in this direction warrant the following conclusions: 1. Variations in results of testing may sometimes be expected in consequence of character of soil in which the tests are made; 2. In the present instance, low results in potting soil, as compared with tests in sand, appear to be due to the greater amount of water held in the earth, causing the seeds to rot. The results may therefore be studied in connection with those upon the influence of varying amounts of watering. (Cf. § II.)

V. Influences of Light.

Darwin, in his "Cross and Self Fertilization" (American edition), p. 13, says, "On other occasions, from the want of time, the seeds, instead of being allowed to germinate on damp sand, were sown on the opposite sides of pots, and the fully grown plants measured. But this plan is less accurate, as the seeds sometimes germinate more quickly on one side than on the other. It was, however, necessary to act in this manner with some few species, as certain kinds of seeds will not germinate well when exposed to the light. . . . This occurred in the plainest manner with the seeds of *Papaver vagum* and *Delphinium consolida*, and less plainly with those of *Adonis estivalis* and *Ononis minutissima*. Rarely more than one or two of the seeds of these four species germinated on the bare sand, though left there for some weeks; but when these same seeds were placed on earth in pots, and covered with a thin layer of sand, they germinated immediately in large numbers."

Of late years there has been more or less said concerning the sowing of seeds for test upon the surface of soil, and covering with glass in order that every seed may be watched; and certain seed-testing apparatus have been devised upon this principle. It appears from Darwin's experience that with some seeds grave errors may occur from this practice, and further evidence of the

same nature is furnished from the tests here recorded. Several tests were made in which the seeds were sown upon the surface of soil in pots or pans; the pots, unless otherwise mentioned, being plunged in sphagnum moss to keep the soil moist. Over the top of the pot or pan was placed a pane of glass, or a close-fitting iron saucer or a board.

The conclusions from these tests — one with *Papaver rhoeas* (English poppy), one with larkspur (Dwarf Rocket), one with *Adonis aestivalis*, and one with radishes (Early Scarlet Globe) — were as follows: —

1. Very great differences in results may sometimes be expected between samples exposed to light during the process of sprouting and those kept in darkness.

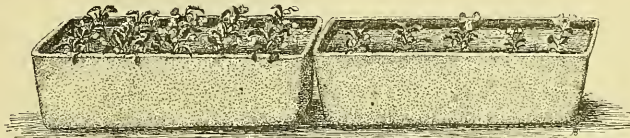
2. When such differences occur, they indicate that light retards or even wholly prevents germination.

3. In some species this influence of light is greatly marked, while in others it is not apparent.

4. It is apparent that those apparatus which test seeds by holding them on a porous plate above water are to be looked upon with distrust, unless provided with an opaque covering; and even then they may prove unsatisfactory, as the experience with the larkspur-seeds indicates that best sproutings follow planting in the soil.

VI. Weight of Seed in Relation to Sprouting.

Many experiments have been conducted this year upon the relation of weight of seed to germination, but the figures are too numerous to be recorded here. The general results of the tests may be indicated, however. Most of the work recorded in Sections VI. and VII. was performed under the direction of Professor Bailey, by



Heavy Seeds.

FIG. 5.

Light Seeds.

Mr. B. R. Wakeman, of the class of 1889, in preparation of a thesis for graduation.

Of itself, *per se*, weight appears to exercise no influence upon germination, but it is often a tolerably accurate measure of viability as determined by various causes. Broadly stated, it may be said that comparative lightness in a seed indicates arrested growth, and consequent lowness of germinative vitality.

Fig. 5, from a photograph, illustrates a test with radish-seeds, in which the differences were marked.

It is often true that over-ripe seeds germinate more slowly, and give lower total results, than others, and this over-ripeness is sometimes indicated by additional weight. It is to be expected, therefore, that in some instances best results in germination come from the seeds of lighter weight.

The conclusions from a number of tests — two with cabbages (one Red Dutch and one Flat Dutch), one with radishes (Early Scarlet Globe), one with beans (Improved Green Flageolet), and one with *Lathyrus sativus* (gesse), and others — were as follows: —

1. Variations in results of testing, both as regards rapidity of sprouting and the total amount, may be expected between seeds of different weights in the sample.

2. This variation is much greater in some species than in others. In these tests the variation was particularly marked in cabbage, radish, sweet pea, bean, gesse (*Lathyrus sativus*), burnet (*Poterium sanguisorba*), martynia, orach.

3. As a rule, the heaviest seeds in any sample give earliest and highest results.

4. In some cases the lightest seeds in the sample give earliest and highest results, apparently because the heaviest seeds, with which they are compared, are over-ripe; or in some instances under-maturity may result in earlier germinations, and such seeds are sometimes light in weight.

VII. Color of Seed in Relation to Sprouting.

Color may be assumed to indicate, in most cases, some vital character of the seed, as determined by various causes. In one species, or even in one individual sample, it may indicate a different character from what the same color does in another species or sample. It may indicate degree of maturity, method of curing, age of seed, or other peculiarity. It is to be expected, therefore, that color may sometimes designate more or less accurately the germinative vitality of the seed. It follows, however, that no general law of relation of color to germination can be announced: every species, and sometimes every sample, must be investigated for the law which governs itself. Many tests in this direction have been made, but one example will show something of the extent of variation in seeds of different colors.

With the bean (Green Flageolet), sproutings were most rapid, and higher in total per cent in the green-colored samples. This test was twice repeated with similarly marked results. The same variety from the Department of Agriculture gave opposite results, however.

Fig. 6 shows tests of white and green colored Lima beans, sown at the same time. The green-colored seeds are ahead.

Four tests with morning-glories (both *Convolvulus major* and *C. minor*) gave results uniformly in favor of white seeds as contrasted with black ones in the same sample.

From a considerable study of the importance of color in relation to germination, the following conclusions have been drawn: 1. Seeds which differ widely in color in any sample frequently give different results under test; 2. This variation in results may lie in

greater rapidity of sprouting, or in higher total amounts, or in both; 3. The relative values of seeds of different colors vary with each species, or sometimes with each sample.

VIII. Influences of Latitude.

Plants of high latitudes are more sensitive to heat and cold than those of the same species growing nearer the equator; i.e., they start or vegetate relatively earlier in spring. This subject has been investigated in several directions; but, so far as the writer is aware, it has not been pursued in this country in relation to germination of seeds. The following tests are incidental to this investigation, being a part of a general series of researches upon the influence of latitude upon plants, but they are suggestive in this connection.

A sample of white dent corn was secured from the Alabama Experiment Station, and samples of white and yellow dents were obtained from the South Carolina Station. The germination of these samples was compared with that of corn grown on the farm of Cornell University.

With corn from different latitudes, fifty kernels in each sample, sown one inch deep in 12-inch seed-pans, sprouting was much the most rapid in the New York corn, but differences in totals were evidently not due to influence of latitude. The plants from New York seed were by far the largest and most vigorous of any in the test during the month which they remained in the house. The Alabama seed gave the least vigorous plants, while South Carolina seeds gave intermediate results. Fig. 7, from a photograph, illustrates the New York and Alabama samples ten days after sowing.

Three other tests were made, with the same result. In one test the sample from New York was represented by seed taken from a crib of soft corn, yet this sample gave earliest results, though less marked than in the other instances. A similar lesson appears to

be taught by the behavior of the seeds of species of *Carex*, which were planted this spring. Of some eighty pots of seeds, collected by Professor Bailey in Europe last year, thirteen showed germination at the present time; and of these, all the most forward, with two exceptions, are northern species, collected in Scotland.

The conclusion is, that northern-grown corn appears to germinate more quickly than southern-grown corn.

IX. Variations in Duplicate Tests under Like Conditions.

It may be well to briefly call attention to the fact that scarcely any two tests made with seeds from the same sample, under conditions apparently identical, are exactly alike in results. It frequently happens that these results are so dissimilar as to give no warrant for expressing an opinion of the value of a sample from two or three tests.

The conclusions are that (1) one test cannot be accepted as a true measure of any sample of seeds; and (2) variation in duplicate tests is likely to be greater when seeds are planted in soil than when tested in some sprouting apparatus like the Geneva tester (cf. introduction to § III).

X. Comparisons of Results of Seed-Tests with Results of Actual Sowing in the Field.

It has been said recently that the ideal test of seeds is actual sowing in the field, inasmuch as the ultimate value of the seed is



White Seeds. FIG. 6. Green-Colored Seeds.

its capability to produce crop. This notion of seed-tests is obviously fallacious, although the statement upon which it is based is true; in other words, actual planting rarely gives a true measure of the capabilities of all the seeds of any sample, because of the impossibility to control conditions and methods in the field. The object of seed-tests is to determine how many seeds are viable, and what is their relative vigor. If planting shows poorer results, because of covering too deeply or too shallow, by exposing to great extremes of temperature or moisture, or a score of other untoward conditions, the sample cannot be held to account for the shortcoming.

Various samples were tested indoors, and actually planted in the field. The seeds were sown in the field June 5, and the last notes were taken from them July 5. They were sown on a gravelly knoll. Rain fell about every alternate day, and the soil was in good condition for germination throughout the month. The indoor tests were made in loose potting earth, or in sand in seed-pans.

The conclusions were, that (1) actual planting in the field gives fewer germinations than careful tests in conditions under control (this difference in total of germination, even under favorable conditions of planting, may amount to over 50 per cent); and (2) in planting, due allowance should be made for the comparatively bungling methods of field-practice by the use of greater quantities of seeds than would seem, from the results of tests, to be sufficient.

XI. Impurities in Samples of Garden-Seeds.

Over one hundred packages of seeds have been carefully exam-

ined for impurities, and in ninety separate instances the results have been tabulated and compared. This examination consisted in counting every seed in the sample, counting the impurities, weighing the seeds and the impurities, and determining, so far as possible, the character of the impurities. The percentages of impurities, both by number and weight, have been calculated. From these analyses it is easy to draw conclusions as to the probable extent of adulteration or impurity in garden-seeds. No evidence of adulteration was found, and weed-seeds were few and unimportant. In some cases the sample had not been properly cleaned, but in general the more important seeds were very free from impurities. The impurities were very largely immature and imperfect seeds. The average of impurities, by number, was found to be 2.76 per cent, and by weight, 1.38 per cent. The investigation appears to indicate that there is no necessity for seed-control stations in this country, for the purpose of preventing dishonesty and carelessness in the sale of garden-seeds. The detailed results will soon appear in *Agricultural Science*.

As a general summary of his results, Professor Bailey gives the following:—

1. The results of a seed-test depend very largely upon the known conditions under which the test is made,

1. Variations in temperature may cause variations in rapidity of sprouting.

2. An essentially constant temperature of about 74° gives

quicker results than an ordinarily variable temperature of a similar mean.

3. It is probable that any constant temperature gives quicker results than a variable temperature of which the mean is the same as the constant temperature.

4. As the mean temperature lowers, sprouting, as a rule, becomes slower.

5. In some instances, greater rapidity of sprouting, due to a constant temperature of 74°, does not appear to be correlated with greater per cent of total sprouting. In beans, however, greater per cent of sprouting appears to follow greater rapidity of sprouting.

6. There is probably a tolerably well defined optimum temperature for each species of plant, in which best results from seed-tests can be obtained. This limit is not closely determined for most garden-seeds.

7. The quantity of water applied to seeds may determine both the rapidity and per cent of sprouting.

8. A comparatively small amount of water gives quickest and largest results.

9. Greater quantities of water than are required for best results lessen rapidity and per cent of sprouting either by causing the seeds to rot or by retarding germination, or by both.

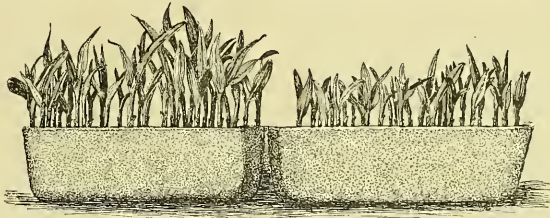
10. The soaking of seeds in water before planting does not appear to hasten sprouting if the planting time is reckoned from the time at which the seeds are put to soak; but, if planting-time is counted from the time of placing the seeds in soil, quicker sproutings are the result. This method of reckoning is incorrect, however.

11. The soaking of seeds does not appear to influence the total amount of sprouting.
12. The results of soaking appear to vary in different species.
13. The character of soil in which the test is made may influence the results, both in rapidity and per cent of sprouting.
14. Light has great influence upon the sprouting of the seeds of some species.
15. When light has any influence, it retards or wholly prevents sprouting.
16. The effects of light upon sprouting are different in different species.
17. The weight of the seed is often a tolerably accurate measure of its viability, as determined both by rapidity and per cent of sprouting.
18. As a rule, heavy seeds germinate better than light ones of the same sample.
19. Seeds of different species may vary in sprouting in reference to weight.
20. The color of the seed in some cases is a tolerably accurate measure of rapidity and per cent of sprouting.
21. When there is any variation in viability in reference to color, it is usually found that the stronger sproutings occur in the darker-colored seeds.
22. The relative values of seeds of different colors vary with each species, or sometimes with each sample.
23. The latitude in which seeds are grown may determine their behavior in germination.
24. Northern-grown corn appears to germinate quicker than

In the ordinary farmer's garden, seed-testing is perhaps of little or no value; but to the market-gardener, who plants considerable areas to special crops, and to the seedsman, it is highly profitable. It is possible that in some cases the character of the crop can be prognosticated with some degree of certainty from behavior of plants in germination, wholly aside from percentages of sprouting. The studies of experts in this country and Germany indicate, that, when accurate information is desired as to the value of seeds, the seed-test should present at least the following data: name of variety, where grown, when grown, how kept, per cent by weight of foreign matter, per cent by weight of apparently good seeds, nature of foreign material, weight of seeds, manner of testing, number tested, average and extreme temperatures during trial, first germinations in hours, last germinations in hours, per cent by number germinated, per cent ungerminated but sound at end of trial, date of test, estimate of agricultural value.

INHERITANCE OF INJURIES.

PROFESSOR A. WEISMANN of Freiburg, Germany, has made some experiments on mutilation. On Oct. 17, 1887, he had the tails removed from seven female and five male white mice. On Nov. 16 the first brood appeared. These and all subsequent broods were removed from the cage. Up to Dec. 17, 1888, 333 young were born, and in none of them was there any sign of the mutilation being inherited. In cage 2, fifteen young, of Dec. 2 1887, were placed, their tails having been removed. These, up to Dec. 17, 1888, produced 233 young, all with normal tails. In cage 3



Итаса.

FIG. 7.

Алабама.

southern-grown corn. It is to be expected, from our knowledge of the variation of plants in reference to latitude, that seeds of most species will give similar results.

25. Variation in results of seed-tests may be due to the apparatus in which test is made.

26. Those apparatus in which the seeds are exposed to light are to be distrusted.

27. Those apparatus which afford no protection to the seeds other than a simple layer of cloth, paper, board, or similar cover, are usually unsafe, from the fact that they allow of too great extremes in amounts of moisture.

28. The so-called Geneva tester appears to give better results of sprouting than tests made in soil, probably from the fact that moisture and temperature are less variable than in the soil-tests.

29. In order to study germination to its completion, tests must be made in soil.

30. Tests made indoors are more reliable than those made in the field.

II. Results commonly vary between tests made under apparently identical conditions, even with selected seeds: therefore one test cannot be accepted as a true measure of any sample of seeds.

III. The results of actual ordinary planting in the field cannot be considered a true measure of the viability or value of any sample.

IV. Rapidity of sproutings, unless under identical conditions, is not a true measure of vitality or vigor of seeds.

V. There appears to be no pernicious adulteration of garden-seeds in this country, and, as a rule, there are no hurtful impurities.

fourteen young of the second generation, with tails removed, were placed; and up to Dec. 17, 1888, they produced 141 young, all quite normal. The experiment was carried, with a negative result, down through five generations of mutilated animals. The length of tail of new-born mice varies from 10.5 millimetres to 12 millimetres. In the series of experiments, 849 young were produced by mutilated progenitors, and in no case was a mouse produced with its tail less than 10.5 millimetres. The author points out, that, while it might be said that experiments through a far greater number of generations were needed, the so-called cases of inheritance of mutilation all imply that the mutilation is impressed on the immediately following generations. A mother breaks her finger, and her daughter has the joint of the corresponding finger imperfect. A cow has her horn torn off, and in due course gives birth to a one-horned calf. Moreover, there are many cases of mutilations which have been made for hundreds of years without result. For instance, Settegast shows that all the crows but the rook have bristly feathers on their beaks. Rooks, too, have these feathers while nestlings; but later on they lose them by perpetually pushing the beak into the ground in search of food. There are a great many cases which at first sight appear to prove the inheritance of injuries. As an example of how easy it is to be deceived, Weismann relates that a friend had a vertical scar (with comb-like striæ) on the left ear, the result of a sword-wound. On the left ear of this gentleman's daughter was a curiously similar marking. But it was ultimately noticed that on the right ear of the father was an appearance precisely similar to that on the left ear of the daughter. On closer examination of the father's left ear, there was seen under the scar a linear streak, from which the striæ ran, forming a comb-like structure. It was this, doubtless a

congenital variation, and not the accidental scar, that the daughter had inherited.

AMATEUR PHOTOGRAPHY IN THE SUMMER OF 1889.

THOSE who ventured to take photographs with the dry plates of eight years ago thought the art a simple one, and well suited to the needs of every one who was willing to go to any trouble in securing photographic record of sights and scenes in which he might be interested.

A year ago the Kodak was brought on the market. In this camera, which is known to all, and whose products are so favorably received wherever shown, in place of the glass negative of the

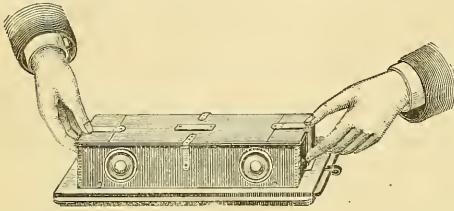


FIG. 1.

past was substituted a strip of sensitized paper stretched between two reels.

This was but a partial solution of the problem, for the paper is of necessity opaque, and to secure the best results it was necessary to strip the delicate film from the paper and attach it to glass or some other transparent support. This was a tedious process. A recent discovery and invention by Mr. George Eastman of the well-known firm in Rochester, obviate every difficulty. He has succeeded in producing a strong and perfectly transparent support, of great flexibility and extreme thinness, which can be wound upon rollers, to be exposed, developed, and printed like ordinary glass negatives. The transparent support is a modification of celluloid, specially prepared by a process invented by Mr. Eastman. The celluloid product is but four one-thousandths of an inch in thickness, and the gelatine film upon it is one two-thousandth of an inch

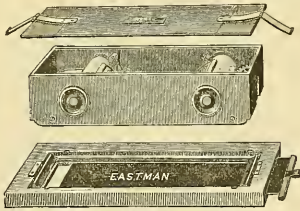


FIG. 2.

in thickness. It will thus be seen that a great magazine of photographic material can be carried in a very small space, and with no inconvenience on account of weight. Every operator can develop and print his own negatives and refill his magazine, with the exercise of only ordinary skill.

Mr. Eastman has removed the greatest difficulty in the way of rapid and satisfactory outdoor work, while adding facility in indoor photography, especially on large work. The handling of large plates is always difficult, and attended with serious risks. The flexible, transparent support makes the handling easy, and the results secure. The new support has been thoroughly tested. It withstands sun-heat necessary in printing, and is unaffected by the chemicals employed in development and other photographic processes.

The accompanying illustrations show the film-holder for the Kodak camera. Fig. 1 shows the holder closed; and Fig. 2, the same open, with a view of the two reels.

HEALTH MATTERS.

The Alleged Spontaneous Combustion of the Human Body.

WHEN "Bleak House" appeared, in 1853, novel-readers were treated to a new sensation in the way of a death-scene, when Krook was taken off the stage by spontaneous combustion, "of all the deaths that can be died." The public shuddered, and medical readers smiled. The subject was then to most physicians, as it is now, well inside the border of medical mythology.

Within the past year or two, several cases have been put on record, which, with the list previously accumulated, serve to establish pretty clearly, in the opinion of *The Boston Medical and Surgical Journal*, "the fact of an occasional abnormally increased combustibility of the human body, which, it should be observed, does not necessarily imply ignitability, or true spontaneous combustion."

For instance: Dr. Booth's case, which is reported, with a photograph of the nearly consumed remains, in the *British Medical Journal* (vol. i. 1888, p. 841), is of a pensioner, aged sixty-five, of very intemperate habits, who climbed into a hay-loft while drunk, at nine P.M. Neighbors saw by a skylight a light struck, which after a while was put out. At eight the next morning, the body, with all its soft parts burned, was seen lying over a hole in the floor which had nearly burned through, but had one or two joists that kept the body from falling through. The chance of the application of fire to the man's clothes is here distinctly stated; and the combustion, remarkable as it was, is not shown to have been spontaneous.

Again, Middlekamp, in the *St. Louis Medical and Surgical Journal*, October, 1885, reported a similar case of nearly complete combustion, where the victim, a man of sixty-six and a drunkard of twenty years' standing, fired a gun at his own breast with a ramrod. Here the heat was so intense as to melt the ramrod and a metal buckle. The body was consumed entirely, except the lower part of the legs, the head, and the arms.

In the *Therapeutic Gazette* of the current year, two more such instances are reported. One of these, Dr. Clendenin's case, was an old Irish woman, addicted to the excessive use of whiskey, of which she had drunk a quart the day she died. She had always been the last of the household to go to bed, and so always extinguished the tallow candle (their sole means of illumination). There was also a fire in the kitchen stove. The inner walls of the house were covered with greasy soot, and the two old men who were the only other occupants were both asphyxiated. A hole was found burned through the kitchen floor about two and one-half by three feet square. Upon examining the opening in the floor, a mass of cinders was discovered on the ground beneath. Upon removing them, the skull, the cervical, and half the dorsal vertebrae were found reduced very nearly to a cinder, also about six inches of the right femur, together with part of the ilium in about the same state as the vertebrae. The feet were found in the shoes: the left foot was reduced to a cinder, the shoe being partially calcined; the other foot and shoe were reduced to a complete cinder. On removing, the entire remains of a woman, who a few hours previous had weighed one hundred and sixty pounds, were placed in a box that would hold less than one bushel. The entire remains weighed twelve pounds. The pine joint against which the remaining cinders lay were slightly charred, but not burning when found.

To burn the human body, under ordinary circumstances, as the editor of the journal states, is not an easy thing. The great heat secured in crematories, and the length of time even then requisite to incinerate the body, illustrate this fact. It has been shown that the body is three-quarters water, and a great deal of combustible material is a necessary adjunct to the successful reduction of so non-inflammable a substance. What, then, is it that occasionally imparts to it so abnormal a susceptibility to flame? Here theories are at fault. We may safely say that it is not, as has been claimed by some, alcohol deposited in the tissues; for Liebig found that flesh saturated in that liquid would burn only until the alcohol was consumed. The hydrogen theory is also fanciful; and the best explanation, namely, an abundant deposit of fat in the cells of the body in such cases, fails to account for the fact that not

all fat people are subject to this fate, but that it is only the fat, elderly alcoholic subjects that have been shown to manifest abnormal combustibility. Possibly the alcohol in such cases has the double effect of laying up fat and stupefying the subject, so that he is unable to save himself when he does take fire.

One of the best recent monographs on this subject is that of Dr. F. Ogsten (*British Foreign Medico-Chirurgical Review*, vol. xlv. p. 179), which details a case of his own, — again, be it observed, one where the spontaneous element was wanting, or was not proved. A woman, fat, intemperate, was in front of smouldering ashes in a grate, and was almost wholly consumed, with little burning of the surrounding objects, and with nothing specially inflammable about her. Ogsten seems to have had some doubt on this subject, seven years later, in referring to the same case (*Medical Times and Gazette*, vol. i. 1877, p. 27), when he says the question is still *sub judice*; but he admits that one cannot explain the facts in this case without assuming that the body was in a condition unusually favorable for and predisposed to the feeding at its own fire.

In the monograph referred to, Ogsten collected the opinions of thirty-five authors who treated of this subject, and he thus classified them: five were quite sceptical on the whole subject, three believed in increased combustibility only, and twenty-seven believed in spontaneous ignitability as well.

The opinion of the editor of the *Medical and Surgical Journal* is, therefore, that the necessarily isolated condition of all persons who perish in this way, and the commonness of fires and lights or of the means of producing them in all places, would make it extremely difficult to establish the fact of spontaneous ignitability, even did it exist. Certainly such proof has not yet been given us. The other point, that of increased combustibility, seems to have received considerable confirmation.

Elimination of Poisons.

In an exceedingly interesting and valuable Croonian lecture on chemical structure and physiological action, recently delivered before the Royal College of Physicians of London by Dr. T. Lauder Brunton, there is a passage in which he discusses the treatment of diseases depending upon infection of the blood or tissues by microbes. In this he calls attention to the difficulty of destroying or weakening microbes, once fairly occupying the animal economy, and the greater probability of success by promoting rapid elimination of the poisonous products of micro-organisms, as well as of the micro-organisms themselves.

One of the most important methods of such elimination is free purgation; another is active diuresis; and a third, not alluded to here by Dr. Brunton, is free sweating.

One of the best diuretics, Dr. Brunton says, is a free supply of water; and Ringer has pointed out the possibility of lessening the effect of poisons by washing them, as it were, rapidly out of the system. This plan has recently been followed by Sanquirico with very striking results. In his experiments he injected quantities of a weak saline solution directly into the veins immediately after the poison had been administered, or just when the symptoms of poisoning began to appear. By treatment in this way he found that three times the ordinary lethal dose of strychnine had to be administered before death occurred. The poisonous action of chloral, alcohol, urethan, pareldehyde, caffeine, and aconitine was also diminished, but not very much; while that of morphine and nicotine was unaffected. In all cases the beneficial effect of the treatment was most marked when the diuresis was greatest. No doubt, the effect of fluids is likely to be greater when they are introduced directly into the veins than when they are introduced indirectly through the alimentary canal; but the effect in both cases will be the same in kind, though different in degree.

The principles laid down in these statements, *The Medical and Surgical Reporter* remarks, are probably those which lie at the base of the empirical practice of hundreds and even thousands of years; and they furnish an interesting demonstration of the way in which reason often, by slow steps, demonstrates the wisdom of practices long since adopted under the spur of instinct or in imitation of nature.

HYGIENIC POLICE REGULATIONS IN BERLIN. — The Berlin correspondent of the *Medical Age* (June 10, 1889) says that the

city of Berlin in many respects is exemplary in its hygienic care and dispositions, especially in its regulations concerning buildings, streets, victuals, and, last but not least, the patent-medicine man. No house is allowed to be built until its plans have passed not only ordinary police inspection, but also a special "hygienic committee," which rejects, of course, every thing which is not in accordance with the principles of hygiene. The streets of Berlin are the objects of admiration of all foreigners, who speedily are awakened to the shameful and outrageous treatment to which they have been subjected for years. Berlin is paved almost exclusively with asphaltum and Belgian blocks, and the streets are always bright and clean-looking, regardless of weather. The inspection of victuals is so rigorous that poisoning from trichinae, or from decomposed meat, fish, or other eatables, is an exceedingly rare occurrence. Quite recently, 24,000 pounds of fish, just from Denmark, were confiscated and destroyed. No milk-wagon is allowed to enter the city until the specific gravity of the milk has been ascertained. Regarding patent medicines, the Berlin police have resorted to very simple means to protect the public; viz., by the absolute interdiction of patent-medicine advertisements in newspapers and other public prints. It will be seen by the foregoing that citizens of Berlin are not permitted to care for themselves, as is the hazardous privilege of Americans, but the government assumes the responsibility of all hygienic and sanitary precautions.

SIR SPENCER WELLS ON CREMATION. — The *London Lancet* (June 8, 1889) says that Sir Spencer Wells deserves credit for the pains he takes to disseminate a knowledge of the arguments for cremation in Great Britain, and of the success which this method of disposing of the dead meets with. It is impossible to deny the strength of the arguments in favor of cremation as a most effective and prompt way of reducing the body to its mineral elements, which process, the *Lancet* says, can be carried out now at Woking at the small cost of ten shillings per body. Sir Spencer Wells argues, that, however light the covering of the dead body, its burial in earth is objectionable, for the reason that infective germs are in this way preserved and carried about by water or air, to operate injuriously when favorable meteorological or social states occur. The rapid growth of population, and especially of urban populations, due to a greater prevalence of peace and a more satisfactory sanitary system, invests this question with ever-increasing importance. The religious objections have been completely answered by men like Lord Shaftesbury and Bishop Fraser. There is evidence that the number of cremations is increasing in Italy and England, as in the week preceding Sir Spencer Wells's speech there had been three cremations at Woking; while in Italy, in the three years 1886, 1887, and 1888, there were 119, 155, and 202.

NOTES AND NEWS.

THE opening season of the tenth annual convention of the National Photographers' Association was held at the Mechanics Building, Boston, on Aug. 6. Mr. J. F. Ryder of Cleveland gave an address of welcome. The next meeting will be held at Detroit. The exhibition of apparatus and pictures was open till to-day. The Eastman Dry Plate and Film Co. of Rochester showed a notable collection of large pictures. Cramer of St. Louis displayed some of the results from his orthochromatic dry plates, which give the true value of the colors in originals.

— London *Industries* reports that C. A. Paillard has recently drawn attention to the valuable properties of some of the alloys of palladium, and advocates their use in the manufacture of non-magnetizable watches. The composition of four alloys has been ascertained, and the author has examined their respective properties. An alloy consisting of palladium 60.75, copper 15.25, and iron 1.5 per cent, is readily formed by mixing half the palladium with the copper and iron, and fusing the mixture with borax and powdered charcoal. The remaining palladium is then added, and the alloy fused and poured into moulds.

— A sister of the late Maria Mitchell will prepare for the press the "Life and Letters" of the distinguished teacher. Her correspondence is said to be very rich in letters from Herschel, Humboldt, and others.

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The World's Fair and Men of Science.			

THE WEEK'S PROGRESS in the preparation for the world's fair in this city in 1892 shows mainly, as is to be expected, in the recommendation, by various commercial and industrial bodies, of persons whom they wish to represent them on the committee of one hundred which the mayor proposes to appoint. So far, no action has been taken by scientific men toward giving suggestions as to the features of the exposition in which they would care to take part; and, while naturally scientific interests are not as keen as those which give the main impulse to the undertaking, it is desirable that the scientific men of the country should be heard from; and we cordially invite a free discussion in the columns of *Science* of the ways by which the interests of American scientific men may be served best by the exhibition. An accompaniment of every exhibition is a series of scientific congresses. To be sure, such congresses to the number of nearly a hundred will have been held in Paris before the close of the summer; but all questions will not be settled by them, and by the summer of 1892 the scientific men of the world will be ready for further debate.

At the present stage of affairs the discussion of the site is going on vigorously, Governor's Island finding a good many advocates. When there was talk of a world's fair eleven years ago, the witty editor of the then flourishing *Appletons' Journal*, Mr. O. B. Bunce, urged Governor's Island as a site in the following terms: "This island is one of the general government military centres, but we

may assume that Congress or the executive, wherever the power lies, would promptly surrender it for the purpose proposed. The situation is superb. It is nearly at the junction of the Hudson and East Rivers, less than a mile from the Battery, and is equidistant from Brooklyn and New York. It lies directly upon the channel which leads to the sea; is fanned by breezes from the ocean and rivers; is healthful, salubrious, and every way charming. Ships from abroad could land their cargoes for the exhibition at the doors of the structures without a foot of land-carriage. Boats down the Hudson, boats from the East through the Sound, steamers from Southern ports, and lighters from the great railroad-depots at Jersey City, could do the same. A ferry would have to be established at the Battery, where are the termini of the elevated railways, which reach through the city to its uppermost limits, thus giving easy and convenient access from every point; while with ferry-boats in addition at points along each river, at Brooklyn, and at Jersey City, the great crowd of visitors could be gathered and dispersed with so little friction and so much comfort as to make this world's fair memorable compared with all others. Those who recollect the fatigue and torment of getting to and from the Philadelphia exhibition must welcome this feature of the prospect with delight; and in all of the exhibitions, so far, the journeyings to and fro have been fatiguing and tedious to a degree almost to outweigh the pleasure derived from the wonders on display. Governor's Island is between sixty and seventy acres in extent, and, as the area of the Philadelphia buildings is over fifty acres, the place may at first thought seem too small. This difficulty can be met by having galleries in the buildings, as was the case in the first Crystal Palace, and by erecting some of the structures over the beach supported by piles. Superb façades could be constructed at the water's edge, facing the harbor and the city, presenting a grand picture to the approaching visitors."

In a recent communication to the *Evening Post*, Mr. Bunce states that the island is a mile and a quarter in circumference, its shape being elliptical. A building encircling the island at the water's edge (which might rest partly on sea-walls) would be of greater length than the united length of the buildings at the Centennial Exhibition, the dimensions of which were as follows: main building, 1,876 feet; machinery hall, 1,402 feet; art gallery, 365 feet; horticultural hall, 383 feet; agricultural hall, 820 feet; making a total of 4,846 feet, with an average width of about 350 feet. A structure encircling the island 400 feet in width would exceed the capacity of the Philadelphia structures fully fifty per cent, and leave the greater part of the island free for the erection of special buildings by the States or otherwise. Whether the form of building here suggested would be adopted is not yet to be decided, but the figures show that there is considerable room on the island, and engineers might be depended on for a few annexed strips out over the water if need should be. The exhibition is to be held, unless all signs fail; it is to be held in New York as the great commercial centre, made so by its being the most accessible city in the United States; and we now urge on scientific men to take such action as will give due prominence to what they are doing for the world's advancement.

THE WHAT AND WHY OF AGRICULTURAL EXPERIMENT STATIONS.

PROFESSOR W. O. ATWATER, director of the Office of Experiment Stations, of the United States Department of Agriculture, has issued *Farmers' Bulletin* No. 1 of that office, containing a brief statement of the history, work, and aims of the agricultural experiment stations.

This bulletin is intended as the first of a series the object of which is to give information about the experiment stations and their work by collating results bearing upon special topics, and putting them into brief, clear, practical form for farmers and others

to read. A series of experiment-station bulletins, of which the first has been published, is intended to furnish accounts of current operations of the stations, and kindred information for station workers and others interested in agricultural science.

What the Stations are for.

"Farming is a perpetual trying of experiments with soils, manures, and crops; with cattle and cattle-food; with milk, butter, and cheese; with ploughs, harrows, and harvesters; with an almost endless list of things. The most successful farmers—those who get the most out of their land, their cattle, their crops, their fertilizers, their implements, and their labor—are those who experiment themselves most industriously, most skilfully, and most intelligently, and who take the fullest advantage of the experiments of others. The best agriculture is that which, in old countries, on worn and intractable soils, has learned by long-continued and varied experiment to make the gain of farming sure."

Once the farmer made the rude tools he needed for the primitive practice of his art. Now he employs implements and machinery which can be made only with large capital and the highest mechanical skill, and by men who make this manufacturing a business. So the experiments which he can make do not meet his needs to-day. Research, the finding-out of nature's secrets, the discovery of the laws which underlie the right practice of agriculture, is costly. The more useful it is to be, the greater must be the outlay of money, labor, and scientific skill. Here, if anywhere, wise economy calls for the best.

Within recent times farmers, and men of science interested in farming, have seen the advantage of using the resources of science to improve the practice of agriculture, and have established agricultural experiment stations.

The object of these stations is to experiment and to teach, "to make a regular business of discovery for the use of farming," "to promote agriculture by scientific investigation and experiment," and to diffuse as well as increase the knowledge which improves farm-practice and elevates farm-life.

Established for the benefit of agriculture, and hence of the community at large, the most of them connected with educational institutions where experience shows their work is most successfully done, these stations seek answers to the questions which agricultural practice is asking as to the tillage of the soil; the nature and action of manures; the culture of crops; the food and nutrition of domestic animals and of man; the production of milk, butter, and cheese; the diseases of plants and animals; and, in general, whatever the agriculturist needs to know and experimental science can discover.

But farmers have asked and have received from the stations more than the help to improve their crops and their cattle and to make more money. They have felt the need of something higher and better for themselves, their wives, their children, their homes, and their profession. In the isolation and the day-by-day struggle of farm-life, the opportunity for intellectual culture is all too small. Modern science reveals operations of nature in their truth and beauty, and lifts us, by their contemplation, out of ourselves to higher things. It finds as much that is wonderful in the growth of a blade of grass as in the motions of the planets, as much of inspiration in the process by which a clod of earth gives up its fertility as in the forces that keep the stars in their places in the universe. It shows us how the things we have to deal with in our homeliest toil connect us, if we but understand the linking, to what is most elevating in man's thought and hope. It helps supply that food for the mind without which we starve in drudgery, but by the strength of which we rise to a higher plane of life. It is for the acquiring and diffusing of such knowledge, which is explained in books, popularized in lectures, and disseminated in the columns of the best papers; which interests the home circle, and supplies themes for farmers' institutes and conventions; which helps farmers to improve their business and increase their incomes, while it elevates farming as a profession, and, what is by no means the least of its benefits, shows the boys that it is a profession in which brains can be used with profit,—it is for this, as well as for their help to farm practice, that experiment stations are established, and their workers are laboring with so much enthusiasm.

What the Stations do.

The stations make experiments in the laboratory, the greenhouse, the garden, the orchard, the field, the stable, and the dairy. It is doubtless safe to say that there are few subjects which the farmer has to deal with in the tillage of the soil, the saving and use of manures, the cultivation of his crops, the care of his stock, the management of his dairy, and the preservation of his crops or stock from insect pests and from diseases, that are not being studied, directly or indirectly, by one or more agricultural experiment stations.

The space here allows only a single illustration of the methods and spirit of experiment-station work. Suppose the question to be one of feeding. What are the effects of different kinds of fodder, as hay, corn-meal, or bran, fed to cows, upon the quantity or quality of the milk? Or what feed shall we use to make better pork at less cost? Or what are the most economical rations for fattening steers or working horses? To get answers to these questions, the stations make actual tests by feeding the animals and noting the results. These tests differ from ordinary farm experiments in that they are more elaborate and accurate; in other words, more scientific.

Successful feeding is not merely a matter of so much hay, or corn, or turnips, but of the nutritive ingredients which they contain, and which the animal digests, and uses to make blood, bone, muscle, fat, or milk, or uses as fuel to keep it warm and give it strength for work. The chemist of the station, with the apparatus of his laboratory, analyzes the material fed; that is to say, he separates the food into its constituent parts, and finds just how much of each nutritive substance the animal consumes. Sometimes the excrement, the undigested portion, is also weighed and analyzed; so that, by comparing this with the food, he learns how much of the whole food and of each ingredient the animal actually digests. In experiments with milch cows, the milk is likewise weighed and analyzed, and sometimes the cream is churned to see how much butter it will make. In some experiments even the air the animals inhale and exhale is measured and analyzed with the aid of very elaborate apparatus. When the feeding-trial is done, the animal is sometimes slaughtered, and the different portions likewise weighed and analyzed. By such means the effects of different kinds of fodder, and methods of feeding and treatment, are learned. A single experiment often requires the labor of several men for weeks or months. The same experiment has to be repeated again and again with different animals, under different conditions. So much does it cost to get reliable answers to the seemingly simple questions which farmers ask.

A recent editorial in one of our leading live-stock journals says that "by the feeding-trials already conducted, especially with young animals, it has been demonstrated that different feeds modify the relative proportion of the different organs of the body; that the blood can be increased or diminished, the liver made larger or smaller, the muscular system increased or decreased in proportion to the rest of the body . . . [even the bones can be made weaker or stronger]. These marked differences in results are not produced either by over or under feeding, but by the difference in the chemical constituents of the ration. Here is a side of live-stock management that is practically new to us, and its development must be of the highest importance."

It is an old saying that "the best part of the breed goes in at the mouth;" but it has been reserved for the experiment stations to show how and why this is so, to give the scientific explanation of the maxim, and to put stock-feeding upon a more rational, that is to say, a more profitable, basis. And they are studying in like manner, and with like results, the other important problems upon which the future progress of our agriculture depends.

Origin and Development of the Stations.

Nearly forty years ago a company of farmers joined themselves together in the little German village of Moeckern, near the city and under the influence of the University of Leipzig, called a chemist to their aid, and, with later help from government, organized the first agricultural experiment station. Liebig in Germany, Bous-singault in France, Lawes and Gilbert in England, and other great pioneers, had been blazing the path of progress for years before.

A great deal of research bearing upon agriculture had been and is still being carried on in the schools and universities; but the action of these Saxon agriculturists in 1851 marks the beginning of the experiment station proper, — the organization of scientific research with the aid of government "as a necessary and permanent branch of agricultural business."

The seed thus sown has brought forth many fold. In 1856 there were five, in 1861 fifteen, in 1866 thirty, and to-day there are more than one hundred, experiment stations and kindred institutions in the different countries of Europe. In each of these, from one to ten or more investigators are engaged in the discovery of the laws that underlie the practice of farming, and in finding how they are best applied.

So rapid and so sure has been the progress of this enterprise in both hemispheres, that private persons, educators, societies, and governments have learned the usefulness, and indeed the necessity, of these institutions, not for the farmer alone, but for all who are dependent upon the products of the soil. The movement is extending to Asia and to South America: everywhere, indeed, its importance is coming to be felt.

The first agricultural experiment station in America was established at Middletown, Conn., in the chemical laboratory of Wesleyan University, in 1875. The example was speedily followed elsewhere. In 1880 four were in operation, and in 1887 there were some seventeen of these institutions in fourteen States. In that year Congress made the enterprise national by an appropriation of \$15,000 per annum to each of the States and Territories which have established agricultural colleges or agricultural departments of colleges. This has led to the establishment of new stations, or the increased development of stations previously established under State authority; so that there are to-day forty-six, or, counting branch stations, fifty-seven, agricultural experiment stations in the United States. Every State has at least one station, several have two, and one has three. Before provision had been made by the last Congress for the admission of the new States, Dakota had established one within her boundaries, and several other Territories are preparing to do likewise.

These forty-six stations now employ over three hundred and seventy trained men in the prosecution of experimental inquiry. The appropriation by the United States Government for the fiscal year just closing, for them and for the office of experiment stations in this department, is \$595,000; for the coming year it is \$600,000. The several States appropriate about \$125,000 in addition, making the sum total of about \$720,000 given from public funds the present year for the support of agricultural experiment stations in the United States. This may seem like a large sum to expend annually for agricultural experiments, but it is less than 10 cents for each of the 7,500,000 farm-workers of the country, less than 2½ cents for each of the 30,000,000 of our population directly dependent upon agriculture for their support, and less than 1½ cents for each of the 60,000,000 of our people who consume the products of our farms. The farming-lands, farm-implements, and live-stock of the country are estimated to be worth \$12,000,000,000. The experiment stations cost us, therefore, about \$6.25 a year for every million dollars invested in agriculture; or, reckoning the annual value of the products of our farms at \$2,200,000,000, we are now spending about 33½ cents for every thousand dollars' worth of products in an attempt to increase the value of those products in future years.

The European Stations.

Of the experiment stations and other like institutions for agricultural research in Europe, sixty-two are in Germany. These latter employ two hundred and seventeen scientific specialists. According to the best accessible accounts, twenty-seven German stations exercise control of commercial fertilizers, twenty-nine of feeding-stuffs, and thirty of seeds by examination of wares in the interest of the purchaser; this, however, in most cases, being only part of the work done. Some stations follow a number of lines of inquiry, others confine themselves to one or two. In general, those have been most successful which have studied the smallest number of questions in proportion to their resources; or, to put it in another way, experience has shown the advantage of specializing. Fifteen are devoted mainly to investigations in vegetable physiology, in-

cluding nutrition of plants; seven to animal physiology, including feeding-experiments; three to dairy industry; four to sugar-beet and three to fruit and vine culture. Nine have buildings for vegetation experiments, four have special structures for feeding-experiments with animals, and two have experimental gardens. While they conduct more or less field-experiments (the first station was started on a farm), few own experimental farms; and those few make but little use of them, for the simple reason that experience has shown, that, generally speaking, the things which most help farmers, outside of what they can study on their own farms, the stations can best find out in the laboratory, the greenhouse, and the experimental stable. They have learned the costly but most valuable lesson that the kind of experimenting which seems on the surface the most practical is apt to prove the least useful, and that it requires abstract and profound research to discover the things which the plain, ordinary farmer needs to know.

The European stations have become as firmly established as schools, and for the same reason; namely, that their value is demonstrated beyond question. A single illustration of their usefulness will suffice here. "The consummate product of applied farm-science is the 'Farmers' Almanac,' which tens of thousands of German farmers carry in their pockets. It contains a calendar; tables of movable feasts; blanks for daily memoranda, cash accounts, and so on, such as we have in our diaries. Then follow blanks for names of workmen, their work and wages; forms for registering cows and their daily or weekly yield of milk, and for other stock; other forms for keeping account with each field on the farm,—its size, crop, manure, seed, and produce; and so on. Then come a series of tables and statements which compress in brief space an amount of pertinent information that is almost marvellous.

"One table gives the amount of seed by weight or measure needed per Prussian acre (morgen) or hectare, broadcast or in drills or hills, for each of ninety-five different kinds of crops. Another gives what they call in Germany fair yields (they would be large yields here), with duration of germinating power of the seed, period of growth of the plants, and what corresponds in German weights and measures to weight per bushel or bulk per 100 pounds of the different kinds of produce. Further on are tables of mixtures of grass-seeds for different soils and purposes, number of plants per acre, valuation of seeds, and so on.

"But the most remarkable tables are those of the chemical composition of plants, fertilizers, feeding-stuffs, fodder-rations, and human food, and even of the whole bodies of animals.

"If the farmer wishes to find how much plant-food he has removed from his field in a hay-crop of 5 tons, he turns to a 'Table for Calculating the Exhaustion and Enrichment of the Soil,' and finds that the 5 tons of hay would contain about 155 pounds of nitrogen, 132 pounds of potash, 8½ pounds of lime, 41 pounds of phosphoric acid, and so on. The composition of nearly two hundred kinds of grasses, grains, straws, root-crops, etc., are given in this table. If he now wishes to calculate how much plant-food he gives back to his field with a given amount of manure, he turns to another part of the table, and finds the average composition of one hundred and twenty-six kinds of manures and fertilizing materials. There are, too, clear figures and explanations to help him calculate how the analysis of a fertilizer compares with standard articles of this sort, and what it is worth. From other pages he learns how to calculate how much material ought to be produced by given kinds of animals from given food, and so on.

"Not a bit less valuable are the tables of the composition of feeding-stuffs and fodder-rations. The farmer sees at a glance how many pounds of the valuable food-ingredients — protein, carbohydrates, and fats — there are in hay, straw, corn-stalks, bran, cotton-seed meal, and two hundred and fifty other materials which German farmers feed to their stock. Close by is a table of feeding standards, which tells how much of each of these ingredients will make a fair daily ration per 1,000 pounds, live weight, of oxen at rest in the stall, oxen at work, milch cows, young cattle, and so on. By comparing the composition of these standards with that of the feeding-stuffs in the barn or store, rations can be calculated which will bring the largest amount of work or meat or milk at the least cost. Of course, these rules are not to be followed

blindly; experience and good judgment combined with the rules make the book useful to the farmer."

The information contained in the almanac does not all come from the agricultural experiment stations; but a large amount of it, and that which is really most useful, does come from them, and would not be available without them. Nor is this all. The disposition and ability to use all this are as important as the information itself. This, too, is greatly aided by the scientific and educational work of the stations.

We want the same things in this country. Much of the fruit of foreign research and experience can be made available for our own use; but it needs working over to fit it to our needs, and we must have independent investigation of our own.

What the American Stations are doing.

Although the first of the American stations was established less than fourteen years ago (Oct. 1, 1875), and the majority of them have been in operation scarcely a year, they have already done a large amount of work scientifically creditable, and of the largest practical value. Future publications of this office will describe what the stations are doing, and explain the practical results. Only a few general statements and illustrations can be given here.

Our stations are conducting a large amount of scientific research in the laboratory and the greenhouse, and an equally large amount of practical experimenting in the field, the orchard, the stable, and the dairy. Some stations make a specialty of experiments with home-made and commercial fertilizers; others are endeavoring to show what can be done to restore the fertility to worn-out lands; others deal largely with the culture of fruit in orchards and vineyards; others are engaged on work relating to the composition of fodders and the methods of storing them; others are experimenting on the feeding of animals, and still others on diseases of animals and plants and their cure. Irrigation receives a good deal of attention in Colorado, sugar-making in Louisiana, wine-making in California. At least one station is doing something in poultry-raising, and another in the keeping of bees. Most of the stations give attention to several lines of work.

It is only the older stations from which we have a right to expect the most satisfactory results. The oldest is the Connecticut State Station. In this State the farmers are especially interested in manures and fertilizers, and in cattle feeding and dairying. This station has naturally devoted a large share of its attention to commercial fertilizers and feeding-stuffs. The result has been that inferior materials have been driven from the markets of the State; and not only that, but the farmers have been taught much concerning the relative values of the materials they buy or produce for feeding their crops and their stock, and how to utilize them most advantageously. Besides this and a great deal of other practical work, the station has done much to benefit other stations and the agriculture of the whole country by scientific researches relating to the methods of agricultural investigations.

When the station began its work in 1875, a number of brands of fertilizers then being sold in the State were analyzed, and their composition compared with the selling price. It appeared, that, at the rate farmers were paying, the nitrogen cost from 10½ cents to \$1.67, and the soluble phosphoric acid from 10½ to 25½ cents per pound. The report of the station for 1888 shows the nitrogen in the fertilizers sold in the State in that year to cost from 12 cents to 18 cents, and the soluble phosphoric acid from 8 cents to 8½ cents. There were no fraudulent articles in the market. Connecticut farmers pay over \$200,000 yearly for the phosphoric acid of commercial fertilizers. In this item alone the station saves more than its cost.

Before the establishment of the stations, very few farmers in New England knew how to judge of the value of a guano or phosphate from its composition. Chemical terms were Greek to them. Of the demands of plants and the deficiencies of soils, they had very little idea. Two or three years ago an advertisement of a firm of fertilizer manufacturers was circulated in Connecticut and in other States thereabouts. There was not a word in it about the remarkable increase of crops which the fertilizers would bring; there was not a single recommendation from a farmer who had put them to practical test, and learned their wonderful value; but

there were statements of percentages of nitrogen, of phosphoric acid, soluble, reverted, insoluble, and of potash as sulphate and chloride, which the fertilizers had been guaranteed by the manufacturers to contain; and alongside these were given the percentages which had been found in the articles as the farmers had bought them and the stations in their behalf had analyzed them. This is a firm of shrewd business-men, who manufacture and sell fertilizers to make money. They had found that farmers had learned something of chemistry, and were buying their fertilizers on a scientific basis, and that to get the most and the best trade it would pay them to advertise and sell on that basis.

At a meeting of the Connecticut State Board of Agriculture, in December, 1888, one day was devoted to the experiment stations, of which there are now two in the State. It has been the policy of the stations to institute experiments among farmers on their own farms, both for practical and for educational purposes. Some of the experimenters were present, and gave accounts of their work regarding the use of fertilizers, and what they had learned from it. They talked of nitrogen, phosphoric acid, and potash; of agricultural and commercial values of fertilizing materials; of the feeding capacities of different plants; of the differences in soils; of the adaptation of fertilizers to soil and crop; of the relative merits of commercial fertilizers and farm manures as shown by the cost, composition, and effect upon quantity and quality of crop produced; of the different methods of applying manures; and of other kindred topics. Their statements were scientifically accurate, and the practical value was so plain as to be appreciated by every one who heard them. One of the station directors, a college professor, remarked that he sat through the whole discussion ready to rise and make explanations if they were called for, but found no occasion to do so, and felt as though his occupation was gone.

The men who thus united science with practice, who showed their fellow-farmers how much of pecuniary profit as well as mental satisfaction there was in all this work, earn their living on their own farms by the labor of their own hands. They had enjoyed no better education than their neighbors, but they had taken advantage of the help of the experiment station. Such men are light-houses. The value of their influence cannot be estimated. Where such work is done, farming will flourish. The tendency of such things is to make agriculture a profitable, elevating, and attractive profession.

The experience in other States is the same as in Connecticut. A farmer in New Jersey, who has conducted some of these experiments under the direction of the station in that State, says that the simple fact that he has learned from them "that his soil lacks potash," which is cheaply supplied by German potash salts, has already been worth \$500 to him. Another farmer in the same State told the writer that the information he had got from these experiments had been worth more than \$2,000 to him in a single year. And it must be borne in mind that the subject of "fertilizers" is only one of the many which the stations are working upon.

The first decade of the life of the North Carolina Station, which was begun in 1877, has been devoted, for the most part, to problems relating to the control of the trade in commercial fertilizers, to the investigation of natural fertilizers (marls, phosphates, etc.) and the best methods for their use, and to the education of the farmers about farm manures and the best ways of saving, composting, mixing, and using them. Among the valuable results due directly or indirectly to this work are an increase of 14 per cent in the quality of the commercial fertilizers sold in the State, and a decrease in the number of acres devoted to cotton; the establishment of fertilizer factories and cotton-seed-oil mills in the State, and the making of thousands of home-made composts by farmers in every section of the State.

The New Jersey State Station was established March 18, 1880. Its work has been both scientific and practical. The analyzing of commercial fertilizers, fodders, and feeds offered in the markets of the State has been largely and regularly carried on, with important results in securing purity of product and honesty of dealing, and in teaching the farmers of the State the real commercial and agricultural value of these fertilizers. Field-experiments have been made with a large variety of barnyard and commercial fertilizers on different crops in most of the counties of the State.

The diseases of plants, vines, and trees have been studied, and remedies sought, and the station has tried to introduce new crops in sections of the State hitherto comparatively barren. The sorghum experiments for this purpose have attracted attention throughout the whole country. It is safe to say, that, in the scientific and practical value of its work, this station is equalled by extremely few of the European stations.

The station had been steadily growing in the favor of the farmers and general public of the State, and is now regarded as an educating agency of the first importance. Farmers depend upon its work, manufacturers of fertilizers are made careful, dealers in seeds and implements seek its approval. The progress of agriculture in New Jersey is marked by larger staple crops; higher enrichment of the soil; extended cultivation of market-garden products, peaches, and small-fruit; and a great increase in dairying. Even from year to year the progress is plainly marked. That the station contributes much to this progress, there is no room for doubt.

Louisiana has three stations, the first of which was established in October, 1885, by an association of sugar-planters; and the last, in April, 1888. These stations have already accomplished much useful work, including investigations of the manurial requirements of various staple crops of the State; analyses and classification of the soils of the State; analyses of all the commercial fertilizers sold in the State; experiments with forty-two varieties of cotton to determine the relative yield of lint, length of staple, and strength of fibre; and the introduction, with the aid of the United States commissioner of agriculture, of more than seventy varieties of sugar-cane, forty-eight of which are now cultivated in the State. Each station is the headquarters for a large agricultural association, which holds monthly meetings on the station grounds. At the North Louisiana Station, at Calhoun, the farmers have raised by subscription the means to build a hall for these meetings, which are frequently attended by several hundred farmers. During the season for sugar-making, the sugar experiment station, which has quite recently been moved from Kenner to Audubon Park, New Orleans, is visited by planters from all parts of the world. The average number of visitors at this station during the past season was about one hundred a day.

The influence of the Wisconsin Station within the State has been very marked. Its experiments on pig-feeding are favorably known throughout the whole country. The following extract from a letter from Director Henry indicates some of the other good things which the station has done and is doing: "Years ago the station, then called the Experimental Farm, sent out the Mansury barley, which has been worth a very considerable sum to our people. Last spring, after a year's patient work, our first assistant chemist announced the completion of a method by which an ordinary dairyman, with a reasonable amount of care, can determine the percentage of fat in milk or cream with about as much accuracy as the chemist by the gravimetric method. This method of determining fat is being brought into general use by dairymen and others. Last summer our chief chemist, Dr. Babcock, announced the discovery of fibrine in milk, and stated that this new compound played an important part in the raising of cream. Work at the station yet to be announced shows that this discovery is of considerable importance to dairymen, and in it we have an explanation of many of the phenomena of milk and cream."

Similarly favorable reports might be given from stations from Maine to California, and from Alabama to Michigan, wherever the experimenting has been carried on long enough to give a fair test of its value.

Americans have the credit of dropping enterprises which do not pay. It is a significant fact, therefore, that no State which has once established a station has ever abandoned it. On the other hand, the revenues which the stations derive from the States, apart from those which they receive from the National Government, have steadily risen from \$2,800, with which the first station began, to more than \$125,000 in the present year.

Even if some of the newer stations have as yet brought but little fruit and some that is not well matured, we may confidently expect before many years to have institutions in all the States which will be of the highest service to American agriculture.

One most favorable indication is the earnest desire of the managers of the stations to do the best possible work. This has been particularly manifest at the conventions of the Association of American Agricultural Colleges and Experiment Stations, in which matters of station policy have formed the principal theme of discussion. The underlying thought has uniformly been to learn to do what will best serve the interests for which the stations are established.

The experiment-station enterprise is now equipped for its great work. From its small beginning, fourteen years ago, it has grown out to the farthest limits of our land, has enlisted the best colleges and universities and the ablest investigators of the country, and secured both State and National resources for its service. It has the favor not only of leading minds in science and education, but also of a great army of practical farmers, to whom it has already brought substantial benefits. As the first secretary of agriculture has justly said, "Of all the scientific enterprises which the government has undertaken, scarcely any other has impressed its value upon the people and their representatives in the State and National legislatures so speedily and so strongly as this. The rapid growth of an enterprise for elevating agriculture by the aid of science, its espousal by the United States Government, its development to its present dimensions in so short a period, and, finally, the favor with which it is received by the public at large, are a striking illustration of the appreciation, on the part of the American people, of the wisdom and the usefulness of calling the highest science to the aid of the arts and industries of life. The present is an auspicious time for this undertaking. 'In the history of no nation before have there been such a thirst for knowledge on the part of the great masses of the people, such high and just appreciation of its value, and such wide-reaching, successful, and popular schemes for self-education; no other nation has so large a body of farmers of high intelligence; never before has the great agricultural public been so willing, and indeed so anxious, to receive with respect and use with intelligence the information which science offers; never before has science had so much to give.' The prospects, then, for this, the largest scientific enterprise in behalf of agriculture that any government has undertaken, are full of promise."

The Office of Experiment Stations of the Department of Agriculture.

The number and diversity of problems to be solved in the widely separated sections of our country, the need of linking the stations together, of helping to co-ordinate their efforts, of bringing to them the fruits of accumulated experience, of assisting them in research, and of collating their products and making them available to the public whom they serve, and the evident propriety that the Department of Agriculture should aid the enterprise in these respects, — all these considerations evince the wisdom of Congress in providing for a central office, as a branch of this department, to meet the need.

The stations themselves, through the Association of American Agricultural Colleges and Experiment Stations, were the prime movers in securing the establishment of this office, and have given to it their cordial sympathy and support.

ENEMIES OF THE PLANT-LOUSE.

THE importance of parasitic and predaceous insects in overcoming our insect pests has long been recognized by the practical entomologist. He sees the destroyers swept off as by a flood, and sees in these prolific friends the easy solution of the problem of insect years. He knows, that, were it not for these friends, the destroying hosts would make our earth a desert, and replace plenty with famine. He knows that adversity among these tiny helpers means success to the swarms of insects that devour the crops, and so is rejoiced when he sees these little helpers active and numerous.

The present season has furnished a vivid illustration of this important and interesting fact. On June 30 the heads of wheat in Michigan were crowded with hungry *Aphides*, or plant-lice. These myriad lice, often five or six around a single kernel of wheat, and two hundred on a single head, were sucking the sap and very vi-

tality from the forming kernels. They were rapidly blighting the grain; and, unless some friendly hand were raised against them, the wheat-crop would be utterly ruined. Even then, when the lice were countless in numbers, and when the winged forms were rapidly spreading to the oat-fields, the hand of deliverance was easily discerned in the comparatively few but wondrously prolific enemies of the lice, which had already sounded a halt in the march of destruction. A week later, and the enemies of the lice were in the ascendancy; and to-day the lice are nearly exterminated, and the wheat-crop is rescued and the oat-crop saved. Close observation easily demonstrates these truths. Even the careless eye can see the savage insects dining on the lice, or the fatal egg laid which dooms the louse which receives it.

The fact that farmers are noticing these insects friends, and have now an object-lesson which should be rightly understood and carefully studied, leads Professor A. J. Cook, the Michigan State entomologist, to send out a bulletin on the subject of the enemies of the plant-lice. Some weeks ago he was receiving scores of letters asking about the lice: to-day he is receiving as numerous inquiries regarding these friends. That instruction is opportune is evident from such questions as this: "Are these insects going to complete the destruction so actively begun by the lice?"

There are two groups of these insect friends, — predaceous and parasitic insects, — both of which are well illustrated on the heads of wheat of Michigan fields to-day. Predaceous insects are such as devour their prey, much as the cat or weasel devours the mouse. Parasitic insects are those that lay their eggs on or in their victims. When these eggs hatch, the larval parasite proceeds to feast on its host, which thus serves it for both home and food. In the case before us, as soon as the parasite has devoured the viscera of the louse, it uses the skin or crust as a sort of cocoon. These gray, circular cocoons are now thick among the kernels of every head of wheat, and must have been noticed by every observer who has taken pains to examine. A tiny black fly is by far the most important of these little friends that have come to the farmers' rescue, and saved the wheat, barley, and oat crops.

The lice that are the victims of these eager parasites are easily distinguished. They are short, rounded, and gray in color. After the larva disembowels the lice, it uses the dry, thick skin as a cocoon, in which it changes to a pupa. Very soon the mature insect comes forth from a small round hole in the upper, hinder part of the abdomen, and very soon mates, and commences to lay its many eggs in new victims. Of course, these parasitic larvæ fairly swim in the rich nutritious blood of the lice, and so are rapidly developed. Thus we see how it is that the parasites are too much for the lice. Prolific as are the lice, and rapid as they are in development, yet the parasites are even more so, and thus it is that in ten days the parasites have so outnumbered the lice that the latter have been routed and driven from the field. The little flies are just about one-tenth of an inch in length; but, tiny as they are, they will save millions of dollars to the farmers of Michigan and adjacent States during this single year.

The lady-bird beetles are also very active and most efficient aids in the work of ridding the grain-fields of the *Aphides*. Both as larvæ and as mature insects, they feed on the plant-lice, and rapidly deplete their ranks. The beautiful rounded beetles, usually dressed in yellow or orange, and often adorned with black dots and markings, are known and admired by all. Few insects do more good than do these lady-bird beetles. The larvæ of these are elongated, dark-colored insects, usually dotted with gray, yellow, or orange, according to the species. So the insect not only does well, but looks well. There are also four rows of black dots which extend longitudinally, which are easily seen without a glass. Other species of lady-beetle larvæ are duller in color, and so less conspicuous, yet equally active and voracious. If any doubt the good work of these insects, especially the larvæ, he has but to enclose them in a box with louse-infested wheat-heads, or with plant-lice from any plant. The rapid disappearance of the lice will quickly convince the most sceptical of the valuable service of these predaceous friends. These lady-bird beetles are hardly second to the parasite first described, in the work of ridding our grain-fields of the lice. Professor C. M. Weed believes they take a first place in Ohio in this important service.

By close watching in the wheat or oat fields, one may observe a large number of very rapid flying two-winged flies. Not only are these very quick, but many are lined with yellow bands, and are very beautiful. These flies, for food, only sip the sweets from flowers, but they lay their eggs on the plants among the lice, and the maggots that hatch from these are perfect tigers.* These syrphus-maggots seem to be veritable gourmands, as the number of plant-lice that one will suck bloodless is surprisingly great. These maggots look some like leeches or blood-suckers. The posterior end is large and truncated, while the mouth end is pointed. The color of the young ones is olive green, while the older or more mature maggots are gray, brown, or purple. There are light-brown transverse bands on the back, and one longitudinal one on each side. These maggots creep along in a slug-like manner, ever reaching into every crevice for the lice. The energetic zigzag motion of the head is very interesting. When it first finds a louse, it stabs him with its sharp mouth-parts, and quickly sucks him bloodless. As the louse shrinks, the maggot swells up. No sooner is one louse victimized than another is seized, and thus these voracious maggots will often destroy a half-score of lice in quick succession. Students have often suggested that these maggots must have India-rubber stomachs. From their great numbers and ravenous appetites, we must conclude that these syrphus-maggots are little, if any, behind the Braconid fly and the lady-bird beetles in their good services in helping to save the grain-crops.

Then the chryso-pa-fies, with their beautiful green lace wings and their brilliant golden eyes, are no mean factor in this warfare against plant-lice. The handsome flies do not feed on the lice, but the larvæ do; and, as they have insatiable appetites, they do excellent execution. These flies lay their minute white eggs on the ends of short hairs attached to wheat-stems, twigs of fruit-trees, in short, to any plant that is harboring plant-lice. The larvæ have strong, sharp jaws, and have well earned the name "aphis-lion," which has been aptly applied to them. These and the syrphus-fly maggots work in confinement, or while we are holding the aphis-infected plant in our hand. The Braconid fly and the lady-bird beetles, on the other hand, are more timid and quite easily disturbed; and so, to see them at work, we must approach them with care, and handle them without the least jar. Thus in these beneficial insects Professor Cook describes the little friends that have come to the aid of the farmers, and banished disaster.

BOOK-REVIEWS.

A Practical Guide to the Climates and Weather of India, Ceylon and Burmah and the Storms of the Indian Seas. By HENRY F. BLANFORD, F.R.S. London, Macmillan, 8°. \$3.50.

THE leisure following Mr. Blanford's retirement from the meteorological department of the government of India, which was developed in his charge, has been employed in preparing a general account of the climates and weather of that vast empire; and students of meteorology the world over are to be congratulated on having such a work from so competent a hand.

The book is divided into several parts. Part I. treats of the elements of climate and weather, with particular reference to their Indian features, under such headings as "Temperature," "Barometric Pressure and Wind," "Dampness and Dryness," "Clouds, Rain, and Storms." Here we recognize the same simple directness of statement and rational physical explanation of processes that characterize the author's "Indian Meteorologists' Vade-Mecum." The second part treats of the climatic divisions of the peninsula, giving a brief description of the several areas, such as the hills, — under which respectable mountain-ridges of 5,000 to 7,000 feet are included, — the plains, the plateaus, and the coasts. This is followed by an account of the weather-maps issued daily from Simla on the basis of nearly one hundred telegraphic reports, the storms of the Indian seas, and the relation of Indian rainfall to water-supply and drainage. Several appendices contain tabular climatic statistics for 92 stations, lists of storms in the Bay of Bengal, and rainfall at 114 stations.

It is difficult to select material for extracts where all is so perti-

ment. I shall therefore make further mention only of the cyclones and cyclonic storms concerning which the information is full and important. It may be recalled that Redfield early recognized the general occurrence of cyclonic whirls, seeing that high velocities were in no wise essential in their circulation, and that our ordinary changes of weather and shifts of wind were to be regarded as closely related to the hurricanes of the West Indies and other tropical regions. There has been and still is a conservative hesitation to accept so large a generalization, an illustration of which is commonly seen in the slowness of weather services in general to use such a term as "cyclonic" in connection with the "lows," "areas of low barometer," "barometric depression," "barometric minima," and other paraphrases in current use. The demonstration of the occurrence of relatively gentle cyclonic storms in India, and at seasons hitherto regarded as exempt from them, is therefore of particular interest not only as a fact, but also in the historic development of the science.

As regards the cyclones themselves, little is here said in the way of theory. For that the reader should go to the excellent studies on individual cyclones, chiefly by Eliot, in the memoirs of the Indian meteorological department. But the incurvature of the storm winds is clearly stated; and, while full justice is done to the tireless labors of Piddington in earlier decades, the errors into which he was led by following the "eight-point rule," or circular theory of storms, are explicitly pointed out. The true seasons of occurrence, the relative rarity of these storms, their extreme violence, their tracks and moderate progressive velocity, their general failure to cross even the southern point of India, and the advances lately made in announcing their approach, are all well treated. Until within a few years, it was only the violent cyclones of the May and October seasons, originating on the Bay of Bengal, that were understood when Indian cyclones were mentioned; but with the establishment of a system of observing stations, and, still more, with the preparation of daily weather-maps, it has become apparent that cyclonic storms occur in India at other months also, and of moderate intensity. Blanford recognizes the essential identity of the two in origin and constitution; but he thinks it advisable to distinguish them as cyclones proper and cyclonic storms, in order to avoid misapprehension as well as to emphasize their differences. While the former are practically limited to the late vernal and autumnal months, and not more than two violent ones occur in an average year, the latter occur in frequent succession all through the rainy summer monsoon, and also bring the winter rains to northern India. Curiously enough, the cyclonic storms of summer advance toward some point between west and north, while the winter storms move eastward, or even a little south of east. Here is certainly a new characteristic of this interesting region, and, as far as I know, it is not matched in any other part of the world. It is presumably an effect of alternation from a torrid to a temperate position in the general circulation of the atmosphere. Two of these storms are illustrated by weather-charts of several successive days, in which the central barometric depression and the general spiral movement of the surface winds are clearly indicated. In one of the winter cyclonic storms — that of late January, 1885 — there was a distinct sequence of weather changes with the eastward advance of the storm-centre, precisely of the kind that we know so well in these latitudes, — in the front, warm, damp, southerly winds, clouds, and rain or snow; in the rear, north-westerly winds, clear sky and low temperature, a veritable "cold-wave," giving some hill stations their lowest thermometric records. If this sort of thing is typical of Indian winters, it is likely that our term "cold wave" will go into use there, as their term "cyclone" has come to be so valuable with us.

Again, as to the conditions permitting rainfall. While it is understood that rain often occurs independently of cyclonic conditions, — as, for example, the diurnal summer rains of Florida or of mountain-peaks, — it appears, from the weather-maps of this country and Europe, that most of our precipitation is cyclonic, either in widespread rains or snows, or in local thunder-showers, whose opportunity is in good part dependent on cyclonic winds and contrasts of temperature thus induced. Now, the same thing appears in India. Rain there also may be independent of cyclones and cyclonic storms, as at Cherrapunji, on the foot-hills of the Himalaya north of the Bay

of Bengal, where the annual rainfall is nearly fifty feet deep, where from April to September there are on the average twenty-five rainy days in a month, and where 40.8 inches of rain have been collected in twenty-four hours (June 14, 1876). Here much of the rain may be "topographic," a re-action of the mountains on the winds; but, as a rule, Indian rainfall is, like ours, cyclonic. The "bursting of the monsoon" is an accompaniment of a summer cyclonic storm; and the alternation of rain, showers, and occasional rainless days in July and August, is but the expression of the passage of a series of summer cyclonic storms. This gives an entirely new aspect to the monsoon rains. All the excessively heavy rains, for which northern India is remarkable, are cyclonic rains, even though recognizable in their true character only when synoptic weather-charts are constructed.

Sind, a dry district in the far north-west, with an annual rainfall only from five to ten inches, and with only from thirteen to thirty rainy days in the year, also is dependent on the cyclonic storms. Rain falls only when, in the summer monsoon, a cyclonic storm comes in from the eastward, and travels as far as Sind before it is broken up; or when, in the winter, one forms in Sind, or passes eastward across it from Baluchistan.

This is certainly a most significant extension of Redfield's acute suggestion. Disturbances in the general atmospheric circulation tend to take the form of convectional whirls, and give forth rain. If the conception of the whirl is rigid and artificial, it will be of little advantage; but if it admit the unsymmetrical irregularities so abundantly illustrated on our weather-maps, it must come to be one of the most significant generalizations that meteorology has brought forth.

Recalling what the meteorological department of India has become under Mr. Blanford's direction, and remembering the high value of his writings on meteorological subjects, we can but wish that his future leisure might be directed to a general work on meteorology, of scope as broad as Schmid's "Lehrbuch," but with the statistical flavor of that book replaced by the physical flavor that characterizes modern meteorology. There is no such work in English, although such a work would have many English readers.

W. M. D.

Numbers Universalized: An Advanced Algebra. By DAVID M. SENSENIG. New York, Appleton. 12°.

THIS volume will eventually form the first part of a higher algebra, soon to be completed, being intended as an advanced elementary algebra. The object in issuing it separately, as we are informed in the preface, is "to meet the wants of such schools as have arranged a higher course in algebra than is outlined and treated in the author's first book, 'Numbers Symbolized,' and yet have not time enough to devote to this branch of mathematics to complete a full course in higher algebra." The book is well adapted to meet the requirements of schools in which students are prepared for entering college, as well as of advanced classes in high and advanced schools.

In his treatment of the subject, the author, who is professor of mathematics in the State Normal School at West Chester, Penn., has aimed to carefully keep intact the logical sequence of thought, avoiding unnecessary difficulties in the discussion, on the one hand, and too great simplicity, on the other. The definitions are well arranged, and concisely expressed in language unusually simple and exact; and illustrations are given only when required by concepts not sufficiently clear without them. The work as a whole is in line with the best school methods now in use, and should be acceptable to students as well as teachers.

AMONG THE PUBLISHERS.

THE supplement to *Harper's Weekly* of July 24 is devoted to the progress made in electric lighting in New York City, the subject being ably treated by Schuyler S. Wheeler, electric expert of the Board of Electrical Control. Mr. Wheeler discusses and explains the subject under the heads of "Generating and Distributing," "Lamps," "Systems of Distribution," "The Alternating Current," and "Construction of the Lines." The article is fully illustrated.

— Frederick Warne & Co. have just issued a "dollar" Shakespeare, printed from readable type on paper of good quality, and neatly bound in cloth.

— D. Lothrop Company have just ready "Around the World Stories," by Olive Risley Seward, an account of curious things met with in her travels; "Dear Old Story-Tellers," by Oscar Fay Adams, brief biographies of popular story-writers from Æsop to Laboulaye; and "Our Asiatic Cousins," by Mrs. A. H. Leonowens, a description of life in the remotest parts of the East.

LETTERS TO THE EDITOR.

A Possible Elephant.

WHILE examining the bluffs along the Missouri, near Vermillion, Dak., recently, I came upon the remains of what I take to be *Elephas Americanus*. The bones found all belong to the upper and back portions of the skull, and include most of the upper jaw, containing about a third of the right tooth and all of the left, portions of the tusk tubes, enough of the occipital to give both articulating surfaces connecting the skull with the spinal column, and many fragments of the upper portion of the skull. The perfect tooth weighs about twelve pounds, as near as can be determined without detaching it from the jaw.

The bones are nearly all in a fine state of preservation. Only a small portion of one tusk was found, and that much decomposed. Judging from the tubes, the tusks could not have been less than six inches in diameter.

The bones lay in a bed of sand and fine gravel (probably Champlain) about twenty feet thick. This sand rests directly upon the Fort Benton clays, and is overlaid by one hundred feet of loess. The *Elephas* bones were near the bottom of the sand, and about one hundred feet above the river. They were exposed by a landslide which carried down with it all of the skeleton except the portion of the skull mentioned.

G. E. CULVER.

Vermillion, Dak., July 29.

Are Beech-Trees ever struck by Lightning?

ON p. 50 of *Science* for July 19, I notice an article on lightning striking beech-trees. The following instance has come to my notice. In the summer of 1887 Marcus Grover was at a saw-mill in Rome, Ashta, County, O. Noticing an approaching storm, he, as he supposed, thoughtfully hitched his two-horse team to a small green beech-tree which stood in the mill-yard. During the storm came a sharp crash of thunder and lightning.

Mr. Grover looked for his team, only to find both horses dead. There were some small holes in the ground, and the hair was scorched a little, but no trace of lightning could be found on the tree.

E. E. BOGUE.

Orwell, Ashta, Co., O., Aug. 2.

Mosquitoes and Science.

REFERRING to the letter of Dr. R. H. Lamborn, on p. 85 of *Science* for Aug. 2, there would seem to be a choice between two evils. I cannot now lay my hand on the article referred to, but recall the fact that the larvæ of mosquitoes were found to be potent agents in diminishing malarial exhalations from stagnant water. The question arises whether it would be better to endure malaria or mosquitoes.

EDWARD H. WILLIAMS, jun.

Bethlehem, Penn., Aug. 5.

Queries.

46. FERN'S NAME. — I send you a small fern which grows in this section of the country, and is said to be a rare specimen. Will you please publish in your *Science* the name of this fern?

WALTER W. FRANCIS.

Idaho Springs, Col., July 23.

Answers.

46. FERN'S NAME. — The name of the fern submitted for determination is *Notholaena Fendleri*. At Idaho Springs, Col., it has probably been collected near its northern limit, the species being much more abundant farther south.

E. J. N.

Exchanges.

[Exchanges are inserted for subscribers free of charge. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

100 botanical specimens and analyses for exchange. Send list of those desired, and those which can be furnished, and receive a similar list in return. Also cabinet specimens and curiosities for the same. Scientific correspondence solicited. — E. E. BOGUE, Orwell, Ashta, County, O.

Lead, zinc, mundic, and calcite. — Lulu Hay, secretary Chapter 350, Carthage, Mo.

I will sell to chapters or individual members of the Agassiz Association, 25 fine specimens of fossil plants from the Dakota group (cretaceous), correctly named, for \$5.00. Send post-office order to Charles H. Sternberg (author "Young Fossil-Hunters"), 1033 Kentucky Street, Lawrence, Kan.

One mounted single achromatic photographic lens for making 4 X 5 pictures, in excellent condition; also one "new model" double dry-plate holder (4" X 5"), for fine geological or mineralogical specimens, properly classified. — Charles E. Frick, 1010 West Lehigh Avenue, Philadelphia, Penn.

Drawings from nature — animals, birds, insects, and plants — to exchange for insects for cabinet; or I will send them in sets of ten each for ten cents in stamps. My drawings in botany are in detail, showing plant, leaves, flowers, seed, stamens, pistils, etc. — Aida M. Sharp, Gladbrook, Io.

The undersigned wishes to make arrangements for the exchange of *Lepidoptera* of eastern Pennsylvania for those from other localities. All my specimens are named and in good condition. — Charles S. Westcott, 613 North 17th Street, Philadelphia, Penn.

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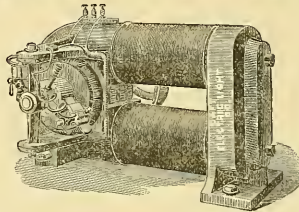
most perfect I have seen. The coils are of one lot of wire throughout, and have therefore a uniform temperature co-efficient, whose low value, .00024, allows one to neglect it in all ordinary work. The box is adjusted to legal ohms at 19° C., and is accompanied by Professor Anthony's statement that they are accurate to $\frac{1}{100}$ of 1 per cent. . . . You will remember that you procured for me while at the University of Missouri a large five-dial bridge from Elliott Brothers. That was a fine piece of apparatus, but I regard this as far superior. It has all the advantages of the dial arrangements, and has in addition the advantage of the possible connection of any single coil, or of almost any desired combination of single coils, and also of any desired combination in parallel. One can therefore check the adjustments of the several coils against one another, the box thus containing means for its own verification. The box answers also the purpose of a set of comparison coils, and enables one to do a number of things which cannot be done with the usual forms."

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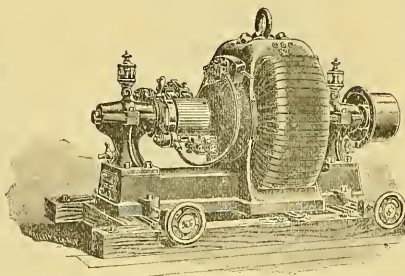
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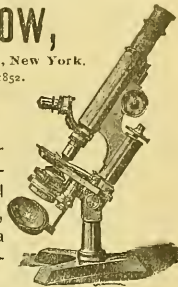
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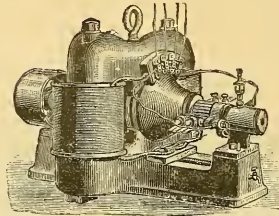
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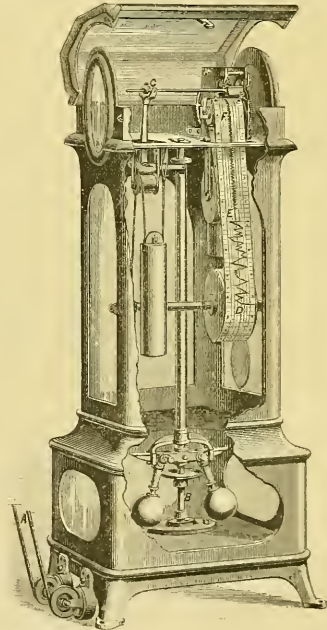
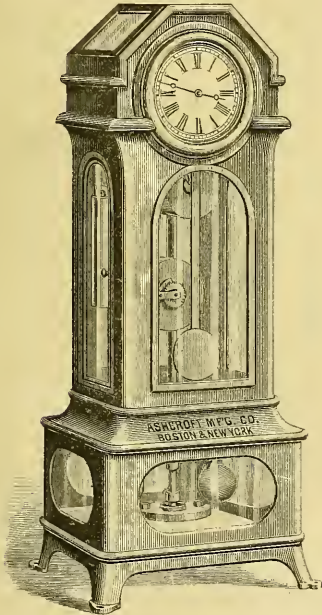
THE MOSCROP CONTINUOUS RECORDER.

THIS instrument was invented by J. B. Moscrop of Manchester, England, who designed it especially for the use of manufacturers of textile fabrics. Its services proved so valuable that its use rapidly extended, not only in Europe, but also in this country. It has found a place in many woollen and cotton mills, electric-light stations, and other places where it is desired to keep an accurate record of the time of starting and stopping an engine, as well as of all variations from a standard speed, with the exact time and extent of such variation.

The instrument consists of an iron case with glass sides, con-

of the balls is transmitted to a horizontal arm at the top of the case. This arm carries a marker, which is movable across the paper band upon which the record is to be made.

When the engine is running steadily at the standard speed, the marker rests at a central longitudinal line on the paper. Sections of this paper are shown at Figs. 3 and 4. Should the speed of the engine be increased or decreased five per cent, the marker would pass to the next line to the right or left, each space passed over indicating a variation of five per cent in the speed. When the engine is stopped, the marker passes entirely off the paper, and makes no record until it is brought back to the paper by the starting of the



FIGS. 1 AND 2.—THE MOSCROP RECORDER.

taining an eight-day pendulum clock, which moves a continuous paper band. Upon this band the record is traced by an inked marker, which is actuated by the motion of the governor-balls as they rise and fall under varying speed. Fig. 1 shows the general appearance of the instrument, and Fig. 2 gives a side view with part of the frame removed, showing the clock-movement and the interior construction. The governor-shaft is actuated by the belt *A*, which transmits motion from the shaft whose speed it is desired to record to a pulley on the lower end of the upright shaft which rises through the middle of the instrument. To this shaft is attached a governor, the balls of which rise by centrifugal force when the shaft is revolved. By means of connecting devices, the motion

engine. As each transverse space on the paper indicates one hour, and as the paper is moved ahead at unvarying speed by the clock, the length of the interval between the starting and stopping of the engine is recorded, also the moment and extent of all variations of speed. One paper band is sufficient for a three-months' run.

Figs. 3 and 4 are copies of actual records taken from different engines, and taken together, show the workings of the instrument under different circumstances. The section marked 1 is almost perfect. The record begins at one minute past seven, and continues till 7.15; the narrow line showing plenty of fly-wheel momentum, and the straight line good governing. Section 2, 7.15 to

7.30, illustrates small fly-wheel combined with good governing. The fly-wheel unsteadiness is five per cent. Section 3, 7.30 to 7.45, illustrates great fly-wheel momentum, governing rather imperfect. Here the speed decreased one per cent by 7.45. As the decrease was gradual, the probability is that it was caused by the steam being down, and the governing not equal to the occasion. Section 4, 7.45 to 8, illustrates small fly-wheel momentum and imperfect governing. Here the speed suddenly increased two and

tions 13 and 14 are another instance of improved running. This engine has been speeded two and a half per cent, and yet never attained the speed it formerly attained during its oscillations. It is now always at its highest speed, combining steady turning with maximum turnout. If an engine is making 60 revolutions, and it proves to be oscillating in steadiness from 59 to 61, it is obvious that it is either running too quickly for good work at 61, or it is losing output when at 59. Sections 15, 16, and 17 are from the

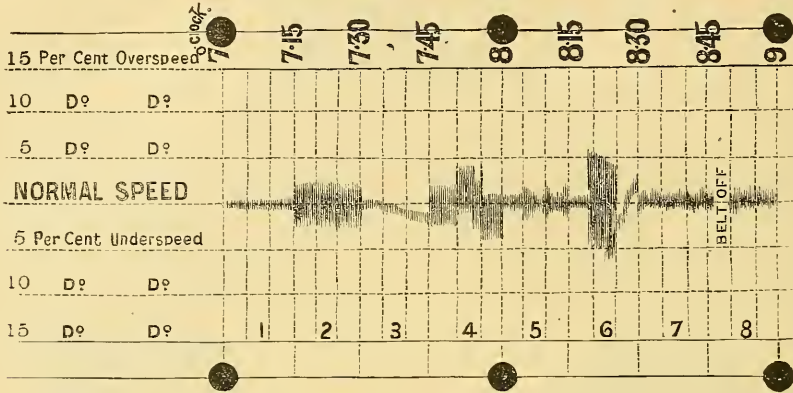


FIG. 3.—MOSCROP RECORDER RECORD.

one-half per cent at 7.50. This would appear to be, by its suddenness, a change in the load and governing not equal to the occasion. Section 5, 8 to 8.14, looks like mule-spinning and throttle-valve. Section 6, 8.15 to 8.30, is frequently met. Without doubt, the governing-gear began to stick at 8.18, the speed oscillating twelve per cent till 8.25. The oscillations have their ebb and flow in periods of a few seconds, and are the unsuspected cause of bad work. This is a good instance of an engine running its natural speed, yet

same engine, and are placed here to show vividly the advantage in steadiness of turning of having an engine lightly loaded. Section 15 is the record of full load, that is, 450 horse-power; section 16, the record with a partial load, that is, 250 horse-power; 17, with a small load, that is, 150 horse-power. This engine was fitted with a supplementary governor, recently patented, and it is worthy of note that it preserved its speed (automatic cut-off) under a change of load from 450 horse-power to 150 horse-power. It was sub-

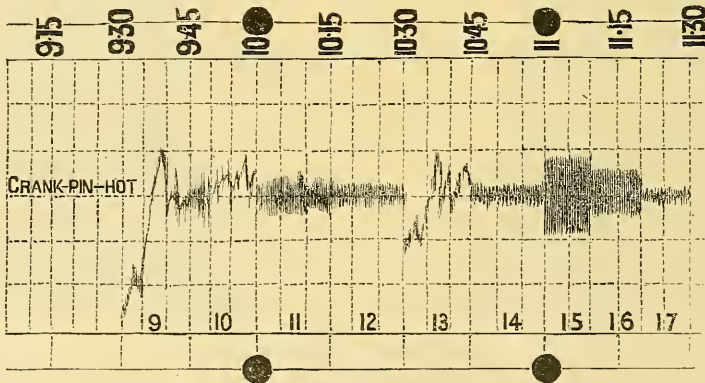


FIG. 4.—MOSCROP RECORDER RECORD.

being all the while dangerously unsteady, subjecting the weak part of the engine and gearing to a severe test. Sections 7 and 8, 8.30 to 9, illustrates respectable mediocrity. It is introduced to show that at 8.46 the record stopped through the belt being off.

As one of the objects in these illustrations is to make the reading of the records intelligible, we will now assume that the engine stopped from 9 to 9.30 for repairs. Sections 9, 10, 11, and 12 are diagrams from the same engine; 9 is the diagram when the recorder was first applied; 10, 11, and 12 are stages in the improvement in the engine's workings as the faults are remedied. Sec-

jected to a similar test with a varied pressure, giving equally good results.

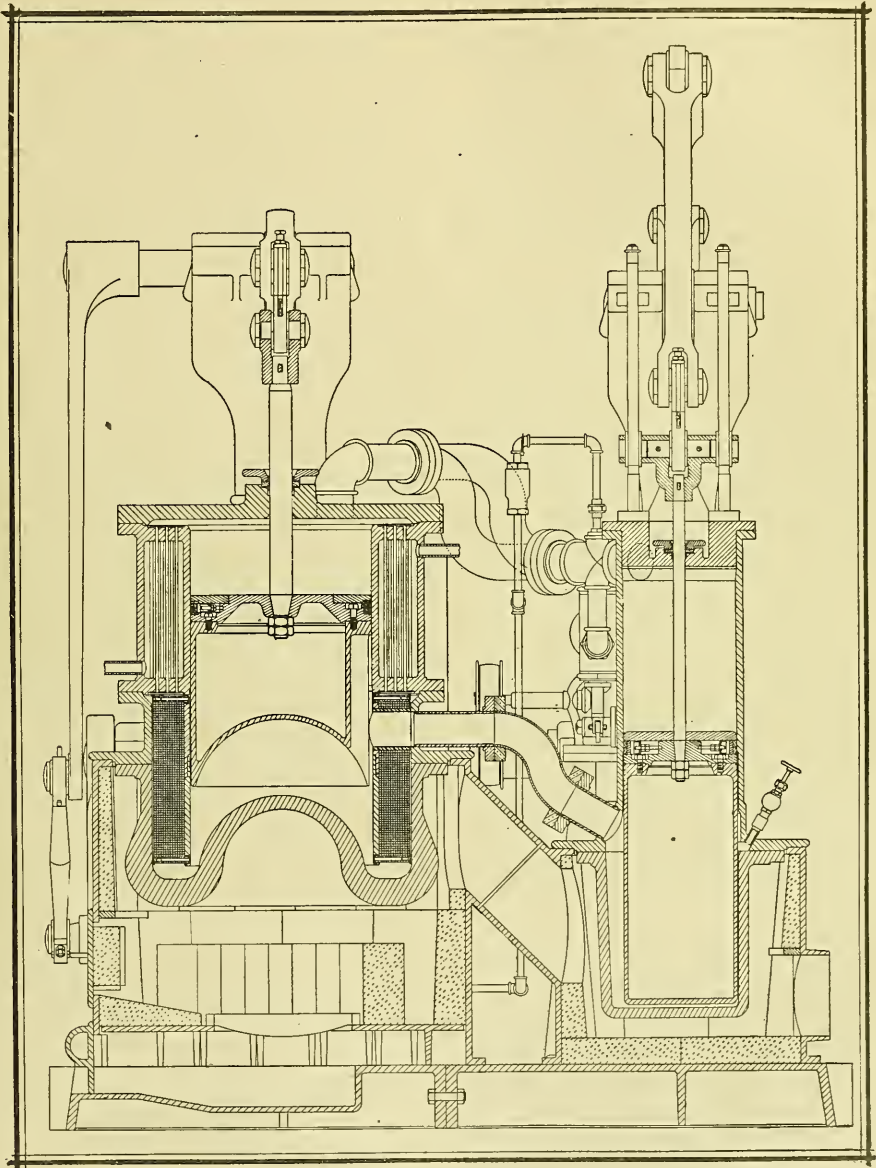
The Ashcroft Manufacturing Company of this city have exclusive control of the Moscrops recorder for the United States.

A NUMBER of Spanish country teachers have gone to Madrid to make known the wretched condition of most of those to whom the education of the rising generation is intrusted, and to urge upon the government the necessity of including the teachers in the civil servants in the pay of the state.

AN IMPROVED AIR-ENGINE.

DURING the past ten or twelve years the firm of Woodbury, Merrill, Patten, & Woodbury, of Boston, Mass., have been steadily at work developing and perfecting an air-engine; and, as a result of their labors, they are now about to place on the market engines

superior in durability and economy to any heretofore constructed. In a test made in South Boston in March last, the quantity of coke consumed was 1.54 pounds per indicated horse-power per hour. A representative of *Science*, on seeing the engine, was surprised at its general excellence and smoothness of movement.



AN IMPROVED AIR-ENGINE.

of their construction in sizes ranging from five to a hundred horse-power. A few experimental engines were built from time to time, as the inventors approached their ideals, and some of those engines are said to have done satisfactory work during a run of five years. But the engines as made at present are claimed to be much

The essential features of this engine are a heater, a regenerator, and a cooler, which three in combination are called a reverser. The engine illustrated is composed of two reversers and two double-acting cylinders, the cut being a section through one reverser and one cylinder. Each reverser is provided with a reverser heater, within a

furnace; a regenerator, composed of wire cloth of great superficial area, extending from the cooler to the bottom of the reverser heater; a cooler, composed of a large number of thin copper tubes, which are surrounded by water; and a displacer piston, having metallic packing rings, and adapted to reciprocate within the cooler. Each working cylinder is provided with a working piston having metallic packing rings. Each reverser is connected by means of pipes with the working cylinders, as follows: the hot chamber below the displacer piston is connected with the bottom of the working cylinder directly opposite, and the cold chamber above the displacer piston is connected with the top of the working cylinder diagonally opposite.

A small single-acting air-pump, having a leather-packed piston, is operated by an eccentric fastened to the main shaft. This pump is used, first, to compress the air to the initial pressure required; second, to maintain the initial pressure so attained, which is subjected to loss by leakage around the piston-rods. The regulation of the speed of the engine is obtained by a balanced equalizing valve of simple construction, placed in an equalizing pipe which connects the top of the working cylinders together, the valve being operated by a common centrifugal governor.

The power produced is due to the energy exerted upon the working pistons by the alternate raising and lowering of the temperature of the same mass of air within the reversers. The cooling medium used is any kind of water, or a blast of air circulated through the coolers. A very small quantity of water is required, and the same body of water may be used over and over again.

In operation, the alternate raising and lowering of the temperature of the same mass of air is accomplished as follows: in the upward stroke of the displacer piston, the mass of air in the cold chamber above the piston is forced through the cooling tubes, in its downward passage through which its temperature is not materially changed. The air then enters the regenerator, in its passage through which it absorbs heat which has been imparted to the regenerator. It next passes over the heated surface of the reverser heater, thereby becoming further heated, and enters the hot chamber below the displacer piston.

The temperature of the air in the cold chamber is about 120° F., and the temperature of the air in the hot chamber is about 600° F.

In the downward stroke of the displacer piston, the mass of air is forced into the regenerator, in its passage through which it deposits therein the greater portion of its heat. It then passes through the cooling tubes, where its temperature is reduced to about 120° F., and then into the cold chamber above the displacer piston. Therefore, at each upward and downward stroke of the displacer piston, the temperature of the same mass of air is alternately raised and lowered. The reversers being in duplicate, it is obvious that the same alternate raising and lowering of the temperature of the displaced air would take place in one reverser as in the other, but at opposite times; that is to say, both displacer pistons being operated by the reverser beam, whenever one displacer piston is making its upward stroke, the other displacer piston is making its downward stroke. It is therefore evident, that, when the displaced air in one reverser is being heated, the displacer air in the other reverser is being cooled.

The alternate raising and lowering of the temperature of the displaced air (in both reversers) generates a power in accordance with the well-known laws of the expansion of gases, which power is developed by the working cylinders, as follows: while one displacer piston is making its upward stroke, and is heating and expanding the displaced air, thereby producing a pressure which is exerted against the bottom of the piston of the working cylinder directly opposite the reverser, and against the top of the piston of the working cylinder diagonally opposite, the other displacer piston is making its downward stroke, and is cooling and contracting the displaced air, thereby reducing the pressure against the bottom of the piston of the working cylinder directly opposite the reverser, and the top of the piston of the working cylinder diagonally opposite. Thus each working piston is subjected to differential pressures, which are alternately reversed as the displaced air is alternately heated and cooled. Thus a power is exerted to cause the working pistons to have a reciprocating motion, which is changed to a rotary motion by means of the working-cylinder beam and its

connected parts to the main shaft and the fly-wheel, from which the power may be taken off by a belt. A portion of the power developed is absorbed in the friction of the engine, and a portion is used to operate the displacer pistons. The engine is designed to run on an initial pressure of air of about forty-five pounds, at a speed of 115 revolutions per minute.

PRODUCTION OF ESSENCE OF LEMON IN SICILY.

LEMONS in Sicily are divided into two classes, — the true lemon and the bastard lemon. The United States consul at Messina says that the true lemon is produced by the April and May blooms; the bastard, by the irregular blooms of February, March, June, and July, which depend upon the rainfall or regular irrigation, and the intensity of the heat during the summer and winter seasons. There are but three harvests of the true lemon. The first is the November, cut when the lemon is green in appearance, and not fully ripe. Lemons of this cut are the most highly prized: they possess remarkable qualities for keeping, and are admirably preserved in boxes or warehouses from November until March, and sometimes as late as May, and then shipped. The second cut occurs in December and January, and the third in March and April.

Bastard lemons present well-defined peculiarities in shape and appearance: their inner skin is fine, and adheres tenaciously to the fruit; they are hard, rich in acid, and seedless. The bastard lemon produced from the bloom of June is still green the following April, and ripens only towards the end of July. It remains on the tree over a year. The true lemon can be left on the tree until the end of May or the first week in June; but it interferes with the new crop, drops off from over-maturity, and is liable to be attacked by insects. The bastards, on the contrary, withstand bad weather and parasites, and they mature from June to October.

In obtaining the essence from the lemon, the following operations are performed by the Sicilian workman. He peels the fruit lengthwise with three strokes of a sharp knife, and lets the peel fall into a tub under the chopping-block. He then cuts the lemon in two, and throws it from his knife into a bucket. He works with wonderful rapidity, and fills from ten to twelve tubs with peel a day, and is paid about five cents a tub, weighing 77 pounds. His left hand and right index are protected with bands of osnaburgs or leather. Decayed fruit is not peeled. Fresh peel is soaked in water fifteen minutes before the essence is extracted. Peel that has stood a day or two should remain in soak from thirty to forty minutes, so that it may swell and offer a greater resistance to the sponge. The operative holds a small sponge in his left hand, against which he presses each piece of peel two or three times, — simple pressure followed by rotary pressure. The women employed in this work run a piece of cane through their sponges to enable them to hold them more firmly. The outside of the peel is pressed against the sponge, as the oil-glands are in the epicarp. The crushing of the oil-cells liberates the essence therein contained. The sponge, when saturated with the essence, is squeezed into an earthenware vessel which the operative holds in his lap. He is expected to press the peel so thoroughly as not to overlook a single cell. This is ascertained by holding the pressed peel to the flame of a candle. Should it neither crackle nor diminish the brilliancy of the flame, the cells are empty. This process yields, besides the essence, a small quantity of juice and dregs. The separation of the essence, juice, and dregs soon takes place if the vessels are not disturbed: the oil floats on the juice, and the dregs fall to the bottom. These three products derived from the peel have no affinity with each other. As the essence rises to the surface, it is skimmed off, bottled, and left to settle for a few days. It is then drawn off with a glass siphon into copper cans, which are hermetically sealed. After the essence has been expressed, a small quantity of juice is pressed from the peels, which are then either given as food to oxen and goats or thrown away.

The yield of essence is very variable, and the industry is carried on five months in the year. Immature fruit contains the most oil. From November to April, in the province of Messina, 1,000 lemons yield about 14 ounces of essence and 17 gallons of juice. An operative expresses three baskets of lemon-peel (weighing 190 pounds) a day, and is paid at the rate of about twenty cents a

basket. The essence is so valuable, that the operatives are closely watched. Six men can work up 8,000 lemons a day; two cut off the peel, while four extract the essence, and obtain 136 gallons of lemon-juice and 7-pounds of essence. In the extraction of essence, defective fruit — thorn-picked fruit, blown down by the wind or attacked by rust — is used. This fruit is sold by the "thousand," equivalent to 119 kilograms, and thus classified: (1) mixed lemons as they come from the groves during December and January, of good quality but not always marketable, often from top branches; (2) lemons from March blooms; (3) lemons refused at the packing-houses; (4) dropped fruit; and (5) shrivelled or deformed fruit.

Lemons grown on clay soil yield more essence and juice than those grown on sandy or rocky soil. Dealers sometimes adulterate their essences with fixed oils, alcohol, or turpentine. Adulteration by fixed oils is detected by pouring a few drops of essence on a sheet of paper, and heating it: upon the evaporation of the essence, a greasy spot will remain. Alcohol is detected by pouring a few drops of the essence into a glass tube in which a small quantity of chloride of lime has been dissolved. The tube is then heated and well shaken, and, its contents being allowed to settle, the essence will float on the denser liquid. For the production of raw and concentrated lemon-juice, the following is the system employed. When the lemons have been peeled and cut in two, as described above, they are carried to the press and thrown into large wicker bags, circular in form, and then well pressed. If the juice is to be exported raw, only perfectly sound lemons can be used; but if the juice is to be boiled down, one-fifth of the lemons may be of an inferior quality. The juice from sound lemons is yellowish in color, and has a pleasant aroma; its density decreases with age.

With all classes of lemons the yield of juice and its acidity vary considerably from month to month. The amount of juice increases from October to April, its acidity and density decrease; and the same is the case with the density of the essence, owing to winter rains. An addition of five per cent of alcohol will prevent raw lemon-juice from spoiling. Lemon-juice is adulterated with salt or tartaric acid. Raw and concentrated lemon-juice is exported in casks of 130 gallons capacity. It requires about 1,500 lemons to yield 26 gallons of juice, while it takes 2,500 to yield the same quantity of concentrated juice, and 2,000,000, more or less, according to their acidity, to give a cask. Experience has shown that the lemons of the province of Messina, especially from the eastern shore, contain more acidity than the lemons grown elsewhere in Sicily. The value of lemon-juice is governed by its acidity. The rule is that concentrated lemon-juice shall show 60 degrees of acidity (the juice extracted from the bergamot or the sour orange must show 48 degrees, or one-fifth less than that derived from the lemon; it also sells for one-fifth less than lemon-juice). Formerly a citrometer, known as Rouchetti's gauge, was used to ascertain the percentage of acidity; now, however, resort is had to chemical analysis, which is said to be more satisfactory to both buyer and seller. Of late years a new article, known as vacuum pan concentrated natural juice of the lemon, has been manufactured at Messina. The juice concentrated by this method contains 600 grains of crystallizable citric acid for every quart. It is exported in casks containing 112 gallons, and in half and quarter casks. It is also shipped in bottles of 500, 300, and 150 grains each. Consul Jones says, in conclusion, that there is an establishment at Messina, probably the only one of its kind in Italy, in which crystallized citric acid is prepared. It takes from 340 to 380 lemons to make a pound of citric acid, which sells at about forty-four cents. The quantity of essence of lemon exported from Messina during the year 1887 amounted to 440,000 pounds avoirdupois, valued at \$625,000; while of lemon-juice, 4,438 pipes were exported during the twelve months ended Nov. 30, 1887.

ARTIFICIAL SILK.

SCIENCE and industry are ever combining to copy Nature, and even dare to attempt improvements on her processes. The Champ de Mars contains many illustrations of this; but perhaps the boldest and most curious attempt of this kind is to be seen in the manufacture of artificial silk, described in a recent number of *Engineer-*

ing. Near the end of the Machinery Hall, that end by the Avenue du Suffren, and quite close to the elevator which raises passengers to the travelling bridges, there is an exhibit showing the manufacture of silk without any aid from silkworms, and on a system which appears to be entirely novel, and is certainly of wonderful simplicity. The silk industry has seen great vicissitudes, and has had to suffer many cruel troubles from disease both of the worms and of the trees they feed upon; but up to the present we believe that it has been spared the struggles of competition. If this new process should prove to be what it promises, a new and dangerous rival to the silk-trade will have to be reckoned with.

The composition of silk may be briefly described as follows: it is a relatively strong, brilliant material, the produce of the digestive juices of the worm acting on the leaves of the mulberry that constitute its food. The cellulose of the leaf is triturated by the worm, and transformed by its special organism into a peculiar substance, transparent, and somewhat resembling horn. This is called keratine, and it fills two glands, from which it exudes in the form of two threads, which unite as soon as they leave the body of the worm. But this material no longer possesses the chemical composition of cellulose: it is largely combined with a new element characteristic of animal tissues, — nitrogen. The silk-fibre thus discharged forms a continuous thread, which often reaches the great length of 350 metres, the diameter of the fibre being only eighteen thousandths of a millimetre.

It was reserved for the present generation of inventors to devise a means of imitating by science the mechanical and chemical functions of the silkworm.

An old student of the Ecole Polytechnique, M. le Comte de Chardonnet, set himself some time ago to try and solve the problem. He took as his material pure cellulose, — a material, as we have seen, entirely different to that of which natural silk is composed. Cellulose is, as is well known, the basis of vegetable tissues, and particularly of wood. Thus all soft woods appeared to be well adapted for the purpose: in fact, any material suitable for the production of a good quality of paper — white wood, cotton waste, etc. — appeared fitted for the production of artificial silk. Paper pulp is, in fact, the starting-point of the industry. The first operation to which the pulp is subjected is that of nitration, which transforms it into pyroxile. This is done by steeping the pulp in a perfectly defined mixture of sulphuric acid and nitric acid. After thorough washing and drying, the nitrated cellulose is formed into collodion by dissolving it in a mixture of 38 parts of ether and 42 parts of alcohol. The collodion thus made is drawn into fibre by the mechanical means which will be described presently, but the thread requires further and very important preparation. The fibre, as it issues from the apparatus that imitates the glands of the silkworm, is one of the most inflammable of substances, and in that state would be absolutely useless: an absolute process of denitration is therefore a necessity. Of this operation nothing can be said, because it is kept a secret by the inventor. Its object is of course to extract from the filament the greater part of the nitric acid that it contains, and it would be curious to know if the nitrogen that does remain after the process is in the same proportion as that contained in natural silk.

However this may be, the thread after treatment ceases to be inflammable to any marked extent; but it may, if desired, be rendered still less liable to burn. After the denitration process, the filament becomes gelatinous, and other substances can be incorporated with it. Thus, when in this state, it can be impregnated with incombustible material, such as ammonia phosphate; and it is at this stage that the filament can be dyed to any desired color. This latter operation cannot precede the denitration process, as all the color would be taken out during that operation.

The mode of manufacture is very simple, and in the exhibition three apparatus are shown in operation to the public. The first of these is only a model to illustrate the principle. The chief feature consists of a glass tube reduced at the upper end to a capillary passage. It is through this passage that the filament of collodion is forced out under pressure. As it issues, the fibre is in a pasty state, and would have no consistency if it did not consolidate immediately. This solidification is secured by means of a second glass tube, which surrounds the first one, and extends beyond it.

Connected to it is a small pipe which supplies a current of water that bathes the collodion filament, and sets it so that it can be secured by pincers and drawn out without breaking. It is afterwards led to a spool, on which it is wound.

The second apparatus, which is more complete, contains a number of such glass tubes, and illustrates the method by which two or more filaments can be drawn out and twisted so as to form one thread. The third machine is arranged for practical work. The dissolved collodion is contained in a copper receiver having a capacity of about 15 litres. In this receiver it is subjected to a pressure of from 8 to 10 atmospheres that forces the liquid through a horizontal tube, to which are connected 72 capillary tubes, each with their surrounding water-casings. In this manner 72 filaments of artificial silk are produced simultaneously, and these can be spun into threads of various thickness; three such filaments being twisted as a minimum, and ten as a maximum. To effect this, there is placed parallel to the horizontal tube a rack carrying a series of bronze blades that serve to guide the filaments. The twisted threads are wound upon bobbins running on spindles mounted parallel to the horizontal tube. A frame carrying as many pincers as there are capillary tubes can be put in movement by means of a cord, and, if any of the threads are broken, these pincers take hold of the filament and join up the broken parts. This apparatus is enclosed in an hermetically sealed glass case, through which a current of air is continually forced by means of a fan. This air is warmed to assist in drying the filaments; but it becomes cool at the exit, and deposits the vapors of ether and alcohol. The circulating water, which is employed to harden the filaments, is discharged into a receiver. It contains a large percentage of the volatile products, which can be recovered by distillation, and in this way only about 20 per cent of the ether and 10 per cent of the alcohol are lost. One tube can produce from 3 to 5 pennyweight of filaments per hour, or a length of nearly 1½ miles. The apparatus works continuously, and with but little attention; and, if by any chance one of the capillary openings becomes sealed, it can be cleared by applying heat.

Under the conditions in which the machine is exhibited at work, the artificial silk can be sold at from 15 francs to 20 francs the kilogram, while real silk costs from 45 francs to 120 francs the kilogram. The manufactured product resembles very closely the natural one. It is smooth and brilliant, and the filament has a strength about two-thirds that of silk. Woven into a tissue, it appears stronger and less liable to cut, this property being due to the fact that it is not charged with destructive materials, which appear to be always used in dyeing silk, such as zinc or lead. These foreign matters are probably introduced solely for the purpose of weighting the silk; but there is no object for similar adulteration of the artificial product, because the metallic preparations employed cost as much as the collodion thread. According to M. de Chardonnet, the density of his product lies between that of raw and finished silk. Its resistance to a tensile strain varies from 15 tons to 22 tons per square inch (copper breaks under a load of about 18 tons, and iron under 23 tons). The elasticity is about the same as that of natural silk, and the inventor claims that it has a superior brilliancy. M. de Chardonnet exhibits a number of stuffs woven wholly of the artificial silk, as well as others mixed with natural silk and other textile materials. The results are really very remarkable. Among other objects, he shows a chasuble of artificial silk which will bear very close examination.

Artificial silk is not yet manufactured on an industrial scale, but it appears that this will very shortly be done; and, while it is impossible to foretell with certainty what will be the commercial results of this curious invention, it is impossible to resist the conclusion that it is highly practicable, and that it even contains the elements of great future success.

TENTH CONVENTION OF THE NATIONAL ELECTRIC-LIGHT ASSOCIATION.

THE tenth convention of the National Electric-Light Association was held at Niagara Falls, N.Y., on Tuesday, Wednesday, and Thursday, Aug. 6, 7, and 8, the sessions being held in the Casino. The convention was called to order on Tuesday morning by Mr.

E. R. Weeks of Kansas City, president of the association, who, in his opening address, briefly outlined the objects of the meeting, and gave a synopsis of the progress made in the electric-light industry since the preceding convention. The address concluded with the statement that statistics of the association show that the number of arc lamps in service in the United States alone during the last six months has increased from 219,924 to 237,017; that of incandescent lamps, from 2,504,490 to 2,704,768; and that the number of street-railroads operated by electricity is now 109, comprising 575 miles of track and 936 motor-cars. The capital invested in these industries at present amounts to \$275,000,000.

At the conclusion of his address the president introduced the Hon. W. C. Ely of Niagara Falls, who delivered the address of welcome. In his address Mr. Ely touched upon the much-talked-of project of utilizing Niagara Falls as a motive power for the generation of electricity on a grand scale, quoting Sir William Thomson's statement that Niagara Falls possesses more power than all the coal-mines in the world, and Edison's remark that Niagara is the greatest storage-battery in the world. "This latter," Mr. Ely added, "is absolutely truthful, and, with the power of the waterfall developed by means of an hydraulic tunnel, a system of powerful dynamos to transform the water-power into electricity, and this transmitted to Buffalo, that city might be supplied with light and power far more cheaply than at present, and a demonstration of the capabilities of electrical power and transmission afforded that would give us something more sure than the world has as yet had."

After Mr. Ely's address, the secretary read a letter from the mayor of this city to the president of the association, Mr. Weeks, requesting his presence at a "conference of representative citizens to consider the advisability of holding an international exposition at New York in 1892," and to arrange for the preliminary work if it is deemed advisable." This letter was responded to by the appointment of a committee of five, whose chairman is to represent the association in any manner desired by the mayor. The members of the committee are, Dr. Otto A. Moses of New York, chairman; E. T. Lynch, jun., of New York; C. J. Field of Brooklyn; Fred A. Gilbert of Boston; and J. P. Morrison of Baltimore.

The report of the committee on the revision of the constitution and by-laws was then received, printed copies of the proposed constitution ordered distributed among the members, and its discussion made a special business for the Thursday morning session. The committee on underground conduits and conductors, being called upon for its report, asked for an extension of time until the next annual convention, which was granted. Mr. E. A. Foote then read a paper on "The Value of Economic Data to the Electric Industry," which was discussed by Messrs. Morrison, Morris, De Camp, Coggeshall, and Whipple; and a resolution based upon the paper was adopted, to the effect that a committee of five be appointed by the president to report at the next convention of the association forms and a system of records and accounts to be kept by central station companies, a system for reporting the same to the association, and for comparing and publishing the data so secured, for the use and benefit of the members of the association.

Mr. M. D. Law then read a paper entitled "The Perfect Arc Central Station," treating of boiler-rooms and boilers, engines, shafting, dynamos, switch-board, lines, store-room, and shop. This paper was discussed by Messrs. Morrison, Law, Smith, Leonard, and De Camp. At the close of the session the president announced the following committee on electrical statistics: A. R. Foote, chairman; A. J. De Camp, S. A. Duncan, E. F. Peck, and S. S. Leonard, assistants.

At the Wednesday forenoon session the secretary and treasurer presented their report, showing a present membership of 251, an increase of 55 per cent over last year. The annual income of the association is at present \$5,050, and the expenses for the past six months were \$2,241.80. The report of the committee on harmonizing electrical and insurance interests was then received and adopted, and the committee continued, with instructions to take under advisement the feasibility of establishing a mutual insurance company. A committee was also appointed to prepare a petition for the abolition of import duties on copper. At the afternoon session a paper was read by Mr. F. A. Wyman, on "The Constitu-

tionality of Execution by Electricity," and was discussed by several of the members, after which it was resolved that the association petition the General Assembly of the State of New York to repeal the electrical execution law at its next session. A paper by Mr. William Bracken, on "Electric Traction by Storage-Batteries," was then read by Mr. S. M. Young, after which J. F. Morrison, E. T. Lynch, jun., C. C. Martin, E. F. Peck, and A. J. De Camp were appointed a committee to nominate the executive committee, and to choose a place for the next convention.

At the Thursday morning session, after the report of the committee on legislation, Mr. C. C. Haskins read a paper on "Dynamo Room Accessories for Intensity, Potential, and Resistance Measurements." Dr. Moses then read the proposed new constitution, which was accepted, after which Mr. G. W. Mansfield read a paper on "Electric Railways," and Professor E. P. Roberts read one on "The Electrical Transmission of Power." The report of the committee on executive committee and place of next convention was then received and adopted, Kansas City being the place selected, and the executive committee being as follows: G. W. Hart, chairman; L. A. Beebe; J. A. Corby; B. E. Sunny; S. S. Leonard; C. R. Faben; P. H. Alexander; Frank Ridlon; and J. F. Morrison. The convention then adjourned.

HEALTH MATTERS.

Disinfection of Springs, and Number of Germs in Ground-Water.

DR. CARL FRÄNKEL, in the *Zeitschrift f. Hygiene*, reports a series of experiments made by him to determine some points of practical importance; namely, what are the relative values of tube-wells and pot-wells, and can they be disinfected by the measure usually recommended?

With regard to tube-wells, from their mode of construction they are not liable to contamination from surface impurities, as the pot-wells are, and it becomes of the greatest consequence to know whether they receive infective micro-organisms from more distant sources. The result of these experiments is, that as a rule the water entering tube-wells is absolutely free from micro-organisms. But it still appears that a growth of micro-organisms takes place in the tube-wells, and a consideration of all the circumstances points to the growth of a pellicle of micro-organisms clinging to the sides of the tube. Hence one way of disinfecting the tube-wells is to brush them clear, and then completely pump off the turbid liquid. In cases where this proceeding proves inadequate, a concentrated solution of carbolic acid and sulphuric acid dropped into the tube, and left for a day or two, will complete the disinfection. Disinfection of these wells by lime is quite unsuitable, as it forms a mortar, and seriously interferes with the entrance of water.

The ordinary pot-well, on the other hand, is incapable of disinfection, and Dr. Fränkel agrees with Plagge that it is a hygienic monstrosity. Considering how common pot-wells are in our country districts, these are results which require careful attention.

The tube-wells, which Dr. Fränkel found to furnish water freer from germs, were sunk in a part of Berlin which, at first sight, would seem to expose them to great risk of infection. In reality, however, after a time a thick pellicle forms in old soils, which effectually precludes the passage of germs beyond a certain depth. Two sources of error have here to be guarded against. In the first place, the pellicle or its equivalent, which prevents the passage of germs downward, may be broken through at some point, or the corresponding ground may be constituted in parts of pebbles or gravel, which allows of the transmission of micro-organisms; and, in the second place, the chemical constitution of the water passing away from these old soils will very likely be such as to lead to a free growth of micro-organisms, as was the case in these experiments. It is practically impossible to exclude all access of micro-organisms to the well.

The chief conclusions to be drawn from Dr. Fränkel's experiments are, that Abyssinian or tube-wells are infinitely preferable to the ordinary pot-well, and that a disinfection of the tube in the

manner indicated above is, as a rule, all that is necessary to make the water quite free from micro-organisms.

PHTHISIS IN ARMIES.—According to Dr. R. Schmidt of Munich, who has collected a mass of material connected with the statistics of phthisis, the number of soldiers who suffer from phthisis in the German army (excluding Saxony and Bavaria) is, says the *London Lancet*, 3 per 1,000; and the number of deaths from this cause, 0.9 per 1,000. In the Austrian army the numbers per 1,000 are 6.4 and 2.2 respectively; in the Italian army, 4.3 and 2.9. In the Russian and French armies, only the number of fatal cases is given, which is 12.5 per 1,000 in the former, and 2.2 per 1,000 in the latter case. In the English army, which on account of long service and foreign service is not to be compared with continental armies, the number of cases per 1,000 is 11.8, and the number of deaths 6.2. At first sight, one would expect, that, as only men who are found on examination to be healthy are taken as recruits, the number of cases of phthisis ought to be very low. As a matter of fact, however, it is, in Bavaria at least, higher than among civilians of similar age and sex. The reason of this remarkable circumstance is discussed in an article in the *Koenigsberger Zeitung*. How important a factor direct contagion is, the experiments of Cornet show, as well as the fact that hospital attendants fall easy victims to the disease; but Dr. Schmidt believes that the most frequent explanation is that recruits come into the army with a latent tendency to phthisis, and that the conditions under which they are then suddenly placed cause a more or less rapid development of the disease. The knapsack, for instance, appears to have a decidedly prejudicial effect, as is shown by the fact that those regiments which do not wear it present a lower phthisis mortality than those in which it is worn. Again, the diet and the whole regimen of the soldier are, according to Dr. Schmidt, calculated to lessen the power of resistance to the development of phthisis; consequently it is not to be wondered at that a larger proportion of soldiers than of civilians develop it.

A GOOD WORD FOR THE GYPSIES.—There is so great a prejudice against this race, that it is with pleasure that we record testimony in favor of what is claimed to be one of their good points. Every one is familiar with the dusty and dishevelled condition of the modern tramp; but it is claimed by Mr. E. L. Wakeman, in an article in the *Annals of Hygiene* for May, 1889, that the gypsies cannot be accused of uncleanness. He has made a close study of the race in many lands for more than a quarter of a century, and says that he has never known a physically unclean gypsy, the only exceptions being a few individuals in the towns of southern Hungary and in Havana. The gypsy-camps are always pitched near a brook or stream, and the morning bath is as certain as the morning itself. The cleansing is not of the skin alone; but the garments are constantly washed, and the straw bedding is likewise daily spread out for a sunning and airing.

THE UTILIZATION OF GARBAGE.—According to the *Bulletin of the Rhode Island State Board of Health* for May, the city of Milwaukee will soon abandon the cremation of garbage, which it was among the first of the Western cities to adopt and advocate. It is proposed to substitute a dry process in the place of combustion. A company is at work with a new method which converts cities' refuse into articles more or less salable. The garbage is made to pass through a series of mechanical driers, and in the course of ten hours becomes a brown powder. The oil is pressed out or drawn off, and the residue can be sold as a fertilizer.

CREMATION IN FRANCE.—The Municipal Council of Paris has appropriated 383,299 francs for the erection of a crematory in that city, and has levied a "cremation tax" to defray the expenses of the incineration of the bodies of those whose friends cannot afford to pay for it.

PASTEUR INSTITUTES.—According to the Rome correspondent of the *London Daily News*, the Municipal Council of Rome has decided to devote a sum of money to the formation of a Pasteur institute. Confidence in M. Pasteur's treatment of hydrophobia is increasing in Italy, as is shown by the fact that little by little all the principal towns are providing buildings for the treatment of the disease by inoculation.

NOTES AND NEWS.

The eighth congress of Russian naturalists will be opened at St. Petersburg on Jan. 7, 1890, and will last a week.

— We regret to have to announce the death of the Rev. J. M. Berkeley, the eminent cryptogamic botanist.

— Mr. Henry Shaw, the founder of the celebrated botanical gardens in St. Louis, has just celebrated his eighty-ninth birthday.

— We learn from *Nature* that the professorship of civil engineering and mechanics in the University of Glasgow is likely to be vacant by the resignation of Professor James Thomson, on account of weak health.

— Actual elevations taken since the recent disaster at Johnstown, Penn., show that during the flood the water in the neighborhood of Conemaugh and the South Fork bridge reached an average height of forty feet above low-water mark. At the big viaduct on the up-stream side the water was seventy-nine feet deep.

— The Russians have recently improved on the sleeping-coaches of the railway and the perambulating schoolmaster of the rural regions. They have provided a school-wagon which is furnished with a room for the teacher, a classroom or study, and a library, all suitably supplied with the necessary material. This wagon will be on the line of the Transcaspian Railway all round the year, remaining as long as may be deemed necessary at districts which are not provided with a school.

— The Imperial University of Tokio, in Japan, is making rapid progress. The number of professors and teachers amounts this year to 138, of whom only 16 are foreigners, the rest being Japanese. The attendance of students has risen to 788. New buildings for technical education, and a new chemical laboratory, have been erected at the cost of nearly \$300,000, and more money is promised by the government for further extensions.

— It is stated that the Electro-Automatic Transit Company, whose railway system was described in *Science* of July 12, has succeeded in running its experimental car at the rate of 120 miles an hour for a distance of ten miles. The experiment was performed at the company's two-mile circular track at Laurel, Md. The company intends to construct a five-mile experimental road in the neighborhood of this city, upon which to test the applicability of their system to passenger service, only light packages and mail matter having been experimented with heretofore.

— The eleventh congress of the Sanitary Institute, which is to meet at Worcester, Eng., from Sept. 24 to 28, will be divided into three sections: viz., Section I. Sanitary Science and Preventive Medicine; Section II. Engineering and Architecture; Section III. Chemistry, Meteorology, and Geology. Each section will begin its work on a separate day. A conference of medical officers of health will be held during the congress; and there will be a health exhibition in the skating-rink and special additional buildings from Sept. 24 to Oct. 19. This exhibition will include sanitary apparatus and appliances, and articles for domestic use and economy.

— "Now, children," said a teacher, after reading the old story of Washington's exploit with his hatchet, "write me all you can remember of that pretty story I have just read to you." The following was the result: Slate I. (Teddy, 8 years old). "George Washington is our father did he tell a lie no he never did he did with a hatchit;" Slate II. (Ethel, 7). "george washington was the father of is countre hes father sed did you do it he sed i wud not lie i did it with my Hathit and then he busted in tears;" Slate III. (Georgie, 9). "George Washington is the father of our country and he did it with his hatchit and he sed father I did it did the boy deny it o no did he try to put it on some other feller No He did not tell no lie he burst into tears."

— It is generally supposed that oak is much stronger than fir, but a series of tests made recently at the car-shops of the Northern Pacific Railroad, in Tacoma, show that the reverse is actually the case. The tests were made by actual breaking strain, on sticks two by four inches, and four feet long, the weight being applied in

the middle of a span of three feet nine inches. The results of five tests were as follows: first, an old piece of yellow fir, six years exposed to the weather, broke at 3,062 pounds; second, a new soft piece of fine-grain yellow fir broke at 3,062 pounds; third, old piece of yellow fir, coarse grain and hard, broke short at 4,320 pounds; fourth, a new piece of fir from the butt of a tree, coarse grain, broke with a stringy fracture at 3,635 pounds; fifth, a new piece of Michigan oak broke nearly short off at a weight of 2,428 pounds. The deflections before breaking were as follows: the first and second pieces, half an inch; third, three-eighths of an inch; fourth, five-eighths of an inch; fifth, the oak piece, one-inch and an eighth.

— The three teaching universities of Australia—Melbourne, Sydney, and Adelaide—all admit women to their lectures and degrees. It appears that there are now thirty-nine women studying in Melbourne University, twenty-three in Sydney, and thirty-four in Adelaide, the latter figures not including a number of students who are not qualifying for degrees. Adelaide first admitted women students in 1876; Melbourne and Sydney, in 1881 and 1882. Ten ladies have graduated in Melbourne, nine in Sydney, and only two in Adelaide. In all three universities, all prizes, scholarships, and university privileges generally are open to women, who are also eligible as lecturers and professors. In Melbourne they are debarred from membership of the senate, but this seems to be the only barrier of any kind placed in their way.

— In connection with the recent heavy rainfall in the neighborhood of New York, it is interesting to note that at a meeting of the Royal Society of New South Wales, June 5, in the course of some remarks respecting the recent heavy rainfall, Mr. Russell (the government astronomer) stated that he had no hesitation in saying that if rain equal to that which fell in and around Sydney (i.e., 20 to 26 inches) had fallen generally over the catchment areas of Windsor, Richmond, the upper parts of the Hawkesbury, and in the valley of the Hunter, most if not all of the towns on their banks would have been swept away.

— In a recent work by Professor Hartig it is stated, says *Garden and Forest*, that a count of the annual rings of a tree when cut three or four feet from the ground may not give the accurate age of the tree. Where trees are crowded in a forest, and have developed feeble crowns, the greatest annual increment is just below the crown, and it diminishes regularly downwards. When the leaf-area is not sufficient to afford food-material to provide for a sheet of cambium all over the tree, the growth stops before reaching the bottom, and the ring which is found twenty feet up the trunk may fail altogether before it reaches the ground. In such trees there may be rings lacking at three feet high for certain years, and the total number of rings would be less than the number of years in the tree's life.

— The Newfoundland bait act, prohibiting the export of fish-bait from that island, instead of having a prejudicial effect upon the French bank fisheries, as was expected, may have the opposite effect. According to the *Montreal Witness*, the French fishermen have discovered, through necessity, the fact that on the fishing-banks they can catch unlimited quantities of large periwinkles, which, when removed from the shell, and used as bait on their trawls, are a bait which codfish take most ravenously. It thus becomes possible for the fishing-snacks to remain on the banks till their take is complete, hauling up bait on one side of the vessel, and cod on the other, instead of running in to port at intervals, and paying an exorbitant price for bait.

— At a meeting of the London Chemical Society, June 20, as reported in *Nature*, a note on a yellow pigment in butterflies was read by Mr. F. G. Hopkins. The color effects on the wings of lepidopterous insects are for the most part probably due to purely physical causes, but in some cases pigments are undoubtedly present. A yellow pigment, which is found in its purest form in the common English brimstone butterfly, and may also be detected in the wings of a very large number of day-flying *Lepidoptera*, can be obtained from the wings by simple treatment with hot water, in which it is freely soluble, and may be identified by its yielding a

marked murexide re-action, when evaporated with nitric acid, and afterwards treated with ammonia or potash. The common brimstone butterfly yields somewhat less than a milligram of pigment from each insect; larger foreign species, such as those belonging to the species *Callitrypas*, may yield as much as four or five milligrams. Examination of the pigment reveals its near relationship to mycomelic acid, a yellow derivative of uric acid; and the author suggests that it may possibly be a condensation product of uric and mycomelic acids.

— The International College, Spring Grove, not far from London, England, which twenty-five years ago was much talked about and seemed to be full of promise, ceases to exist at the end of this month. The college was brought into existence through a suggestion of the late Richard Cobden, made soon after the French treaty of commerce was concluded in 1860. The intention of the promoters, as given in *The Educational Times*, was to found three proprietary colleges, — one in England, one in France, and a third in Germany, — which should follow the same curriculum, so that students could spend part of their time in each of the colleges, the change of residence being effected without any break of continuity in their studies. There was probably involved in the notion a dream that the international intimacies which such a system would necessarily bring about would tend to put an end to wars and rumors of wars. Indeed, we find it suggested in one of the earlier prospectuses of the college, that, "if the boys of these nations were taught each other's languages in these colleges, when they became men the connection would be made still closer; and it was hoped, that, if this principle were extended to other nations, it might in time have the effect of lessening the number of wars." The Continental members of the triangle were never fairly started, but Mr. Cobden and his friends succeeded in establishing the English college.

— It is claimed that in the new Bookwalter process for converting crude metal into malleable iron or steel, the air-blasts are brought into contact with every portion of the metal, thereby securing a uniformity of structure throughout the entire mass, which has not always been secured with other processes. The main portion of the process is thus outlined by its inventor, Mr. J. W. Bookwalter of Springfield, O.: "Having ascertained that the tendency to form local currents or vortices is much greater when the air-blasts enter the metal near the surface than when they enter at a greater depth below the surface, I devised means whereby to secure a continuously uniform action of the air upon limited uniform quantities of the metal at one time, feeding the metal gradually to the air within a fixed or limited space. By this means small portions of the metal as they are fed to the air are driven thereby out of the zone of violent agitation of the air and metal, and thereafter are thrown back toward the greater body of metal while a new portion of the latter is being brought under the influence of the air, that portion of the metal which is submitted to the action of the air being the purest portion of the body, — that is, having combined with it less scoria than any other portion, — and the greater body of the metal which is not under the direct influence of the air being comparatively stationary, and free from currents or vortices."

— In a letter to *Nature* under date of Cambridge, Mass., July 15, Dr. H. A. Hagen writes, "Having studied Sir J. Lubbock's interesting book, I remembered a fact observed by me, which, though it is not conclusive, seems worth mentioning. I was amused some years ago to observe the feeding of the young in a sparrow-house near an upper window of my house. The old sparrow alighted upon the small veranda of the sparrow-house with four living canker-worms in his beak. Then the four young ones put out their heads with the customary noise, and were fed each with a caterpillar. The sparrow went off, and returned after a while again with four living canker-worms in his beak, which were disposed of in the same manner. I was so interested and pleased with the process that I watched it for some time and during the following days. A fact which I have not seen noticed here in the extensive sparrow literature, is that for a number of years sparrows begin to build nests of dry grass and hay at the top of high trees. The first I saw were large irregular balls placed on the tripod of twigs. The

entrance was on the inner side near the lower end of the balls. Last year I observed another form of the nests. A strong rope formed of dry grass, as thick as a man's wrist and as long as the fore-arm, is fastened only with the upper end to strong branches at the top of high trees. The rope's end has a rather large ovoid shape, with the entrance to the inside near the end. Of such nests I saw last winter about a dozen on the elms here in Main Street, near the college grounds, and similar ones in Putnam Avenue and other streets. A long pole near my house strongly covered by a vine (*Celastrus scandens*) had such a nest for three years, used every year. In the sparrow-houses around my lodging the sparrows stay throughout the winter, commonly one male and three females in every house, till in spring the superfluous females are turned out."

— At the thermometric bureau of the Yale College Observatory during the last year the comparison of thermometers has continued to be made by Mr. C. B. Peck. The number received for verification during the year ending June 1, 1889, was 7,475, being 249 in excess of the preceding, the maximum year. It is perhaps well to call public attention to the fact, not new, but continually overlooked, that the most accurate thermometers may be made to give false testimony by misinterpretation of their language. Although every certificate issued from this observatory, for other than clinical thermometers, contains a statement of the only conditions under which the correction therein given can be truthfully applied, they are continually called upon to explain, especially in the case of high-temperature thermometers, that, when only the bulb is immersed in a liquid of high temperature, the indicated temperature is too low by an amount depending upon the number of degrees of the mercury in the cooler stem and the difference between the temperatures of the bulb and stem. They have been called upon to show frequently that this error, which is independent of any correction due to the thermometer, may be as much as eight or nine degrees in the case of high-temperature oils, as their temperatures are generally measured. A simple remedy for this indefiniteness of measurement would seem to be a special form of thermometer in which nearly all the mercury should be immersed. Of the same nature is the correction of possibly 0.1° to be applied to clinical thermometers of the "Indestructible Index" form, when the detached column of mercury constituting the index is quite long (expressed in degrees), and is read after removal to a much cooler atmosphere; but the probable error on this account does not exceed the probable error of reading.

— Recent reports to the United States Hydrographic Office regarding the seeming failure of certain fog-signals render it desirable to give the conclusions of an expert in this subject. We extract the following from a paper read before the Philosophical Society of Washington, October, 1881, by Mr. Arnold B. Johnson, chief clerk of the Lighthouse Board: "When approaching from windward, the fog-signal is picked up earliest aloft; from leeward, on deck. Do not assume that you are out of hearing distance because you fail to hear the signal, nor that you are at a great distance because the sound is faint, nor that you are near because you hear it plainly. Do not assume that you have or have not reached a given point in your course because you do or do not hear the signal with the same intensity as on some former occasion. Do not assume that the signal has ceased sounding because you fail to hear it even when within easy earshot. Do not assume that the aberrations of audibility are the same in different fog-signals. Do not expect to hear the signals as well as usual when the upper and lower air-currents run in different directions, or when wind and tide do so, or during a time of electric disturbance, or when the sound must reach you from over an island or point of land. When there is a bluff behind the signal, be prepared for irregular intervals in addition, as would follow were the sound to ricochet like a cannon-ball. Thus you might hear it at 2, 4, 6, 8, etc., miles, and lose it at 1, 3, 5, 7, etc., miles, or at any other combination of distances, regular or irregular. Until the laws governing these aberrations are evolved and a method is discovered by which the irregularities can be corrected, you will do well, when you do not get the expected sound of a signal, to assume that you may not hear the warning that is nevertheless faithfully sounded, leave your lead, and use other means to make sure of your position."

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THE APPOINTMENTS BY THE MAYOR to the committee of one hundred on the world's fair of 1892 in New York give very general satisfaction. Fifty-seven industries are represented, and in addition the mayor has named forty-three substantial citizens to fill out the number. Among those specially representing industries, we note, for artists and art collectors, Henry G. Marquand; architects, Richard M. Hunt; banks and bankers, Levi P. Morton; clocks and watches, Daniel F. Appleton; mechanical engineers, Henry R. Towne; civil engineers, John Bogart; periodicals and publishers, John Foord; printing, J. J. Little; railroads, Chauncey M. Depew; scientific and educational interests, Charles F. Chandler. The members of the committee of one hundred have been duly apportioned among the four committees on permanent organization, finance, legislation, and site and buildings. As many of the members of these committees are out of town, no meeting will be held this week. On Tuesday of next week, however, at 3.30 P.M., the committee on finance will meet in the governor's room in the City Hall; and on the following Thursday, at the same hour and place, the committee on site and buildings. The other two committees will not be called upon to act until these two have met. After a site has been selected, the committee on legislation will prepare a bill to be presented to the Legislature.

There is naturally some desire on the part of the smaller cities, more especially Chicago, that the exhibition, or some part of it, should be held within their limits; Boston, for instance, asking only a branch show specially devoted to New England. There is no likelihood of any splitting of the show into local exhibitions, and the site for the whole will depend, except in so far as political influences may warp things, on the commercial interests at stake. As the time has come when world's fairs pay their expenses if skillfully managed, there is no longer need of a call for any sacrifice on the part of those who will pledge themselves for the expenses. This needed guaranty of funds can be secured in this city just as soon as it shall appear wise to ask it; the question now agitating those having the financial matters in charge being as to how far the money shall be raised by popular subscription to bonds of small denomination, the better to enlist popular interest. If any city except Washington should ask for government aid, it is to be supposed that this of itself would rule that city out of the race, the winner in which will be decided by Congress.

Washington not being a commercial city, it seems undesirable that the exhibition should be held there, especially as there are lacking the facilities for handling the large shipments of goods and the number of visitors. At the same time, the hotels of Washington are of low grade, and entirely unequal to the demands of a world's fair. Then, again, the weather in Washington is likely to be much more oppressive in summer than in New York. The great objection to New York that has been brought forward so far is the lack of local pride. This lack, as is well pointed out in *The Evening Post*, is due to the fact that New York is *facile princeps* among American cities: it is only the little man and the little town that have to boast continually of such good as they may possess, in order that they may not be ignored, and that have to strive constantly to make their good points the better. New York certainly lacks this spur; but she is made up of shrewd business-men, who are amply able to carry through a world's fair just as soon as they have decided that their interests demand it.

THE UNITED STATES, THEIR GROWTH IN POPULATION IN TWO HUNDRED YEARS.

In 1798, eight years after the first census of the United States was taken, Malthus, in England, published his "Treatise on the Law of Population," which excited great interest, and brought the author much hostile criticism. In June, 1890, we shall take the eleventh census of the United States, and will know with certainty what has been our increase in a hundred years. We expect to find a population of 67,240,000. Malthus held that population in a wide country, affording plenty of space and producing abundant food, doubled every twenty-five years. Trying his estimate by the recorded figures of ten decennial census enumerations, we find that he was very nearly correct.

With the aid of this information, we attempt to discuss the results to date, and to infer something of the progress of the next hundred years. We do not think it rash to infer the work of a century from the known advance during one just expiring. Taking the figures of the past from "Johnson's Cyclopaedia," we find the population of the North American Colonies estimated by Bancroft as follows:—

Year.	Population.
1750	1,260,000
1754	1,425,000
1760	2,195,000
1770	2,312,000
1780	2,945,000

The following table shows the rate of increase since 1799, as shown by the census returns :—

Year.	Population.	Increase in to Years.
1799	3,929,214 3	
1800	5,308,48	35.1 %
1810	7,239,881	36.3
1820	9,653,822	33.1
1830	12,866,020	33.5
1840	17,069,433	32.6
1850	23,191,876	35.8
1860	31,443,321	35.6
1870	38,558,371	22.6
1880	50,175,000	36.0
1890	67,240,000	34.0

The mean of the rates is 33.46 per cent. If we substitute for 22.6 (the exceptional rate of the increase between 1860 and 1870) 34.8 per cent (a mean between the rates immediately preceding and following the decennial epoch), we find as probable rates of increase and aggregates of population, had peace continued, the following :—

Year.	Population.
1870	42,380,000
1880	57,130,000
1890	77,100,000

This is 9,860,000 more than the population actually to be expected in the next census, — loss to be attributed to a great war. Other variations in the decennial rate of increase are due to the war of 1812, the Mexican war, the cholera epidemics, etc., and to emigration.

In estimating the progress of population during another century, it is not perhaps rash to assume a rate of 33.3 per cent, which is a little less than the mean rate, including war and pestilence, which has ruled our growth in the last century. Adding one-third to each decennial estimate, we find the probable population to be as follows :—

Year.	Population.
1890	67,240,000
1900	89,653,333
1910	119,737,777
1920	159,650,377
1930	212,867,177
1940	283,822,877
1950	381,763,837
1960	509,018,449
1970	678,691,265
1980	904,921,686
1990	1,206,562,248

This completes the century. Then, as the area of the territory of the United States is 3,026,494 square miles, the density of its population in 1990 will be 399 to the square mile. The density of population in certain countries is given in the same cyclopædia (printed in 1878) as follows : United States, 12.7 per square mile ; Atlantic States, 46.6 ; basin of the Ohio, 37.7 ; Massachusetts, 201 ; Ohio, 66 ; Belgium, 434 ; China, 420 ; England, 389 ; Europe, 71 ; Asia, 46 ; Africa, 16 ; America, 6 ; Australia, $\frac{1}{3}$. Such a nation will have a power and a commerce and industry not heretofore known to the world. Our ships and those of our allies will bring the spare products of every land to our shores. Systems of interior land and

water transport, perhaps mostly operated by electric power, will rapidly and cheaply distribute them.

For a century we may hope to live comfortably and abundantly within our boundaries. But other people must grow also. The now empty and waste places of the earth will be occupied by civilized and industrious nations. We have in this generation made wonderful and rapid progress in the discoveries and inventions of science. We use the electric force, as did our fathers that of steam. In all probability, electricity will heat as well as light our houses, and will cook our food. It will drive other as well as our city passenger railroads. And it is not probable that man has yet discovered all the resources laid up by the Creator to be discovered and utilized by his creatures when needed for their happiness and comfort.

The Anglo-Saxon race will occupy the continent from the Isthmus to the Arctic, and, when crowded therein, must spread over South America, or perish. That they are not likely to submit to As the prairie wolf disappears when man drives off or subjugates the animals on which he lives, and for whose regulation he appears to have been created, so will the weaker races give way to the stronger. It has been thus in all history, and the law still holds. There are in the United States a majority of whites over blacks of 51,000,000. They will be able to settle without bloodshed most of the apparently troublesome questions as to races, as may to them seem best ; and when they agree upon the methods, and necessity enforces the duty, they will settle them for the best good of the greatest number.

Soon after the civil war it was often said that they who believed in the success of the United States, and conducted their affairs on the theory of such success, grew rich and prospered. They who took the opposite belief were unsuccessful, and lost their fortunes. Those who believe in the prospects here set forth will rule their undertakings and investments in the expectation that property in real estate must advance in the next half-century ; that commerce and transportation and production must increase enormously. As the discoveries and inventions of science and industry make towns more and more healthful, convenient, interesting, and agreeable places of residence, our people will tend more and more toward them. Museums, libraries, public halls for the education and instruction and amusement of the people, will be more and more numerous and cheap. The streets and parks will be embellished and made gay with public and private buildings. Electric engines will do the heavy work of the day. More time will be at the disposal of men for enjoyment, as these improvements relieve men and women from slavish toil for the means of living.

It may be assumed that the cities will grow at least as fast as the country. In 1799 the urban population was estimated at one-thirtieth the whole ; in 1840, at one-twelfth ; and in 1870, at one-fifth. In 1990 the urban population will be 240,000,000 ; and of these, New York will probably contain over 30,000,000. What will be the value of lands in that city then, may be inferred from the auction-sales of London, which has 4,000,000 people. But there is here an inexhaustible field for investigation and speculation. We leave it to others to explore, having fulfilled the task we set ourselves, of calling the attention of those who inaugurate or direct great enterprises to the need of looking, in arrangements for the future, to a longer period than the decennial census, which is the limit of all speculations on the subject of population and growth which I remember to have seen in print. Twelve hundred millions of intelligent, educated, industrious people, of one race and blood, under one free government, armed with all that science teaches and man has invented — who will wish to interfere with their happiness ? Who will attack them ?

The probable increase in the ten years from 1930 to 1940 will be about 68,000,000. This is equivalent to 13,600,000 families. Considering only the building trades, this will require the construction in ten years of 14,000,000 new domiciles or family residences. Each will need as much floor and window area as now. Does any one yet foresee the volume of business and its activity, in constructing within a single decade as many buildings as at this time exist within the limits of the United States ?

What work for architects, contractors, builders, carpenters, masons, brick-layers, plasterers, brick-makers, quarriers, saw-mills,

lime-kilns, sand-gatherers, rolling-mills for structural and roofing iron in sheets and beams, for tanners and roofers, and the thousand other trades engaged in construction, not only of the 14,000,000 new homes, but of the markets, stores, warehouses, post-offices, court-houses, city-halls, jails, penitentiaries, etc., necessary in the administration of an additional population equal to all that exists now on the northern continent! What will be the work of providing, and delivering at every house, three meals a day, and every day, for each inhabitant thereof? M. C. MEIGS.

BACTERIA IN MILK AND ITS PRODUCTS.

DURING the past year, investigations on the bacteria of milk have been carried on in the laboratory of the Agricultural Experiment Station, Mansfield, Conn., under the direction of H. W. Conn, professor of biology in Wesleyan University. The following is a brief summary of some of the more interesting results of this work.

The term "bacteria" is used to comprise a class of organisms found abundantly in the air, water, and soil, and in plants and animals. As commonly employed, the term includes a large variety of organisms, which naturalists divide into the three classes, bacteria, yeasts, and moulds. The term "microbe" has been recently introduced to cover this same ground, and is for many reasons preferable. The plants included under this head are exceedingly numerous, and the part they play in nature is of great importance. They multiply with the greatest rapidity, a single individual in the course of a few days being able to give rise to millions. While they are thus growing and multiplying, they produce great changes in the medium in which they grow. All fermentation (such as raising of bread, fermenting of beer, cider, etc.), putrefaction and decay (such as rotting of potatoes, decay of wood, etc.), are produced by the organisms here included. They are of immense value as well as injury. Through their agency, dead animal and vegetable matter is decomposed, and prepared to be incorporated with the soil and to be used as food by plants. It is doubtful if vegetable life could be long continued without their aid. On the other hand, they cause disease in plants, and disease in animals; many of the most dangerous diseases, as cholera, typhoid-fever, consumption, hog cholera, bovine tuberculosis, chicken cholera, etc., being produced by these disease germs. These organisms are extremely minute and simple. They are commonly not more than one two-thousandth of an inch in length. In shape they show three chief varieties, which may be compared to a lead-pencil, a ball, and a corkscrew. To-day they are universally regarded as plants, in spite of the fact that many of them are endowed with motion.

Methods of Experiment.

The method of experiment has been that common in modern bacteriological research. For culture solutions the ordinary beef peptone solution, stiffened by gelatine, or more commonly by agar-agar, has been used. For most of the experiments with cream, "ripened cream" has served as a starting-point. In some cases sweet cream has been ripened in the laboratory, and examined each day, but more commonly specimens of ripened cream have been obtained from the dairy of a butter-maker and directly studied. Plate cultures have been made from the cream, usually with agar-agar, since the organisms found grow in this medium most readily. From the various colonies found in the agar plates, needle cultures have been made in gelatine. Subsequent purification of the organisms has been made in the ordinary way, by transferring from tube to plate, and plate to tube, until the bacteria were separated from each other in pure cultures.

For further experiment, milk has been sterilized in test-tubes. This can be done at a temperature of about 70° C., but it has been found more convenient to put the tubes for a few minutes in a steam sterilizer. Sterilization upon three successive days is commonly sufficient, but in a few cases milk was found to change even after such treatment. The sterilization of cream has been accomplished in the same way. There is more difficulty in this, however, for the cream is apt to form a thick layer on the surface, with a thin watery layer below; and this occurs even in cream that

is thoroughly sterilized. In the experiments upon the action of the different bacteria upon milk, the inoculations have been made, and the tubes allowed to remain at the temperature of the laboratory for a day or two. If no change occurs, they are then placed in a thermostat at a temperature between 30° and 35° C., and allowed to stay there till they have produced their effect upon the milk.

Accompanying all of the experiments upon milk and cream, a series of experiments have been carried on with the same organisms upon three different solutions. One was the ordinary beef peptone solution without gelatine; the second, the same solution, to which a small amount of milk-sugar had been added; and the third, the beef peptone solution, with the addition of glucose instead of milk-sugar.

Inasmuch as the object has been to determine the general effect upon milk and its products of the various bacteria present in the air, it has been necessary to work with all the numerous species that have been found in ripened cream. This has necessitated a very large number of experiments, continuing through eight months. The account of these experiments, which, to be in any way useful, will require a large number of pages of detailed description of individual species of bacteria, as well as their action and effects, is reserved for the next annual report of the station. At present it is designed to give only a brief summary of the most important facts concerning the relation of bacteria to milk and its products. For this reason the following remarks include results of the work done at the station, and of other investigators as well, and some conclusions derived from them.

Bacteria in Milk, Cream, and Butter.

Milk is a medium in which bacteria grow with the greatest readiness. Experiments have thus far given indication of some thirty or forty species of bacteria that are floating in the air in this vicinity, every one of which is found in cream, and grows with the greatest facility in milk. Probably none of those which were studied produce disease, and hence are called non-pathogenic. The researches of others have shown that many of the disease (pathogenic) germs also find in milk a favorable medium for growth. According to experiment, cream seems to be even a better medium for the growth of bacteria than milk; for it will keep longer without putrefying, and thus allow some of the slower-growing species to develop. Butter is not a good medium for the growth of bacteria, apparently because they require for their development a certain amount of albuminous material, of which good butter, being mostly fat, contains only a minute amount. Bacteria have, however, always been found present even in the sweetest of butter, but usually in small numbers. When for any reason they become very numerous, the butter becomes tainted.

If milk, cream, or butter is kept free from bacteria, the ordinary changes do not take place in them. For example: the bacteria in milk can be readily killed by heating the milk to a boiling or even lower temperature for a few moments upon three successive days; and then, bacteria being excluded, the milk is found to keep sweet indefinitely. Killing the bacteria by heat is known as sterilizing. If a lot of milk is thus sterilized, and then a few of any particular species of bacteria are put into it, the effect which this species produces upon the milk can very easily be determined. It is in this way that the experiments have been made.

Milk and cream under ordinary conditions cannot be kept free from bacteria. Milk drawn from a healthy cow is free from them, but they may get into it when the milk is in contact with the air during milking. A single experiment will indicate the difficulty of keeping them out of milk. Eight test-tubes were washed perfectly clean, and plugged with a mass of cotton. They were then heated very hot until all living matter in them was killed. These were taken into a milking-yard, and, after the teats of the cow and the hands of the milker had been carefully washed, the cotton plug was taken out and milk drawn directly from the cow into the tubes, and the cotton plug replaced. Of these eight tubes, seven soured in a few days, and many bacteria were found in them. The other remained sweet for a long time, but eventually it also changed. From this experiment it is seen that in the few seconds in which it was exposed to the air the milk was contaminated with bacteria. A very common source of contamination of milk is from

vessels in which the milk is placed. These, unless recently washed in boiling water, contain bacteria clinging to their walls. These bacteria begin to grow as soon as the milk gets into the vessels, and in a few hours will multiply so as to be extremely abundant.

Number of Bacteria in Milk. — Different Species.

The number of bacteria in milk will depend chiefly on three things: 1. The cleanliness of the vessels; 2. The temperature of the milk, warmth being favorable to their growth; 3. The length of time that the milk has been standing. Ordinarily the number of bacteria in the air is of comparatively little importance, unclean vessels being the great source of contamination. If, however, the vessels are perfectly clean, the number of organisms in the air becomes the important factor. In cream which has been allowed to "ripen" for a few days, the number is extremely great. In the specimens of ripened cream which we have examined, from 10,000 to 100,000 individuals have been found in a single drop, the latter number being usually nearer the truth than the former. Even under conditions most unfavorable for their growth, in a cool cellar during the winter, 12,000 have been found in a single drop. These are capable of multiplying with the greatest rapidity, producing hundreds of thousands in a few days.

Not only is the number of individuals very great, but the number of different species is considerable. Some thirty or more different species of bacteria have been found during the winter in specimens examined in the laboratory. No single specimen of cream contained them all, but each contained several species.

The number of bacteria present has, however, no significance until we know something of their effect. Some are harmless, some are hurtful; some affect cream, milk, and butter injuriously, and others do not. The effect produced by most of these organisms upon milk is striking.

Of the large number of organisms found in milk, two or three seem to be characteristic. The first is the one that produces the ordinary souring of milk (*Bacillus acidilactici*). This organism, upon being introduced into sterilized milk, grows rapidly, and soon breaks up the milk-sugar that is present into either lactic or acetic acid and carbonic acid. The acid thus formed causes the milk both to curdle, by hardening or coagulating its albuminous matter, and to acquire its well-known sour taste and odor. This organism is very abundant in the air in warm weather, but in the winter seems to be much less abundant; indeed, it can at times almost be said to be absent. Milk has been kept in an open dish in the laboratory, during cold weather, for two weeks without its going through the characteristic changes of souring. It finally curdled, but with a peculiar odor of decay, and did not sour in the typical manner at all. The vessel in this case was absolutely clean, so that the air was the only source of contamination. The changes which did take place were produced by bacteria other than the common sour-milk bacterium, this one not seeming to be present at all. The fact that the typical souring was thus prevented shows that the common sour-milk bacterium was not present in the air at the time, at least in any great quantity. Such an experiment would not succeed in the summer.

A second species almost always found in milk is *Oidium lactis*. This produces no important change in milk. It grows rapidly, but does not cause the milk to sour or curdle. Besides the two mentioned, a large number of other species have marked effects upon milk.

Action of Different Kinds of Bacteria in Milk.

As concerns their action, we may divide them into four classes: 1. Some, like the bacteria of sour milk, cause the milk to sour by breaking up the milk-sugar into lactic or acetic acid and carbonic acid; curdling of the milk results. 2. Many produce the same result, but only at somewhat higher temperatures. At ordinary temperatures, they grow, but do not curdle the milk; in a warm oven, however, the milk will soon curdle. Accordingly, these would sour and curdle the milk in summer, but would not do so, or would do so less readily, in winter. The temperature and time required to produce the curdling differ with different species of bacteria. 3. Some do not have the power of breaking up milk-sugar, do not produce any acid, and do not coagulate the milk. The milk remains liquid, and sometimes becomes decidedly alkali-

line. 4. A few species curdle the milk, but produce no acid, the milk becoming alkaline instead. The majority of bacteria of milk and cream which have been experimented upon produce a souring and curdling of milk at some temperature. Experiments have also indicated that the action in all these species is somewhat similar; i.e., the breaking-up of the milk-sugar into an acid and some other product. But, although the action is thus fundamentally the same, the details of the action vary with each different species of bacteria.

The curdling is very different in character with different species. In some cases a hard curd and a clear liquid are formed; in others a curd is formed, but no liquid is separated from it; in still other cases the whole milk is turned into a semi-gelatinous mass. Sometimes the curd is easily broken or cracked, like the curd of common milk; in other cases it is very tenacious, sticky, and slimy. Sometimes the curd is dissolved in a few days, and the milk is left as a clear and almost transparent liquid. Here the caseine seems to undergo a change similar to digestion; i.e., conversion into peptones.

In connection with the curdling, there also arises in all cases a characteristic odor, which differs with different species of bacteria. There is a sour smell, a smell like sour bread, a smell like soft-soap, like salt mackerel, like a pig-pen, like the barnyard, and in many cases a smell of putrefaction. Besides these, there are others that cannot be described because of the lack of words in our language to distinguish odors. As far as the studies have gone, the effect of each species of bacteria upon the milk seems to be different from all others. The dairyman or the housewife would in most cases say that the milk had soured, but careful study shows that in reality the different bacteria do produce effects differing to a greater or less extent. The results of the experiments seem to indicate that what is commonly known as the souring of milk is not always caused by the common sour-milk bacterium, as has been usually supposed, but is frequently produced by others, and that the products formed are different. Particularly is this true in winter.

Bacteria in Cream.

Experiments were undertaken in the expectation that the so-called "ripening" of cream would prove to be a definite change due to the growth of bacteria. Having found that the souring of milk is less simple than had been supposed, one is prepared to find that the "ripening" of cream is also a complex process. It is not easy to say just what is meant by "ripened" cream. In ordinary farm practice, cream is usually allowed to stand for a few days before churning, when it becomes somewhat thickened, and acquires a pleasantly sour odor. In the creameries the cream is also ripened, though for a shorter time, and it does not become so thick or so sour. That the ripening is due to the growth of bacteria there can be no doubt. Ripened cream always contains these organisms in almost inconceivable abundance. In some places the ripening is hastened by adding a little sour cream as a "starter." This simply means the addition of a large number of bacteria, which of course hastens the process. Sometimes an artificial starter in the form of an acid is added. This practice proceeds upon the supposition that the ripening is due to the formation of an acid, which is probably a secondary matter. It is doubtful if this kind of a starter has any definite value.

By successive heatings, specimens of cream have been deprived of all bacteria, and it is then found that the cream remains unchanged indefinitely. In these specimens of sterilized cream have been planted the various species of bacteria that have been experimented upon. All of them grow well in the cream, and each has its characteristic effect; but no one of them has yet been found to produce exactly what would be called ripened cream. Some curdle it; some cause it to putrefy. From all of the experiments it may be concluded that the ripening of cream is a complex matter. The souring is apparently due to a process similar to the souring of milk; the thickening, in part to the curdling of the small amount of milk left with the cream, and in part to immense numbers of bacteria that develop. Another important factor in the ripening of cream is the decomposition of the albuminous matter present. In general we infer that different kinds of bacteria assist in the ripening of cream, but doubt whether any one has such a definite

relation to it as the sour-milk bacterium has to the curdling of milk.

Objects of the Ripening of Cream.

There seem to be two chief objects in ripening cream. It is a matter of experience that the butter will separate more readily from ripened cream, and the churning therefore be easier; and it is believed by many that the butter made from ripened cream will keep longer than butter made from sweet cream. A simple explanation is suggested, if not warranted, by the facts at hand, and may be of interest to butter-makers. Dr. Babcock of the Wisconsin Agricultural Experiment Station has pointed out, that, shortly after milk is drawn from the cow, there appears in it a fine, inappreciable network of fibres, which produce in the milk a slight thickening somewhat like the clotting of blood, except that it is much less marked. This, which Babcock calls "fibrine," is of an albuminous nature, and will readily putrefy. When the cream rises to the surface of the milk, a considerable quantity of this so-called fibrine is entangled with it, and is skimmed off with the cream. The butter-globules are enclosed in this fibrine, and in churning they must be shaken out. Now, in the time that the cream is ripening, the numerous bacteria are at work upon this albuminous fibrine, feeding upon it and decomposing it. The breaking down of the fibrine is also assisted by the acid that is formed by the bacteria, for it is a well-known fact that acid will greatly assist in the solution of materials similar to this fibrine. After the fibrine is thus partly dissolved by the action of the bacteria, the butter-globules will much more readily be shaken free from them, and churning be made easier.

The keeping-property of the butter is easily explained by the same considerations. There is no doubt that bacteria are the cause of rancidity in butter. Bacteria cannot live upon pure fat, but require for food a certain amount of albuminous matter. It follows that the more albuminous matter there is in the butter, the more readily will they grow, and the quicker will the butter become bad. If the cream is churned before the albuminous fibrine has become decomposed, the butter will usually contain more of the fibrine than will butter made from cream after the fibrine has decomposed. Butter made from ripened cream will naturally contain more bacteria than that made from sweet, since the ripened cream itself contains them; but this is a matter of less importance than the ability of the bacteria to grow and multiply in the butter, and, for reasons above stated, this they can more readily do in butter made from sweet cream.

From this it would seem that the value of ripening cream depends upon the albuminous fibrine that is present in the cream; and any process that diminishes this diminishes the necessity of ripening, at least so far as concerns the two objects above mentioned. Babcock has shown that the quicker the cream rises, the less will be the amount of the fibrine entangled with it; and that, when cream is separated by a centrifugal machine, a considerable part of the fibrine collects on the drum of the machine, and less in the cream. It would seem, therefore, that there would be less need of ripening centrifugal cream than that raised in the more common way.

A third object attained by ripening cream is to give a certain flavor to the butter which is not obtained in butter made from sweet cream. This is a matter of as much importance to butter-makers as either of the other two, for the value of butter usually depends more upon its taste than upon its keeping-properties. But the relation of the taste of butter to the ripening of the cream, and to the method of handling the butter, is a matter too vague and indefinite at present to warrant definite statements.

Cleanliness in Dairying.

It must be remembered that many bacteria are so minute that thousands of them might occupy less space than the point of a needle; that they multiply so rapidly that millions may be produced in a short time from a single one; that organic (animal and vegetable) matters, including many forms of what are ordinarily called dirt, are media for them to grow in; that milk is especially adapted to their development, and the most minute quantities of it may serve for their dwelling-place, and furnish food for their rapid growth; and that they are sure to adhere to the surface or cling

in the joints of vessels that have contained milk. Bearing all of these facts in mind, the necessity for thorough cleansing of all vessels used in handling milk is apparent. To wash such vessels so that no particles of dirt will remain on the surface or in the joints is extremely difficult. It has been frequently demonstrated that no amount of washing in cold or even warm water will remove all bacteria. It is necessary to use boiling water, and to leave it in the vessels for a considerable time, to destroy the active forms of bacteria that are sure to be present. Even though the active forms may be killed by boiling water in the course of a few minutes, their spores, which correspond to seeds, will resist boiling temperature for a long time. The danger of contamination from spores is not so great but that it may be neglected for all practical purposes, and, unless the vessels are contaminated with some dangerous bacteria, a thorough washing in boiling water is sufficient. But vessels in which milk is to be kept cannot be properly cleaned by pouring boiling water into one, allowing it to remain there for a few minutes, and then pouring it into another, and making one heating of the water suffice for the cleaning of several vessels. The last ones thus treated will not be much cleaner, so far as bacteria are concerned, than if they were washed with cold water. To clean vessels thoroughly, it is necessary to use a higher temperature than that of boiling water, which can be readily obtained by putting them for a few minutes in a hot oven or on a hot stove. If this is thoroughly done, there is no danger of contamination of milk from the milk-vessels.

The use of sal-soda in washing milk-vessels is advantageous, because it acts chemically upon fatty matters (grease), and thus helps to remove them and other materials which adhere to the vessels with them. In like manner, the use of "live steam" to "dry" vessels after washing has the advantage of sterilizing them; i. e., killing the bacteria by the highly heated steam.

BOOK-REVIEWS.

The Ice Age in North America and its Bearings upon the Antiquity of Man. By G. F. WRIGHT. New York, Appleton, 8°. \$5.

IT may perhaps be questioned whether the time has yet come for a popular presentation of the glacial theory in so detailed a form as is given in Professor Wright's book, for it is still a matter upon which much investigation must be expended; but, on talking with teachers and intelligent readers who have not access to the scattered literature of investigation, it is apparent enough that they greatly need a compendium of the results of glacial study as it now stands, as they have no sufficient comprehension of its remarkable conclusions. This book on the ice age in North America will therefore have a wide reading, and, if its readers note carefully the expressions of doubt as well as the expressions of fact, it must be serviceable to them. Professor Wright's style is entertaining, and he brings together a large and well-selected body of description from the works of pretty much all the glacialists in the country. The illustrations are excellent, and the citations are numerous; but, for the sake of historical precision, it would have been better to add the date of publication of the writings of others, and it might have been advisable for the author to place the "Report of the Ohio Geological Survey," and several other papers, before his own in the extended list of essays on our terminal moraines (p. 139), to which the studious reader is referred.

The book opens by discussing the nature of glaciers in general, and illustrates this by descriptions of our glaciers in the West, and by the author's account of his observations on the Muir glacier in Alaska in 1886. Glaciers in Greenland and other parts of the world are then allowed two chapters before taking up the indications of extinct glacial action, to which the rest of the volume is devoted. Some of the more important headings are, "The Glacial Boundary and Terminal Moraines," "Glacial Erosion, Transportation, and Deposition," "Contrasts of Pre-glacial, Glacial, and Post-glacial Drainage;" "The Date of the Glacial Period and its Relation to the Antiquity of Man."

If one may judge by the small attention given to glacial topography in our ordinary text-books on physical geography, it may be

concluded that there is no general appreciation of its great significance. One may hardly find a history of the United States that does not give an introductory account of the early Indians; and yet it is safe to say that they are of less importance in forming an understanding of our historic progress than the work of the old glaciers is in gaining a conception of our geography. The moraines and drumlins, the kames and sand-plains, the lakes, falls, and gorges, the gravel-filled and terraced valleys that characterize the northern glaciated country, are, to be sure, relatively small topographic forms; but they are forms on which we live, and which we daily see around us. It is proper that they should be introduced to public notice; and Professor Wright's book will certainly aid in calling attention to them, particularly if his readers go further than his text, and follow up his footnotes, through which they will be led to the most important discussions on these subjects. Look, for example, at the illustration of a new river-course marked by a waterfall, or of an old river-course blocked into a lake, both of these excellent views being copied from Chamberlin and Salisbury's invaluable essay on the driftless area of Wisconsin; or at the strongly marked morainic wall of the Kettle range in Wisconsin, taken from one of Chamberlin's reports; or at the extraordinary loops of the moraines in Minnesota and Dakota, taken from Upham's and Todd's figures; or at the drumlins reproduced from Hitchcock's report on New Hampshire; or at the map of the kames of Maine by Stone. All of these are not only valuable illustrations of highly significant topographic forms, they are also tempting suggestions towards study of the original sources on which Professor Wright has drawn freely in preparing his book. The same may be said of numerous quotations, often extended over a page or more, from the writings of those who have given us the best interpretations of glacial geology. There are extracts from Gilbert's and Pohlmann's papers on the recession of Niagara Falls; Winchell's account of the post-glacial recession of the Falls of St. Anthony; Upham's description of Lake Agassiz, now the great wheat-growing plain of Minnesota and Dakota; Clappole's suggestive although rather highly deductive account of the temporary lakes marginal to the retreating ice-sheet; Newberry's studies on pre-glacial drainage; and many more. The thoughtful reader of all this will perceive something of the long growth of the present belief in glacial geology, and of the efforts of the many workers who have so greatly contributed to its understanding. Professor Wright's own observations on the margin of the glaciated tract are of course also described.

Among the questions on which the conclusions favored by the author are most likely to find dissent with some investigators are the date and duration of the glacial period, and the ice-dam at Cincinnati, by which the Ohio was blocked into a great lake. The objections to the latter theory are not so much on account of its inherent improbability as because the effects and products of such a lake have not been as yet clearly enough seen to require a moderate sceptic to admit its existence. It is natural enough for Professor Wright to feel a paternal fondness for this idea, which he originated some years ago, and look with favor on facts that point towards it; but, before it can command general acceptance, it must be examined in the light of a broader view of the evolution of rivers and of the various changes to which they are subject. It does not seem as if this broader view has been attained, for it is said that the Ohio has been at work on its present valley from the first elevation of the continent to glacial time, that is, through all mesozoic and nearly all cenozoic time; while it must be apparent to the student of river history that the present valley of the Ohio is of by no means so great an age. The water-worn pebbles on high land in West Virginia have relatives in similar deposits in Tennessee, outside of the hypothetical Ohio lake. The terraces of western Pennsylvania are not described in such a way as to make it clear that they are of lacustrine and not of fluvial origin. The case had best stand open yet for a time till further facts are developed.

The date of the glacial period commonly alluded to, as determined by such post-glacial river-gorges as the Niagara, is rather the date of a somewhat late phase in the disappearance of the ice. How long a time elapsed from the maximum advance of the ice to the beginning of work on the gorge is not now determinate. The

unknown factors in this problem are very numerous, and they will require much labor in their definition. Prominent among these is the time-interval between the various terminal moraines and drift margins; and in this question, Wright differs from the conclusions of Chamberlin, McGee, and Gilbert, as to the division of the glacial period into two distinctly separate epochs, and regards the whole period as essentially single and continuous. Extracts are given from the writings of the above-named investigators; but the reader will do well to consult the original essays, as the discussion is rather intricate. Here, as in the case of the ice-blocked Ohio, it appears to me that Professor Wright does not sufficiently consider other arguments than those of strictly glacial geology. The evidence of topographic development, as adduced by Chamberlin and McGee, particularly needs further examination.

On these larger questions, it is to be hoped that an open mind can be maintained for some years to come. It is only by regarding them as settled that the student may be unwisely guided. The treatment of the smaller subjects, such as those of which many examples have been named above, will prove instructive to many readers.

W. M. D.

An Elementary Treatise on Mechanics. Part I. Statics. By ISAAC WARREN. London and New York, Longmans, Green, & Co. 16°. \$1.

THIS is a compact and well-arranged little volume, intended for the use of schools and students in universities. It is the first part of a work on mechanics, the second part of which will treat of dynamics, under which term the author includes kinematics and kinetics. The work follows to a great extent the same lines as those of the same author's elementary treatise on plane trigonometry, and is especially rich in exercises,—a feature which ought to recommend it to teachers. As additional exercises, a series of ten examination-papers proposed in Trinity College, Dublin, are annexed to the volume, and a note on the order of lever to which the oar belongs. This latter, though a clever thing in itself, and well adapted to develop certain faculties of the youthful mind, might well be omitted in a text-book.

Steam Engine Design. By JAY M. WHITHAM. New York, Wiley. 8°. \$6.

MECHANICAL engineers, students of engineering, and draughtsmen will find this a book well adapted to their requirements, and it will not be without value to any person interested in mechanical engineering as a profession. Its author was at one time assistant engineer in the United States Navy, and is now professor of engineering in the Arkansas Industrial University. The work treats of the application of the principles of mechanics to the design of the parts of a steam-engine of any type or for any duty, and also of auxiliary attachments and constructive details. The best and most approved engineering practice, evidently, has been drawn upon freely for the examples with which the book abounds; and the illustrations, of which there are a profusion, are, with one or two exceptions, excellent specimens of the engraver's art.

The more general elements pertaining to steam-engine practice, such as types of engines, clearance, piston speed, friction, fuel, weight of parts, and radiation of heat, are discussed in a brief introduction, after which pistons, slide-valves, and valve reversing gears receive a chapter each. A separate chapter is devoted to the steam-chest, stuffing-box, link, eccentric, etc. A description of the principles of the compound and triple-expansion engines is condensed into one chapter, though the growing importance of this branch of the subject would seem to warrant a more extended and detailed treatment of it. After a brief chapter on indicator-diagrams of a compound engine, a chapter each is given to crank-effort diagrams, the relation of friction to the turning-power of the engine, the piston-rod and its cross-head and guides, the connecting-rod, and the crank-pin. Then comes a long and full chapter on crank-arms, crank, line and propeller shafts, bearings, and couplings; one on condensers and pumps; and one on the engine-frame, pillow-blocks, reversing-engines, walking-beams, etc. The screw-propeller and paddle-wheels, both radial and feathering, are treated of in the final chapter; and a short appendix is devoted to the strength of materials and a saturated-steam table.

The volume contains 210 illustrations, many of which are folding inserts. A very full and well-arranged index fittingly completes the work.

AMONG THE PUBLISHERS.

ROADS and road-making are ably discussed by Capt. Francis V. Greene in the supplement to *Harper's Weekly* for Aug. 10.

— J. B. Lippincott Company will soon publish Mr. George W. Childs's "Recollections," parts of which have appeared in *Lippincott's Magazine*.

— Macmillan & Co. will publish in September a revised edition of Bryce's "American Commonwealth." It is said that ten thousand copies of this work have been sold in the United States.

— *Wood's Medical and Surgical Monographs* for September will contain a practical work on the art of embalming, something unique in our medical literature.

— A. Lovell & Co., 3 East 14th Street, New York, will publish early in September a volume on the "Honors of the Empire State in the War of the Rebellion," by Thomas S. Townsend, the compiler of the well-known "Library of National Records."

— Thomas Whittaker will publish at once a new revised and enlarged edition of King's "Classical and Foreign Quotations." The first edition was exhausted three months after its appearance, and the author has been engaged on the revision since that time.

— A lady in one of the New England towns recently returned a copy of Robert Louis Stevenson's story "The Wrong Box" to her bookseller, for the reason that the cover was "defaced by a newspaper scrap, which, although I have applied soap and water, I have been unable to remove." So much for an attempt at novelty in book-making.

— Henry Holt & Co. have in hand a second "History of the United States," the manuscript of which was left with them ready for the press by the late Professor Johnston of Princeton. It was written on a plan somewhat similar to that of his already well-known text-book, but suited to a shorter course, and perhaps to less mature minds.

— The historical treatise on Columbus, for which a prize has been offered by a Spanish commission, must be delivered to the secretary of the Royal Academy of History, at Madrid, before the 1st of January, 1892. Works written in Spanish, Portuguese, English, German, French, or Italian, may enter the competition. The two prizes amount respectively to \$5,700 and \$2,895; each of the two successful authors receiving, besides, five hundred copies of his work.

— The New Haven Colony Historical Society will publish at once a compilation of the inscriptions in the old Milford graveyard prior to 1800. The transcription will be literal, the type being varied to represent as nearly as possible the appearance of each stone. The work will fill seventy pages, and will be illustrated by facsimiles of seventeen of the most interesting stones. Genealogical notes by Mr. Nathan G. Pond, the transcriber, will be included.

— The Worthington Company have secured for America an edition of the supplementary new volumes of the Villon Society's renowned version of "The Book of the Thousand Nights and One Night." The Arabic text of two favorite stories in the collection — "Aladdin; or, The Wonderful Lamp," and "Zeyn Al Asnam and the King of the Genii" — has at last been discovered in a manuscript recently purchased by the Bibliothèque Nationale at Paris.

— Scribner & Welford have just issued the sixth volume of the Henry Irving Shakespeare, which was delayed by the illness of the editor, Mr. Frank A. Marshall. This volume contains the plays of "Othello," "Antony and Cleopatra," "Coriolanus," and "King Lear." A prefatory note explains that it was intended to print "Hamlet" here instead of one of the four plays given, but that the revision of the proofs had not been finished when Mr. Marshall's health broke down. Two new artists are represented here, the illustrations to "Antony and Cleopatra" being by Mr. Maynard Brown, and those to "Coriolanus" by Mr. W. H. Margeton. The

introductions have been written by Mr. Joseph Knight and Messrs. Wilson Verity and Arthur Symons.

— Mr. Lodge's volumes on Washington, recently published in the series of American statesmen, have been warmly praised by many critics, but perhaps the most valued approval is that from the Nestor of American historians, Hon. George Bancroft, who writes to the publishers as follows: "I like your new work on the unique man of the last century exceedingly. It is written independently, as well as with a full sense of the unique greatness of Washington. You did your part nobly, and gained honor and a claim to gratitude by publishing so valuable a volume."

— The author of "Micah Clarke," the historical novel recently published by Longmans, Green, & Co., is an English physician who is only thirty years old, and who has been a writer of magazine stories for ten years past. Dr. A. C. Doyle is a tall, athletic young man, who not only attends to a good practice and writes novels, but is a famous cricketer. He has, moreover, seen service on the West African coast, and has roughed it in a whaler. He is a nephew of Richard Doyle, the *Punch* artist, and illustrator of "The Newcomes."

— The Worthington Company, in addition to the announcements already made, are preparing the following books for the fall. First in importance is a new edition of "Taine's English Literature," with an introductory essay by Richard H. Stoddard, which enables them to copyright the book. "The Memoirs of the Count de Grammont" will be brought out as a holiday publication with photogravures and portraits. There will also be *éditions de luxe* of Macaulay's "Lays of Ancient Rome" and Main's "Treasury of English Sonnets."

— D. C. Heath & Co. have just published "Modern Facts and Ancient Fancies in Geography," a handbook for teachers, by Jacques W. Redway. This book will treat the subject in the light of modern science, and suggest some new methods of teaching this much-abused subject. They have also just ready "Topics in Geography," by W. F. Nichols. This is not a text-book, but a specific course, a systematic enumeration of the items or classes of items to be taught in each of the grades, with something of the methods of presentation, all built upon the general plan of language-work done in our schools. The "topics" have been prepared for seven grades, beginning with the lowest.

— Mr. C. H. Lee of Leesburg, Va., great-grandson of the eminent statesman Richard Henry Lee, is, according to a correspondent of the New York *Evening Post*, engaged in writing the memoirs of his illustrious ancestor. Mr. R. H. Lee was the friend of Patrick Henry, and in warm concurrence with him in disdain of the acts which led to the war of the Revolution. The Tory party had pronounced him a "political demagogue," but those on the other side, approving his resistance to oppression, hailed him as the "young reformer." The "Life and Correspondence" of R. H. Lee was published in 1829 by his grand-nephew, but the forthcoming work by a direct descendant will probably be fuller and more complete.

— A study of animal life and character is contributed by Olive Thorne Miller to the September *Popular Science Monthly* in the shape of a description of a pet lemur which the author possessed, and which represents a group of animals closely allied to the monkeys. The tariff question is discussed from a novel point of approach by Mr. Huntington Smith in "The Ethical View of Protection." The author lays down his points with considerable skill; and his article, which it is fair to say is adverse to the principle of protection, commends itself to the attention, if not to the acceptance, of readers of every shade of opinion. The number will contain an essay on the "Origin of the Rights of Property," by Henry J. Philpott. The author compares the views of a number of writers on the subject, points out wherein he thinks they are wrong, and draws his own bold and independent conclusion that the recognition of private ownership was in the beginning a truce in the war against its exercise by others. A paper by Professor Huxley bearing directly on the question involved in the recent discussion between himself and the Rev. Dr. Wace, concerning the genuineness of miracles, and entitled "The Value of Witness to the Miraculous," will also appear.

— F. A. Davis of Philadelphia has in press a new work on the "Practical Applications of Electricity in Medicine and Surgery," by Dr. G. A. Liebig, jun., of Johns Hopkins University, and Professor George H. Rohé of the College of Physicians and Surgeons, of Baltimore. The part on physical electricity, written by Dr. Liebig, one of the recognized authorities on the science in the United States, will treat fully such topics of interest as storage-batteries, dynamos, the electric light, and the principles and practice of electrical measurement in their relations to medical practice. Professor Rohé, who writes on electro-therapeutics, discusses at length the recent developments of electricity in the treatment of stricture, enlarged prostate, uterine fibroids, pelvic cellulitis, and other diseases of the male and female genito-urinary organs. The applications of electricity in dermatology, as well as in the diseases of the nervous system, are also fully considered. The work will be fully illustrated by engravings and original diagrams.

— The last regular article in the railway series will be contributed to *Scribner's Magazine* for September by H. G. Prout, editor of the *Railroad Gazette*, who will write of "Safety in Railroad Travel," explaining in a popular way many of those ingenious devices which have come into general use and have made railway

travel the safest form of locomotion except walking. This article, which will be very fully illustrated, will explain, among other things, the Westinghouse air-brake, and complicated system of semaphore signals and interlocking switches, and crossing-gates, detector-bars, and automatic couplers. W. Hamilton Gibson will write on "Night Witchery," describing what may be seen of nature on a very dark night with other organs of sense than the eye. The article will be illustrated with a number of Mr. Gibson's most characteristic drawings. A. R. Macdonough will contribute the fourth paper in the fishing series, entitled "Nepigon River Fishing," in which he will describe one of the most attractive spots in Canada for all lovers of good sport. Lake Nepigon is two-thirds as large as Lake Ontario, filled with picturesque islands, and with strangely irregular shores. It is some distance from the line of the Canadian Pacific Road. Professor George Trumbull Ladd of Yale College will have in the number a very timely article on the "Place of the Fitting-School in American Education," in which he discusses certain plans for enabling the preparatory schools of the country to accomplish much better work than is now possible, so that they may send out their pupils as well educated at eighteen as they now are at twenty. Such changes he believes necessary in order to effectively raise the standard of American universities.

INDUSTRIAL NOTES.

Electrical Apparatus for Medical and Surgical Purposes.

THE engravings given herewith illustrate two pieces of electrical apparatus, manufactured by Charles Reitz of Indianapolis, and intended for the use of physicians and surgeons.

The office battery, shown in Fig. 1, is furnished with thirty-six

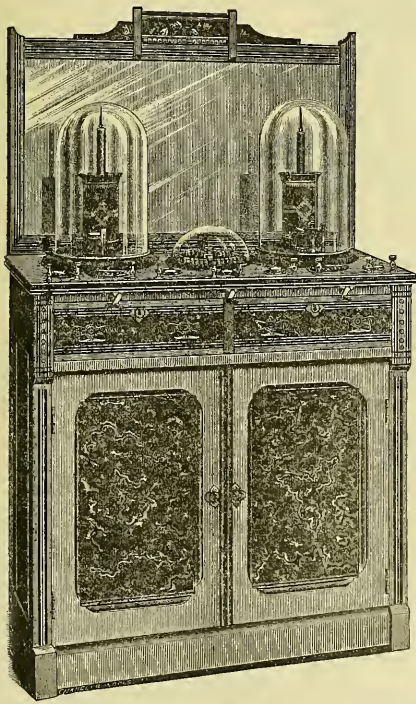


FIG. 1. — REITZ'S ELECTRICAL APPARATUS.

zinc-carbon cells, for galvanic current, and two electro-magnetic machines. The manufacturer claims that the battery may be used daily for a year without refilling. The cells are so arranged in the lower part of the case, that, when removed for refilling, no mistakes in connections can be made when returning them to their places.

The jars are $3\frac{1}{2}$ inches square by $5\frac{1}{2}$ high. The porous cups are $1\frac{1}{8}$ inches in diameter and $4\frac{1}{2}$ inches high. The cells are connected to a hard-rubber switch-board in such a way that one cell after another may be added to the circuit, giving a current of any intensity, from that of one cell to the full power of the battery.

Each electro-magnetic machine has two large cells of battery of a capacity sufficient to run the machine from three to five hours with one filling, and they are so connected by a switch-lever on top that one or both cells may be used. The machines are kept covered by glass shades, the regulating-tubes in the coils being raised or lowered by turning a small crank in front of the case, the shades thus not requiring removal.

A magneto-electric generator and small incandescent lamp are shown in Fig. 2. The armature is of the Siemens type, $\frac{3}{4}$ inches

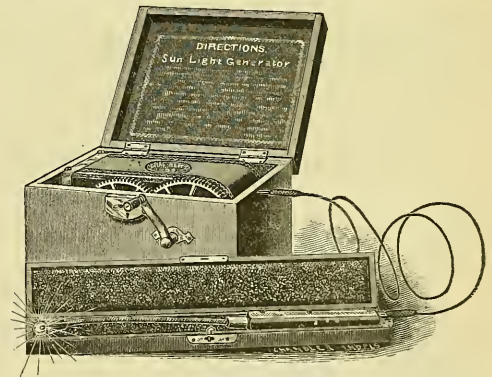


FIG. 2. — REITZ'S ELECTRICAL APPARATUS.

long and $1\frac{1}{2}$ in diameter, with $\frac{3}{8}$ -inch bearings running in phosphor-bronze boxes. The lamp is one-half candle-power, and is mounted in a hard-rubber socket on the end of a flexible stem. It is a neat and convenient apparatus for the use of medical men.

Electric Motors.

The C. & C. Electric Motor Company of this city have just taken a contract to furnish a notable power-equipment for the works of the Hickox Manufacturing Company, ruling-machine makers of Harrisburg, Penn. The power-plant will consist of four C. & C. electric motors, three being of 20 horse-power, and one of 15 horse-power. The current to operate them will be taken from the Edison central lighting station. This installation is notable, both because of the amount of power used from large motors, and the fact that it is all derived from a central station.

Publications received at Editor's Office,
July 8-Aug. 3.

ALLEN, A. H. Commercial Organic Analysis. Vol. III. Part I. 2d ed. Philadelphia, Blakiston. 431 p. 8°. \$4.50.
COLLAR, W. C. Practical Latin Composition. Boston, Ginn. 268 p. 16°. \$1.10.
ELSMERE Elsewhere; or, Shifts and Makeshifts, Logical and Theological. By a disciple of James Freeman Clarke. Boston, Wm. Macdonald & Co. 167 p. 24°.
FROEHL, Friedrich, Autobiography of. Tr. by Emilie Michells and H. Kestley Moore. Syracuse, N. Y., C. W. Bardeen. 167 p. 12°. \$1.50.
MACDONALD, D. Oceania: Linguistic and Anthropological. Melbourne, M. L. Hutchinson; London, Simpson Low. 218 p. 16°.
MERCUR, J. Elements of the Art of War 2d ed. New York, Wiley. 302 p. 8°. \$1.
NATIONAL Electric Light Association, Proceedings of the, at its Ninth Convention, Annual Meeting held at Chicago, Feb. 19, 20, and 21, 1889. Vol VI. Boston, Mass., Press of Modern Light and Heat. 261 p. 8°.
NEW JERSEY, Annual Report of the Board of Education,

and the Superintendent of Public Instruction of. 1888. Camden, State. 241 p. 8°.
PEABODY, C. H. Thermodynamics of the Steam-Engine and other Heat-Engines. New York, Wiley. 470 p. 8°. \$3.
SENSENIG, D. M. Numbers Universalized: An Advanced Algebra. Part I. New York, Boston, and Chicago, Appleton. 353 p. 12°.

Exchanges

[Exchanges are inserted for subscribers free of charge. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

100 botanical specimens and analyses for exchange. Send list of those desired and those which can be furnished, and receive a similar list in return. Also cabinet specimens and curiosities for the same. Scientific correspondence solicited.—E. E. BOGUE, Orwell, Ashta. County, O.

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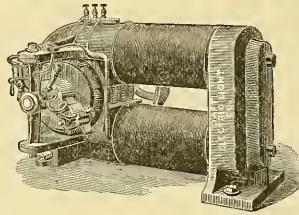
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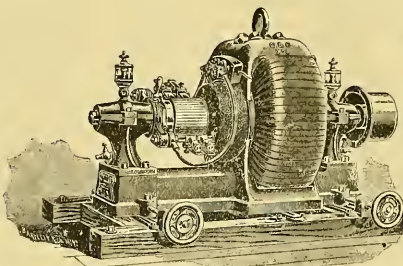
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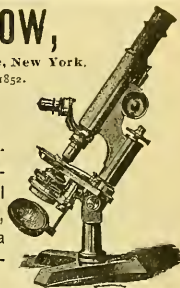
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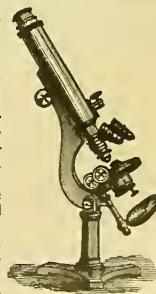
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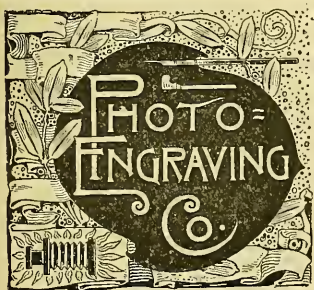
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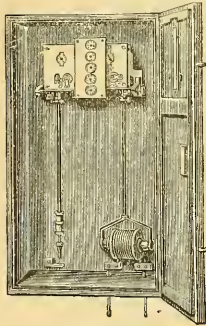
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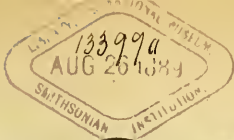
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ARON'S ELECTRIC METER.

An electric current meter which is attracting much attention in this country, where it has been introduced but recently, is shown in the accompanying illustrations. It is the invention of Professor H. Aron of Berlin, who claims for it that it surpasses all similar devices in point of reliability. It received a gold medal at the Melbourne Exhibition, and has been adopted, in preference to other meters, by the Siemens & Halske and Edison electric lighting companies of Berlin, and by the Berlin municipal electric lighting works. It is also used in Paris, Vienna, Constantinople, and other cities, where it has proved itself valuable for central station work.

The Aron electric meter is made to measure both direct and alternating currents, and from three-wire to nine-wire systems, from fifteen to twelve hundred amperes, and from a hundred up to any

meter, the pendulums swing in unison until the current begins to pass through the coil, when the measuring pendulum swings faster, its rate of swing being governed by the amount of current.

The measuring-pendulum of the meter for the three-wire system carries two permanent magnets attached to a cross-piece of brass.

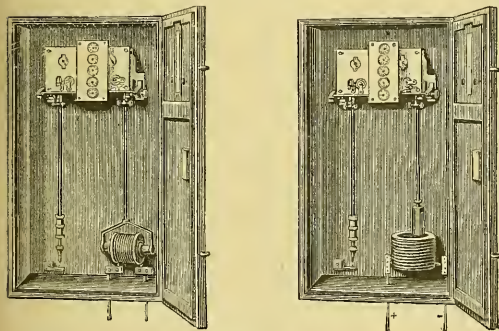


FIG. 1 AND 2.—ARON ELECTRIC METER.

desired number of volts. The action of the meter is based upon magnetic attraction. The mechanism consists of two sets of clock-work of ordinary construction, the pendulums of which swing synchronously while no current is passing through the meter. The left-hand pendulum is of the usual construction. The other varies according to the current to be measured. The measuring pendulum shown in Fig. 1, which is an alternating-current meter, carries a fork-shaped piece of brass fitted with a coil of fine wire, which swings freely through the interior of a fixed coil of large wire. The main current passes through the outer coil, the interior coil being in a shunt-circuit. The mutual action of the two coils upon each other effects a variation in the time of oscillation of the right-hand pendulum proportional to the product of the electric tension and the quantity of the current; hence the measuring pendulum swings faster the greater the tension and quantity of current passing through the meter. While the pendulums swing in unison, the dial train is idle, but when the current is passing, the dial-train registers the difference in the pendulum oscillations, the latter being greater or less according to the tension and quantity of the current.

In the direct-current meter, the right-hand pendulum carries as a weight a permanent steel magnet, which swings over a coil of copper wire, through which the current passes. As in the other

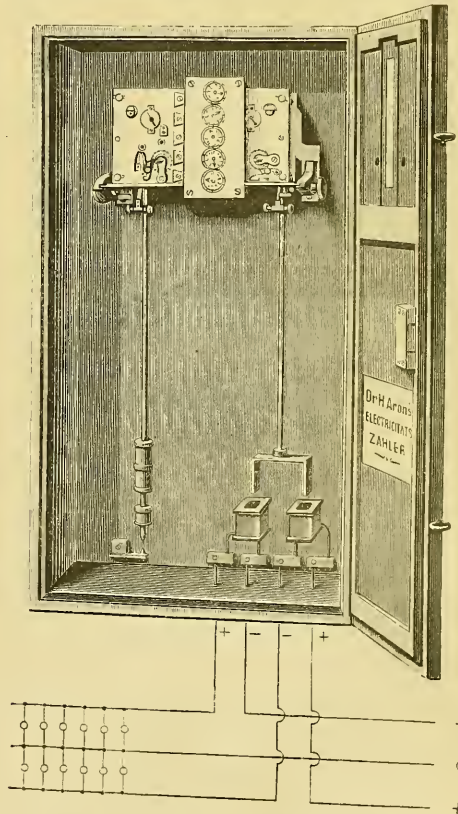


FIG. 3.—ARON ELECTRIC METER.

(For three-wire system.)

each magnet swinging immediately above a coil of wire through which the current passes, the main wires being connected to the coils as shown in the diagram at the bottom of Fig. 3. The meters for five, seven, and nine-wire systems differ only in the fact that they are provided with a greater number of permanent magnets on the pendulum and a corresponding number of coils.

RAILROADS IN THE UNITED STATES IN 1889.

THE year 1888 is notable for the reason that it marks the beginning of the second century of our existence as a nation. When Washington was inaugurated one hundred years ago, our population was less than 4,000,000; to-day it is estimated at 65,000,000. Enormous as has been this increase in the population of the country within the short period of one hundred years, the increase in wealth and material prosperity resulting from the rapid development of the country's wonderful resources has been in even greater ratio; has, in fact, no parallel in the history of the world.

That these wonderful results are due chiefly to the rapid expansion of our railroad system, none will gainsay. What our condition would be without railroads, it is impossible to conceive: what it is, having them, is universally known.

Of the total railroad mileage of the world, the United States now possess nearly one-half. At the end of 1888 the aggregate length of all lines in the country, according to "Poor's Manual for 1889," to advance sheets of which we are indebted for our facts, was 156,082 miles, all built in sixty years, the average mileage constructed per year being nearly 2,600 miles; but this record of sixty years, wonderful as it is, fades into insignificance when compared with the achievements of the past twenty-three years, — since the close of the civil war.

The total mileage of our railroads at the close of 1865 was 35,085 miles. In the twenty-three years since then, there have been constructed 121,000 miles of new road, — an average of 5,260 miles per annum, twice the annual average of the whole period of sixty years, and 5.3 times the annual average of the first period of thirty-five years. During these twenty-three years the country has experienced three great waves of railroad construction, which were checked only by extraordinary financial reversions.

The first of these great construction waves occurred within the eight years intervening between the close of the war and the panic of 1873. In that time the mileage increased more than 100 per cent, or from 35,085 miles in 1865, to 70,268 miles in 1873. Within this period was completed the first Pacific Railroad line, and construction on a second line to the Pacific was well under way. The cash cost of the 35,000 miles of road constructed in these eight years must have exceeded \$1,400,000,000; and the panic, which began in the fall of 1873, was largely the result of the transformation — following so close in the wake of a great civil war — of this vast sum from floating into fixed capital.

In New England, during this period, railroad mileage increased nearly 2,500 miles; in the Middle States the increase was 6,070 miles, about 75 per cent; in the South it increased 4,000 miles, 44 per cent; and in the Pacific States the increase was from 166 miles to 2,193 miles. But the great increase of this period was in the Western and South-western States.

At the close of 1873 the total capital investment in all the railroads of the United States was \$3,784,543,034, represented by share capital to the amount of \$1,947,638,584, and bonded debts to the amount of \$1,836,904,450. This vast aggregate represented also the cost of 70,651 miles of railroad then in operation, the average cost per mile for the whole country at that time equalling \$60,057. In New England the average cost was \$47,850 per mile; in the Middle States, \$67,737 per mile; in the Western States, \$52,125 per mile; in the Southern States, \$36,994 per mile; and in the Pacific States, \$95,590 per mile. The maximum cost per mile was in New Jersey, where it averaged \$115,829; the minimum was in Florida, where the average was only \$18,445 per mile.

The increase of mileage from 1871 to 1873 had been 21,623 miles, and the increase of the cost of the roads \$1,119,915,389, nominally. One cause for the excessive mileage built within a few years was the extraordinary effort to complete roads, in order to save from lapsing the vast grants of land made by Congress, on condition that the roads should be built within a certain time. But the increase was far beyond the possibility of speedy returns for the capital invested. That much land could be found unoccupied near the line of a railroad implied a sparse population; and, although prairie soil could quickly be brought into cultivation, it would be long before there could be sufficient traffic to pay the interest on the cost of the roads. Excessive competition and specu-

tion in railroad building and railroad bonds and stocks ensued, until, in September, 1873, the great financial storm which has since passed into history as the "panic of 1873" burst upon the country.

The depression which followed extended through the years 1874-78. During 1879 matters began to improve throughout the country, and this feeling soon became reflected through the railroads. In that year construction increased nearly 100 per cent over the preceding year.

During these fifteen years there were built 85,814 miles of new railroad, an increase of over 122 per cent; that is, in the last fifteen years we built 15,546 miles of railroad more than we built in the preceding forty-five years. The first five of these fifteen comprised a period of depression; the next four years were years of unexampled activity; while the three years of 1883, 1884, and 1885 were years of hesitancy, in which no new railroad enterprise of great magnitude was begun, as was natural, after the completion in a single year (1882) of 11,600 miles of road. In 1886 there were built 8,128 miles, and in 1887, 12,984 miles, the latter surpassing the record of any previous year; and in 1888, 7,028 miles. In the three years the new construction aggregated 28,140 miles, or within 58 miles of the extraordinary record of the three years 1881-83.

The increase in mileage during the ten years from 1840 to 1850 was 6,202 miles, or 220 per cent. The average mileage constructed per year in this decade equalled 620.3 miles. In the succeeding decade, 1850 to 1860, 21,605 miles were added, an average of 2,160.5 miles per year, the increase equalling nearly 240 per cent. The next ten years, 1860 to 1870, showed an increase of only 73 per cent, or 22,296 miles, the falling-off from previous records being due to the outbreak of the war. Between 1870 and 1880, 45,375 miles were added, an increase of nearly 86 per cent. Since 1880, 57,786 miles have been built.

Since the revival of railroad construction in 1879 there have been completed three additional through transcontinental railroads, — the Northern Pacific, the Atlantic and Pacific, and the Southern Pacific; while the Union Pacific by the construction of its Oregon Short Line north-west to a connection with a branch of the Oregon Railway and Navigation Company's system, the Atchison by the construction of its line to a connection with the Southern Pacific, and the Chicago, Burlington, and Quincy by the construction of its Denver extension, have added three other important routes to the Pacific. At least three of the great Western railroad systems are now stretching westward, with the evident intention of speedily reaching the same ocean.

A striking feature of the last decade of railroad building is the large number of speculative and parallel lines which were put under way, and many of them completed, notably the West Shore Railroad, which parallels the New York Central line for its whole length from New York to Buffalo; the "Nickel-Plate" line, which parallels the Lake Shore in like manner from Buffalo to Chicago; and the South Pennsylvania, paralleling the Pennsylvania Railroad between Philadelphia and Pittsburgh, upon which a vast sum was expended, but which has not been completed. In some instances such lines were perhaps undertaken with a view to forcing their subsequent purchase by the older companies whose lines they sought to parallel; and in the case of the two roads first mentioned these plans met with eminent success. But their fulfillment was in the main the cause of the depression which existed during the years 1885, 1886, and 1887.

The chief feature of railroad construction of the "wave" of 1886-88 has been the extraordinary activity displayed by the older and more powerful corporations of the North-west and South-west in the extension of their lines, with the apparent purpose of securing a firm foothold upon every available foot of territory contiguous to their several systems, or within reach thereof. The result of this policy has proved in many instances unwise, if not disastrous, as an examination of the facts herein set forth will show.

The most important lines which have been constructed during that period are here briefly summarized: North and north-west of Chicago there have been completed the Duluth, South Shore, and Atlantic Railway, forming a new short route between Duluth and

Sault Ste. Marie, where connection is made with the Canadian Pacific Railroad, under whose control the Duluth line has passed. The Minneapolis, St. Paul, and Sault Ste. Marie has completed an equally important line between Minneapolis and St. Paul and the "Soo," and has also constructed an extension north-west of Minneapolis to within a short distance of Bismarck, Dak. Between Chicago and St. Paul two important new routes have been opened, — the Chicago, Burlington, and Northern, and the Chicago, St. Paul, and Kansas City. The latter company also extended its line south-west to Kansas City, to which point the most important extension of the Chicago, Milwaukee, and St. Paul Railroad within the three years was built. Running far west to Helena and Butte, Mont., the St. Paul, Minneapolis, and Manitoba Railway Company completed a line which is the most northerly east-and-west line of importance in the United States.

The total number of miles of railroad in the United States at the close of 1888 was 156,082, of which 7,028 miles were constructed during the year, the rate of increase being 4.7 per cent. The mileage of lines making returns of their share capital and funded and floating debts equalled 154,276, against 147,999 for 1887, the increase being 6,277, the rate of increase being 4.24 per cent.

The share capital of the mileage completed at the end of 1888 equalled \$4,438,411.342, against \$4,191,562.029 in 1887, the increase equalling \$246,849.313, the rate of increase being about 5.9 per cent.

The funded debts of all the lines at the close of the year aggregated \$4,624,035.023, a sum \$437,091,907 in excess of the total of 1887 (\$4,186,943,116), an increase of nearly 9.5 per cent. The other forms of indebtedness of the several companies at the close of the year equalled \$306,952,589, against \$294,682,071 for 1887, the increase being \$12,270,518. The total share capital and indebtedness of all kinds of all the roads making returns equalled at the close of the year \$9,369,398.954, an increase in the year of \$696,211,738 over the total of 1887 (\$8,673,187,216) the rate of increase for the year being about 8 per cent. The cost per mile of all the roads making return as measured by the amount of their stocks and indebtedness equalled very nearly \$60,732, against \$58,603 for 1887.

The gross earnings or receipts of all the lines (including elevated railroad) from which returns were received for the year equalled \$960,256,270, of which \$251,356,167 were received from transportation of passengers; \$639,200,723 from transportation of freight; and \$69,699,380 from the transportation of mails and express matter, profits of leased lines, and other miscellaneous sources of revenue. In the latter sum are included the gross earnings of elevated railroads. The gross earnings of all the lines for the year ending Dec. 31, 1887, equalled \$940,150,702; the increase for the year 1888 equalled \$20,105,568, or 2.14 per cent. The earnings in 1887 from transportation of passengers equalled \$240,542,876; from freight, \$636,666,223; from transportation of mails and express matter, etc., \$62,941,603, against \$69,699,380 for 1888. The earnings per mile from which full returns were received in 1888 equalled \$6,540, against \$6,861 for 1887, the decrease equalling \$321 per mile. The net earnings of all the lines for 1888 equalled \$301,631,051, against \$334,989,119 for 1887, the falling-off equalled \$33,358,068, the rate of decrease being about 10 per cent.

The amount of interest paid in 1888 equalled \$207,124,288, against \$203,790,352 in 1887, the increase being \$3,333,936, the rate of increase equalling more than 1.63 per cent. The amount paid in dividends in 1888 equalled \$80,243,041, against \$91,573,458 in 1887, the falling-off equalled \$11,330,417, the rate of decrease being about 12.4 per cent.

The number of persons transported in 1888 by all the lines was 451,353,655, against 428,225,513 for 1887, the increase for the year being 23,128,142, the rate of increase equalling 5.4 per cent. The number of passengers carried one mile in 1888 equalled 11,190,613,679, against 10,570,306,710 for 1887, the increase equalling 620,306,969 persons carried one mile, the rate of increase equalling very nearly 6 per cent. The distance travelled by each passenger in 1888 equalled 24.78 miles; in 1887, 24.68 miles. The amount received per passenger per mile equalled 2.246 cents in 1888, against 2.276 cents in 1887. Had the passenger rates for 1887

been maintained for 1888, the earnings from this source would have equalled \$255,034,086, a sum \$14,491,210 greater than that received.

The number of tons of freight transported on our railroads in 1888 equalled 589,398,317, against 552,074,752 tons in 1887, the increase equalling 37,323,565 tons, the rate of increase being about 6½ per cent. The value of the tonnage moved in 1888, estimating its value at \$25 the ton, equalled \$14,633,957,925. The number of tons transported one mile in 1888 equalled 70,423,005,988, against 61,561,069,996 tons moved one mile in 1887, the increase of service performed for the year equalling 8,861,635,992 tons moved one mile, the rate of increase being about 14.4 per cent.

When "Poor's Manual for 1888" was published, it recorded the greatest amounts, in the aggregate, ever earned, either gross or net, by the railroads of the country. In the midsummer of 1888 the situation presented many hopeful aspects, and it was widely believed that the period of depression had passed. The volume of business throughout the country was larger than ever in its history, and an improvement in earnings was therefore confidently looked for. But unfortunately, while the traffic was large and of increasing proportions, the rates received for its transportation, owing to the fierce and unbridled competition in the West, drooped continually.

It appears that in the seven years 1882-88 the tonnage increased 228,907,942 tons, or 63 per cent. In the same period the mileage of lines in operation increased 49,588.91 miles, or 51 per cent. Computed on the basis of tonnage per mile of road, the traffic of 1882 was 3,650.5 tons per mile; of 1883, 3,744.7 tons per mile; of 1884, 3,526.2 tons per mile; of 1885, 3,578.6 tons per mile; of 1886, 3,853.4 tons per mile; of 1887, 4,030.1 tons per mile; and of 1888, 4,055.2 tons per mile. It thus becomes apparent that the traffic of the past two years was the largest ever carried by the railroads of the country. During 1888 the volume of freight traffic was exceptionally large; and, with an increase of eight miles in the average length of haul per ton, the earnings from this source should have been, had fairly remunerative rates prevailed, sufficient to insure a continuance of dividends by the great trunk lines rather than their suspension, as has been the case in so many instances.

The tonnage-mileage of 1887 was 61,561,069,996, for transportation which the railroads received an average rate of 1.034 cents per ton per mile, producing a revenue of \$636,666,223. In 1888 the tonnage-mileage was 70,423,005,988, which produced an average revenue per ton per mile of .907 of a cent, or, in the aggregate, \$639,200,723. Had the rates received in 1887 prevailed in 1888, the difference of about 1¼ mills per ton per mile would have given the railroads an increased revenue of \$89,189,819, sufficient to pay more than 2 per cent upon the total amount of capital stock outstanding at the end of 1888, upon all of the roads contributing toward this grand aggregate.

The causes which led to this unlooked-for result are now thoroughly understood. The sentiment is unanimously expressed that the chief elements of disturbance in the railroad situation in the West have been, first, the unprecedented activity with which the railroad systems of that section have been extended, as a result of the desire to secure entrance to the newly developed lands in the West and South-west; second, the partial failure of the crops, and the consequent loss of a large proportion of the traffic which had been calculated upon; third, the complications resulting from the application of a new and radical law, — the Interstate Commerce Act; and, fourth, the spirit of hostility and repression evinced by the legislatures of some of the Western States.

To these several causes, which were in themselves sufficient to demoralize the business of even so powerful a system as that of the railroads, might be added a fifth and perhaps most potent cause of all; that is, the very mightiness of the contestants and the magnitude of the interests involved. In no period of the world's history has there been such vast aggregations of capital engaged in commercial enterprises as are now to be found in this country. Nor is there any country in which competition in business is freer and sharper than in ours. In this general competition the railroads of the country have taken active part. The construction of new lines has been encouraged in every part of this country, in no section more strongly than in those which are now displaying the most

violent antagonism toward them. Nowhere were greater inducements held out to capital to supply railroad facilities than west of the Mississippi, between the close of the war and the early seventies; yet in those very States, which owe their present prosperity and development to no cause more than to railroads, we see the most rampant hostility displayed toward the creators of their wealth.

In the early days of railroads in this country, their profits reached very respectable proportions. In some instances, where the lines were especially favored in respect to location and physical surroundings, these returns were so large as to excite the cupidity of capital to such an extent that, at several periods of the country's history, the eagerness displayed by railroad constructors in pushing their lines beyond the requirements of the territory resulted in plunging the country into financial crises having far-reaching effects. But the days of large profits appear to have passed. A railroad which in the future can pay regular dividends of 5 per cent per annum, will be regarded in much the same light as those which formerly paid 8 and 10 per cent for years without intermission.

In the Manual are three tables, showing the decline in freight rates upon various railroads of the United States. Table No. 1 includes seven leading Eastern trunk lines, running between Chicago and the seaboard, and covers the twenty-four years, 1865 to 1888 inclusive. Upon these roads the rates received for transportation of freight declined from 2.9 cents per ton per mile in 1865, to .609 of a cent per ton per mile, — a reduction of 79 per cent within the period covered by the statement; in other words, the railroads comprised in that statement received, in 1888, \$21 for the performance of a service for which in 1865 they received \$100. What other business can show a corresponding decrease in returns?

Table No. 2 gives like statistics for six leading Western trunk lines running west, north-west, and south-west of Chicago, and embracing the same period, 1865 to 1888. Upon these lines the reduction equalled 73 per cent in the twenty-four years, or from 3.642 cents per ton per mile in 1865 to .934 cent in 1888.

The thirteen roads embraced in these two tables are typical of the entire railroad system. Upon the basis of the deductions here shown, it may be assumed that the average reduction throughout the whole country since the close of the civil war has been at least 70 per cent. To earn an amount equal, on the average, to that earned twenty-four years ago, the railroads are now required to perform a service nearly three times as great. Yet, notwithstanding this, the cost of operating the lines has not been decreased to any appreciable extent. Of the total cost of operating a railroad, fully 80 per cent is paid to labor in one way or another. Expenses of this nature cannot be materially reduced; in point of fact, the tendency is constantly toward an increase. The average rate of wages paid by railroads is to-day as large as in 1865, if not larger. It comes plain, therefore, that the immense sums that have been annually lost to the railroads of the country by their voluntary reductions in rates have been a corresponding saving to the public at large. A calculation of the sums saved to the public by these reductions in rates during the past quarter-century would reach far up into the thousands of millions.

During all these years the railroads have met with most active competition from the waterways of the country, upon which freight can always be transported at about one-third of the cost of railroad transportation. It early became apparent to the railroad companies that to make their lines pay required an immense volume of traffic, which could only be secured by the development of their routes to a point where competition from waterways need not be feared. With this view, tracks have been doubled, trebled, and even in some cases quadrupled; roads have been almost entirely rebuilt with heavy steel rails; locomotives and cars of double or treble their former capacity have been constructed; and trains have been run with a frequency and at a rate of speed which were once considered to be among the impossibilities.

The effect of all this is seen in the wonderful development of all sections of the country, but particularly in the Western States, in which the progress recorded in a short quarter of a century is justly regarded as one of the marvels of the present age.

In proportion to population, the earnings of the railroads in the

States of Ohio, Michigan, Indiana, Illinois, Wisconsin, Minnesota, Dakota, Iowa, Nebraska, Missouri, and Kansas were considerably higher in 1888 than in 1870, being \$18 per capita in the former year as against \$12 in the latter, the increase being 50 per cent. But this increase of averages is a very deceptive one, as, calculated upon the basis of mileage, — the only true test, — the earnings in 1888 were but \$5,728 per mile, as against \$6,753 per mile in 1870. The falling-off of revenues in these States equalled more than \$1,000 per mile, which for 1888 alone amounted to an aggregate of \$73,000,000.

With these facts before us, it is difficult to understand the extraordinary antipathy to railroad corporations now prevalent in the West. The railroad mileage of the West has advanced in far greater ratio than the population, and the wealth and commerce of that section have kept pace with the railroad mileage. Were the railroads to be advanced only in ratio to the increase in population, the situation in the West and throughout the country would present an entirely different aspect, and public sentiment would experience a corresponding change.

The acreage of wheat and corn in Ohio, Michigan, Indiana, Illinois, Wisconsin, Minnesota, Dakota, Iowa, Nebraska, Missouri, and Kansas in 1888 was 66,435,304 acres. No figures of acreage in 1870 are obtainable, but it was undoubtedly less than 30,000,000 acres in that year. Without railroads, the products of this immense territory would be to a large extent valueless; but such trifling matters as these are always dismissed from the consideration of demagogues when they strive to excite the public mind upon the rapacity and greed of railroad corporations.

In point of importance, the railroad interest now takes precedence of all other industries or enterprises. Its magnitude is greater than any other interest in the world, and it has become so thoroughly a part of the economic system of the Republic as to be second only to the government itself.

In order to show how closely interwoven are the interests of railroad stockholders and the working-classes of the country, a few calculations are herewith submitted.

If we estimate that in the operation of our railways there are employed in prosperous times an average of six persons per mile of road, it would show a total, on the basis of our present mileage, of more than 936,000 persons regularly employed in connection with that single interest; and if to this number we add 780,000 — a number representing an average of five to the mile — as the number of persons employed in connection with all those industries which are directly affiliated with and dependent on our railway system, such as locomotive and car building establishments, rail-mills, etc., we have a total of nearly 1,716,000, or an average of 11 to the mile of railroad. Assuming that each of these would represent a family averaging five persons, we have an aggregate population of 8,580,000, — nearly one-seventh of the total for the country at large, — of which 90 per cent are actually dependent on the railway system for the sustenance of life. If we allow, as the average rate of wages of those employed in operating, say \$450 per annum, and for those employed in locomotive building, etc., say \$500 per annum, we have a total pay-roll of \$911,200,000 per annum, of which at least \$500,000,000 is directly chargeable to operating account, while the remainder is for account of betterments, improvements, and new construction. Add to this the amount paid to laborers engaged in construction in such a year as 1887. In that year there were built new roads whose aggregate length was 12,984 miles. If we take, as the average cost of labor in grading, track-laying, etc., for each mile of this total, say \$10,000, and allow the average daily wages of laborers to be \$1.50, with, say, 100 laborers of all classes to each mile, this would show the average time for the completion of a mile of railroad to be 67 days. On this basis, the construction of 12,984 miles of railroad would give steady employment for 300 days in the year to an army of 289,976 laborers, whose total earnings would be \$129,840,000.

This gives a total of 2,006,000 persons, to which we will add 44,000 as the number whose labors are stimulated by the employment of the 289,976 last mentioned, making a total of 2,050,000, representing families numbering in the aggregate 12,250,000 persons. To maintain this number, there would be expended by railroads and others under the above calculations at least \$1,040,000,000

per annum, or very nearly \$3,000,000 for each day in the year. The regular expenditure of more than 90 per cent of this vast sum stimulates other industries, and in this manner the volume of general business is increased in progressive ratio.

In these calculations no account has been taken of the large number of people forming the proprietary interest of this vast aggregation of capital, which comprises people in all classes and in all occupations, and scattered throughout all parts of the country.

The New York Central Railroad Company has 10,000 stockholders, whose average holding is about \$9,000. If we take that sum as representing the average holding of all stock and bondholders in the country, the total number of such would be over 1,000,000, representing more than 5,000,000 persons with important interests in the success of the railroad system.

From these deductions a general idea can be gathered of the magnitude of the railroad interest, and how vast and widespread is the interest of our people in that system.

From the tables in the Manual it appears that during the past ten years the following percentages of profit have been distributed to holders of the share capital of our railroads. In 1879 the dividends paid averaged 2.5 per cent of the total amount of capital stock outstanding; in 1880, 2.8 per cent was paid; in 1881, 2.9 per cent; in 1882, 2.91 per cent; in 1883, 2.75 per cent; in 1884, 2.43 per cent; in 1885, 2.02 per cent; in 1886, 2.04 per cent; in 1887, 2.18 per cent; and in 1888, 1.77 per cent.

BUHACH.

IN an article on the California insecticide known as buhach, which was mentioned in *Science* of May 24, the *Journal of the Society of Arts*, London, says this product is a fine powder made from the flowers of the *Pyrethrum cinerariaefolium*, largely used for the destruction of insects. This plant was originally a native of Persia, from whence it was introduced to Dalmatia and adjoining States of Herzegovina and Montenegro, where it has been almost exclusively cultivated until a few years ago. The importance of this industry was considered so great in these countries that special efforts were made to prevent the export of seeds and plants by the governments. The plant was first introduced into California about twelve years ago by a Mr. Mileo, a native of Dalmatia, who succeeded, after some trouble, in obtaining seed from his country. After experimenting for some time, in order to find a suitable soil and climate, this gentleman finally succeeded in growing the plant on an extensive scale, and in 1880, associating himself with other capitalists, established the Buhach Producing and Manufacturing Company. At the present time the company have about 300 acres of this plant under cultivation at their farm near Atwater, Cal., and own mills for grinding the dried flowers to powder at Stockton. The cultivation of pyrethrum requires careful and intelligent supervision, and it cannot be grown successfully without irrigation. It requires three years from the time of sowing to grow plants capable of producing a paying crop of flowers, and then they will bear from four to five years longer. It is at its prime, however, in its fourth or fifth year. The plant grows about thirty inches high, and is set out in rows four feet apart, and from fifteen to twenty-four inches apart in the rows. The flowers are harvested towards the latter part of May. The stalks are cut just above the roots, and the flowers stripped from them by passing the plants through a kind of comb. The detached flowers fall into a box below, and are carried to the drying ground, where they are spread on sheets and exposed to the rays of the sun during the day, being repeatedly turned over in the meantime. They are covered during the night to prevent their absorbing moisture, as the perfect drying of the flowers is most important in order to retain the volatile oil which gives the powder its insecticide properties. It is also very necessary that this operation should be done quickly, and that the flowers during the drying process should be protected from moisture. A slight dew falling upon the flowers at this time will injure their color, and reduce their strength as an insect destroyer. In this respect the California-grown flowers are better cured, and, consequently, more valuable than those produced in Dalmatia, it being acknowledged by experts that the particular conditions of soil and climate in California are extremely favorable to the growth and curing of plants rich

in the essential oil which renders them so destructive to insect life. Like many other products, insect powders are liable to adulteration, and last year a large quantity made from the flowers of the Hungarian daisy, mixed with a small proportion of pyrethrum, was placed upon the market by unscrupulous dealers. Inferior powders are also manufactured from the stems and leaves of the plant, which possess, to a certain extent, the properties of buhach.

SAWING STONE BY HELICOIDAL WIRE CORD.

A NEW plan of cutting stone by means of wire cord has been adopted in many European quarries. While retaining sand as the cutting agent, M. Panlin Gay, of Marseilles, has succeeded in applying it by mechanical means, and as continuously as the sand blast and band-saw, with both of which appliances his system—that of the “helicoïdal wire cord”—has considerable analogy.

An engine puts in motion a continuous wire cord (varying from five to seven thirty-seconds of an inch in diameter, according to the work), composed of three mild steel wires twisted at a certain pitch, that found to give the best results in practice, at a speed of from fifteen to seventeen feet per second, the higher speed being adopted for the smaller diameter.

Instead of the stone being brought to the saw, the wire cord, which may be of indefinite length, is led to the stone, being guided by grooved pulleys, mounted on bearings with universal joint, which permits of their adapting themselves to any change of direction. The same cord, which is kept at uniform tension by a weighted truck on an inclined plane, may act upon any number of blocks, provided sufficient space be given between them to allow for cooling.

The pulleys are mounted in standards, and are fed down by endless screws rotated automatically if the stone be uniform, but preferably by hand if there is reason to suspect irregularities in its texture. Sand and water is allowed to flow freely into the cuts, the sand carried along by the cord in the spiral interstices between the wires causing a uniform attrition of the stone. The twist of the cord causes it, while travelling, to turn upon itself, and thus become worn evenly. A cord of 150 yards in length will cut about seventy feet deep in blocks fifteen feet long, or produce four hundred and ninety square feet of sawn surface before being worn out.

The sand must be sharp, and not used more than three times. The nature of the sand is determined by the hardness of the stone; thus, quartz sand will cut granite and porphyry, which has hitherto been found impossible to saw, or indeed cut in any other way than by pick or chisel. An hourly advance of one inch in granite or porphyry and four inches in marble, is regularly obtained in blocks of fifteen or sixteen feet long. At the Brussels Exhibition of last year, where the system was awarded a prize, the same cord which cut marble also cut a block of concrete composed of quartz pebbles.

Not merely does the helicoïdal cord saw blocks of stone, but it even cuts them out of the solid rock in the quarry. To do this, it is necessary to sink shafts of two or two and a half feet in diameter, in order to introduce the pulley-carriers. If there is a free side to start from one shaft is sufficient for a triangular block; but for a quadrangular one, which is preferable, two shafts are necessary. They are bored by a mechanical perforator, consisting of a hollow plate-iron cylinder, having at its lower end a slightly thicker collar which acts with sand and water in its latest development. The cylinder is made to revolve, at a speed of one hundred and forty revolutions a minute, by means of a tele-dynamic cable, advancing about an inch per hour in marble. An annular space is cut in the rock, leaving a core, which may be utilized as a column. The diameter of the shaftway depends upon the diameter of columns most in demand, provided a sufficient number be sunk, and the intervening angles broken down, so as to afford sufficient room for the pulley carrier.

In the case of stratified rocks, the shaft-cuts are carried down to a natural parting; but in unstratified rocks a nearly horizontal cut may be made with the cord, sufficient inclination being given to insure the flow of sand and water to the bottom of the cut.

Such is the method of working practised at the Traigneaux

Quarry, near Philippeville, in Belgium, where fifteen thousand cubic feet of marble are extracted yearly with a thirty horse-power engine, and only thirty hands in summer and twenty in winter, besides the lads who tend the wire-cords. The system is also employed at granite and marble quarries in France, Germany, Spain, Italy, Algeria, Tunis, and other countries, where it is said to be giving satisfactory and economical results.

SEWAGE PURIFICATION.

A NEW process for the purification of sewage, under patents granted to the firm of Jagger, Son, & Turley, of Halifax, England, was recently experimented with at the corporation sewage works of that city. The apparatus employed is described as follows. A carbon filtering medium is obtained by reducing to a carbonized state dry asphalt refuse which contains a large proportion of animal and vegetable matter. The refuse is placed in a carbonizer, where it is allowed to remain until the whole mass is charred by a process of slow combustion. After the carbonized material is withdrawn from the carbonizer, it is sifted by means of a circular riddle; and the cinders and a small percentage of clinkers are laid on one side for use in forming the bottom layers of the filters. The finer grades given out by the riddle, composed principally of charcoal and a small percentage of ashes, are placed as an upper layer of a shallow filter bed, about four inches in thickness.

A small carbonizer has been erected at Halifax, and a filter of 102 superficial yards laid down. The filter is two and a half feet deep, it has a six-inch concrete bottom, and brickwork sides joined in cement. The filter is divided by a fourteen-inch wall, underneath which is laid a channel for conveying away the effluent. The bottom course of brickwork of the central wall is open jointed to allow the effluent to pass from the layers of cinders to the channel. The filter bed is formed as follows. At the bottom is placed a six-inch layer of rough material, which may be clinker or broken bricks or stone. Above this layer is placed another composed of one-inch cinders laid three inches thick; then follows a layer three inches thick of quarter-inch cinders, and finally a layer of carbon four inches thick, giving a total thickness of sixteen inches. The filter is worked with a six-inch head of sewage. The sewage is conducted to the filter by a six-inch pipe, having branches, the pipe being laid on the top of the central wall. Under each branch is placed a floating splash-board, which prevents the sewage washing a hole through the filtering material. The sewage flows over and through the carbon. The effluent is clear, inodorous, and colorless, and has been proved by analysis to be very pure. The organic matter in suspension was 417.2 grains per gallon in sewage, and 1.12 grains per gallon in effluent. The albumenoid ammonia in solution was also reduced from 0.280 grains per gallon in sewage to 0.007 grains per gallon effluent.

The manner of dealing with the sewage is as follows. Across the outfall sewer are placed a series of wire-work baskets filled with cinders of different grades, to arrest the grosser floating solids. The sewage then flows to the filter-bed, where the purification of the sewage is accomplished. No chemicals whatever are used. The filter-beds will work at a rate of from 240 to 300 gallons per superficial yard per day, according to the density of sewage treated. An acre of filtering surface will be ample for dealing with the sewage from 30,000 persons, or say, 1,000,000 gallons per day. The land required for this process is only one two-hundredth part of that required for broad irrigation, or one-fortieth that required for combined precipitation and filtration. The capital cost for this process will be about \$340 per thousand inhabitants up to a population of fifty thousand, and the annual working expenses for collecting and disposing of refuse and purifying sewage, inclusive of interest on capital and royalty fees, about sixteen cents per head of population.

This process solves the sludge difficulty. No chemicals being used, no weight is added to the solids in the sewage; the grosser solids are arrested in the cinder baskets, and the finer solids are deposited on the top of the filters in the form of a thin skin. After a filter has worked for twenty-four hours, the flow into that particular filter is stopped, the moisture allowed to drain off, and the deposit removed by a scum plow, a little fresh carbon is laid,

and the filter is then again ready for work. By a simple mechanical contrivance, a filter of one hundred yards can be cleaned and re-charged in ten minutes. The average weight of sludge made per million gallons of sewage treated by chemicals is twenty tons. In place of a semi-fluid, offensive sludge, by this carbonized refuse process, there remains a manure uninjured by chemicals, which can be carted away as it is removed from the filters, and which will equal in bulk seven and a half tons per million gallons treated.

HEALTH MATTERS.

Leprosy.

AT a recent meeting of the Epidemiological Society of London a paper was read by Dr. P. S. Abraham, on leprosy, of which the *Lancet* gives the following abstract. With the exception of the case recently brought forward in Dublin, no British society has lately had the subject under consideration. Its importance in British medicine is, nevertheless, well indicated by the fact that the Royal College of Physicians of London has its "leprosy committee," which, in view of the fact that there is increasing evidence respecting the communicability of leprosy, has just recommended a full and searching scientific investigation into the whole matter.

Dr. Abraham demonstrated on a map the wide prevalence of the disease, especially in the British Empire, and remarked that it is no wonder that the subject is coming to the front. He hoped that the inquiry urged by the College of Physicians would be sanctioned by the government, not only to set at rest, if possible, doubtful points regarding the causation of the disease and the desirability of preventive measures, but also to allay a possible emotional scare on the part of the British public. From the insufficiency of data it is difficult to say accurately whether leprosy be really increasing or decreasing in many of the British colonies. In many cases we have to rely chiefly upon general impressions. Even the death returns cannot be depended upon always, for they are frequently, as in Jamaica, uncertified by qualified practitioners; and we must remember the natural and universal tendency on the part of the sufferers and their friends to conceal their affliction. The belief in the increasing spread of leprosy at the Cape of Good Hope was so strong that a leprosy repression act was passed in 1884. From the numerous medical reports which Dr. Abraham quoted there can be little doubt that the disease is really on the increase in South Africa. It probably is spreading, but in a less marked manner, in the West Indies; and on the whole, in India, especially in certain districts.

The articles which are now appearing in the Anglo-Indian press indicate that the public mind is becoming somewhat inflamed over the matter; and that there is some cause may be inferred from the large amount of official attention which has been for some time past directed in India to the matter. Dr. Abraham quoted the late resolution (September, 1888) of the Indian government, stating that a measure of rigorous segregation would be repugnant to public opinion, and recommending for the present the grant of medicine and charitable relief in voluntary hospitals and asylums. A short history of leprosy in Hawaii was then given, the latest information having only just come to hand. He pointed out that, in spite of the efforts at isolation, the disease had enormously increased since 1865. The author gave an account of his visit last year to the Norwegian leper asylums, and gave particulars relating to the treatment of the patients, and the views with which he was favored by Drs. Danielssen, Nickoll, Kaurin, and Daud, who were in charge of the asylums at Bergen, Molde, and Trondhjem. He showed curves indicating the relations between the gradual decrease of the disease throughout the country and the number of patients in the hospitals.

With regard to leprosy in Great Britain and Ireland, he referred to cases he had recently seen in London. Through the kindness of Mr. Larder he was able to exhibit to the Society two fairly typical examples of the chief varieties of the disease, one the "nodular dermal form," and the other the so-called "anæsthetic" form. The latter case was that of a man sixty-four years old, a meat salesman, of English parentage, and born in London. When young he had been a sailor in the Mediterranean and in the Baltic, but had not been out of London for upwards of forty years. Until

six years ago he had always enjoyed the best possible health. The author did not admit that this was a case of *de novo* development, though the period of incubation was extraordinarily long. The germ must have been dormant, like the "mummy" wheat, for nearly forty years.

After referring to the present unsatisfactory nomenclature of varieties, and to the army and navy records of the disease, he, in conclusion, summed up, and, had time allowed, would have adduced arguments in support of the theories that leprosy is caused by the bacillus, that the disease is communicable from person to person, and that segregation is justifiable. Microscopic specimens, prepared by the author, were exhibited, showing the *bacillus leproe* scraped from the tongue and mouth of a patient, and sections of dermal nodules, anæsthetic skin, nerves, etc. Many of the references were from hitherto unpublished sources, both private and official.

Death from Electricity.

A DEATH recently occurred at Brighton, England, from the accidental contact of the conducting wire of the electric lighting apparatus with the neck of one of the employees at a brewery. The deceased was "found dead" in the neighborhood of the fatal electrical conductor, and a report in a local newspaper states that a post-mortem examination revealed perfectly healthy organs, the only abnormality in this case being "a mark half-way round the neck as if grazed by the wire." With the extension of electric lighting, says the *Lancet*, occasional fatalities of this kind are to be expected, and the number of deaths from this cause has already been considerable. In the case recently reported there was, it is to be observed, a slight mark upon the body, and in a case which occurred in 1884 a blister was found upon one of the fingers of the deceased with which contact had been accidentally made by the machine. In other cases there has been no mark whatever, so that we may conclude that the pathological evidence of the cause of death in such cases is almost *null*. It seems to us of the greatest importance that these accidents should be carefully studied, and it would almost seem to be the duty of the local government board to send a trained pathologist to attend the post-mortem examination of every case which occurs, in order that a careful comparison might be established between the cases, and any points which they might present in common be duly noted. This could only be done by one having considerable accumulated experience, and such experience could only come to one having such opportunities as an official position would give.

The matter is of very great importance, because a cause of death which is, so to say, gradually becoming omnipresent, and which leaves no mark, is tolerably sure to be made use of for criminal purposes, and if there be any certain means of establishing how death took place, a knowledge of this would be the only means of checking the misdeeds of persons with criminal intentions. It generally has happened hitherto that the surrounding circumstances have left no doubt as to the cause of death, but it is not reasonable to suppose that such would always be the case, and if it suited the crafty schemes of a criminal it might very easily be contrived otherwise. In short, there is no doubt that we ought to use every endeavor to increase our exact knowledge of this cause of death, and we can only hope that post-mortem examinations will be carefully made in all cases which occur, and that practitioners will regard it as a duty which they owe to the profession and the public to place upon record the results of such examinations.

CANCER. — A small commune in Normandy, Saint Sylvestre-de-Courcelles, with a present population of only 379, as compared with 500 twenty years ago, has in the eight years 1880 to 1887 lost no fewer than eleven of its inhabitants, between the ages of sixty-two and eighty-three, from cancer, — a proportion of 15 per cent of the total mortality. All but one of the cases were males, and in as many as eight the cancer was seated in the stomach. Such facts have led Dr. Arnaudet, according to *L'Union Médicale*, to conclude that cancer is contagious, and is propagated through the medium of water. It is true, he remarks, that not one of the eleven persons mentioned were water drinkers, but then they drank cider, which is made with the pond water of the district. Dr. Arnaudet thinks this sufficient ground to advocate the use of antiseptic

tics and of boiled water as prophylactics against cancer, as well as against typhoid fever or phthisis.

TYPHUS BACILLI IN WATER. — Several cases of typhoid have recently occurred in a town in the province of Baden, Germany, and it came to light that three of the patients first affected procured their drinking water from the same well. The water was then examined, the strictest precautions being used to prevent infection from other sources. In three days the cultures were found to have developed on an average one hundred and forty thousand colonies to the cubic centimetre. Ten tests had been made, but only in one of these was there found a single colony of typhoid bacilli.

NOTES AND NEWS.

It is officially announced that a general national exhibition of agriculture and sylviculture will be held at Vienna, next year, from the 15th of May to the 15th of October. The exhibition is to include the following international sections: (1) machinery and implements used in agriculture, sylviculture, and the industries cognate to them, such as horticulture, viticulture, hop-growing, bees, silk, fishing, and hunting; (2) artificial and auxiliary branches of agriculture, such as artificial manures, remedies for sick animals, etc.; (3) models, plans, designs, and statistical information respecting agriculture and forestry; (4) inventions dealing with the utilization of waste material; (5) information and suggestions respecting the food supply of large cities.

— The fifty-ninth annual meeting of the British Association will be held at Newcastle-on-Tyne, beginning on Sept. 11 and 12; and the Durham, Northumberland, and Newcastle Botanical and Horticultural Society has arranged to hold its autumn meeting and exhibition at the same time and place. The local committee have spared no efforts to make the arrangements for the meeting as complete as possible, and their labors have been greatly lightened by the fact that many fine buildings suitable for the purposes of the association have been erected since it held its last meeting at that place in 1863. The reception-rooms, occupying a central position with respect to the various section rooms, will be located in the new buildings of the University of Durham College of Medicine, in which building a writing-room and ladies' drawing-room will be provided, and special rooms for the use of the officers of the association. The Cambridge Drill Hall, near the reception-room, is to be fitted up for a luncheon-room. Sections A and B will meet in the new buildings of the College of Science, opened in November last; and in the chemical laboratory of this college it is intended to bring together a series of exhibits illustrating the chemical and allied manufactures of the district. The general meetings of the Association will be held in St. George's Drill Hall. The Natural History Museum, opened in 1884, in which building is Mr. Hancock's unique collection of British birds, will be used for the two *soirées*, the first to be given by the mayor and corporation, and the second by the local committee. A guide-book, arranged in three sections, has been prepared for the occasion, dealing respectively with the history and topography, the geology and natural history, and the industries of the district.

— The Royal Society of New South Wales offers its medal and a prize of £25 for the best communication (provided it be of sufficient merit) containing the results of original research or observation upon each of the following subjects, to be sent in not later than May 1, 1889: "Chemistry of the Australian Gums and Resins;" "Aborigines of Australia;" "Iron Ore Deposits of New South Wales;" "List of the Marine Fauna of Port Jackson, with Descriptive Notes as to Habits, Distribution, etc." The same offer is made for the best communication on the following subjects, to be sent in not later than May 1, 1890, "Influence of the Australian Climate (general and local) in the Development and Modification of Disease;" "Silver Ore Deposits of New South Wales;" "Occurrence of Precious Stones in New South Wales, with a Description of the Deposits in which they are found;" also on the following, to be sent in not later than May 1, 1891, "Meteorology of Australia, New Zealand, and Tasmania;" "Anatomy and Life History of the Echidna and Platypus;" "Microscopic Structure of Australian Rocks." The competition is in no way confined to

members of the society, nor to residents in Australia, but is open to all without any restriction whatever, excepting that a prize will not be awarded to a member of the council for the time being; neither will an award be made for a mere compilation, however meritorious in its way. The communication, to be successful, must be either wholly or in part the result of original observation or research on the part of the contributor. The society is fully sensible that the money value of the prize will not repay an investigator for the expenditure of his time and labor, but it is hoped that the honor will be regarded as a sufficient inducement and reward. The successful papers will be published in the society's annual volume, and fifty reprint copies will be furnished to the author free of expense. Competitors are requested to write upon foolscap paper—on one side only. A motto must be used instead of the writer's name, and each paper must be accompanied by a sealed envelope bearing the motto outside and containing the writer's name and address inside. All communications are to be addressed to the honorary secretaries, A. Livensidge, and F. B. Kyngdon.

— The English Consul at St. Petersburg says that naphtha residuum is being more and more employed as fuel in Russia. All the steamers of the Caspian Sea, and many of those plying on the Volga, have for some time past used it as fuel. At the present time manufactories and railways are adopting it in the place of wood and coal. It is also being utilized for domestic purposes in stoves of special construction, ingenious specimens of which were exhibited last year at the St. Petersburg Naphtha Products Exhibition. By the employment of this new combustible a considerable saving is effected under the head of fuel. Some large manufactories in Moscow and its immediate neighborhood employ naphtha residue in their furnaces, because, in addition to its great cheapness, it possesses the advantage of occupying less space than wood or coal for storage. It is kept underground in large cisterns communicating by pipes with the furnaces, and owing to this method of storage it is also less exposed to danger from fire. It is established that the cost of naphtha dregs as fuel is about 35 per cent less than that of wood and coal, and this, too, at Moscow, which is 1,500 miles distant from the source of supply at Baku, whence naphtha dregs are conveyed by water to Nijni Novgorod, and beyond by rail to Moscow. Several manufacturers of the province of Vladimir have also adopted the new combustible, and the railway lines existing in the Tambov and Riazan provinces are on the point of doing the same. During 1888, 867,857 tons of naphtha residue were transported from Baku up the Volga, for use in the interior provinces and in those bordering the Volga. It is expected that in 1889 the supply will exceed 1,125,000 tons. In the northern zone of the empire, wood will, it is stated, hold its own as fuel for some time to come. It is specially in the central, south-eastern, and eastern provinces of Russia that the employment of naphtha residuum as a substitute for both wood and coal promises to attain great proportions.

— At the Yale Observatory, during the summer months of 1888, Dr. Elkin completed the measures with the heliometer for the triangulation of the region near the north pole. The reductions of these measures are well advanced. In October they commenced the series of observations on the minor planet Iris in conjunction with the observatories at the Cape and at Leipzig. The autumn months were unfortunately by no means as favorable as usual, and they only secured measures on thirty-four of the sixty-five planned nights. They undertook at the same time a further series for the diurnal parallax of the planet. They are now commencing a similar series on the planet Victoria, to continue through until September; and a third series on Sappho is to occupy them in September and October. As, in addition to the heliometers used for Iris, those at Bamberg and Göttingen will probably co-operate this year, the three series together will doubtless furnish a very accurate value of the solar parallax. The heliometer has also been employed in some supplementary series on the parallaxes of the northern brighter stars, Mr. Hall having taken up Procyon and α Aquile, and Dr. Elkin, Vega and α Leonis. During the winter, Mr. Hall completed the reductions of his work on the orbit of Titan, the results of which are in very satisfactory agreement with those of Bessel and Hermann Struve. The value found for the

mass of Saturn is 1 : 3500.5 of the solar mass, Bessel's revised value being 1 : 3502.5, and Struve's 1 : 3498. Dr. Elkin spent the winter months in the West, observing the total solar eclipse of Jan. 1, 1889, at Winnemucca, Nev., under very favorable circumstances. He used the finder of the heliometer for a general view of the corona, and, with the low power and large field of about 4", could trace the equatorial streamers to a distance of about 100' on either side from the limb. He devoted a part of the time near the beginning and end of totality to a careful scrutiny of a small portion of the outer rays of the corona with a view of detecting any possible rapid changes in the same; but during the 90 seconds of observation, and in the portion he looked at, nothing of this nature occurred.

— In his annual report on education in Hong Kong, Dr. Eitel, the government inspector of schools, says, according to *Nature*, that the total number of educational institutions of all descriptions known to have been at work in the colony of Hong Kong during the year 1888 amounts to 206 schools, with a grand total of 8,717 scholars. More than three-fourths of the whole number of scholars—that is to say, 6,728—attended schools (99 in number) which are subject to government supervision, and either established or aided by government in some form or other. The remainder—viz., 107 schools, with 1,989 scholars—are private institutions entirely independent of government supervision, and receiving no aid from public funds, except that they are exempt from payment of rates and taxes.

— M. Taupin, who was recently despatched by the Governor-General of French Indo-China to the Laos States on an exploration, thus sums up the results of his labors:—"I have studied the language and system of writing of the Laos—that is, of the only population in the world possessing a graphic-alphabetical system. Of this there has been up to the present no positive knowledge. It was only known that the Laotian language and writing were somewhat similar to those of Siam. The language is spoken by about four millions of people. I have collected interesting information relating to the natural history of these regions, and much commercial information. . . . I have made numerous meteorological observations, and taken a large number of anthropometrical measurements according to the Broca system."

— At a recent meeting of the Genevan Society of Physics and Natural History, says *Nature*, M. Mallet exhibited two balls of almost perfect sphericity, about four inches in diameter, one black, and of vegetable origin, the other white, and of mineral origin, but both produced by a mechanical movement. The black ball had been found with another in a piece of oak which had long served as the shaft of a mill-wheel. A cavity having formed in the wood, through disease or the work of some insect, the dust of the wood, with acquired moisture, had been rolled into this spherical form, growing in size, like a snowball (a slow process of many years probably, as the wheel was very old). The white ball, a calcareous pebble, was found with many others in a grotto traversed by a torrent which flowed into the Rhone.

— The twelfth annual meeting of the American Society of Microscopists met at Buffalo, N.Y., on Aug. 20, in the Library building. On the opening day, Hon. Davis F. Day, President of the Buffalo Society of Natural Sciences, delivered the opening address, which was followed by a brief address by President Lewis of the Microscopists. The morning session concluded with a paper on "A Microscope Stand," by Professor P. J. Burrill. The afternoon's session consisted of routine business and the reading of papers by Professor W. A. Rogers, "On a New Method of Determining Temperature from the Readings of Mercurial Thermometers;" by Professor S. A. and Mrs. Susannah Gage on "Staining and Permanent Preservation of Histological Elements Isolated by Means of Nitric Acid or Caustic Potash;" by Dr. Lucien Howe, on "Microscopic Growths on the Normal and Diseased Eye;" by Professor D. S. Kellicott, on "A New Rotiferion;" and by Professor W. A. Rogers, on "A Practical Method of Securing Copies of the Standard Centimeter Designated Scale A." The society's annual exhibition was held on Thursday evening.

— Count Joseph Florimond Loubat of New York has given to the Academy of Sciences of Berlin \$5,500, as a fund the income of which is to be given in prizes every five years. Count Loubat has given the academy also money to be expended on a first set of prizes in 1891. The special object of this gift is to encourage anthropological studies of matters pertaining to North America. For the prize of \$750, to be awarded in July, 1891, articles published between July 1, 1884, and July 1, 1889, will be accepted for competition, provided they are sent to the Academy before July 1, 1890. The subject for this first prize will be the colonization of America by Europeans up to the present day.

— Elias Loomis, Professor of Natural Philosophy and Astronomy at Yale, died at New Haven, Aug. 15, 1889, of Bright's disease. He was born at Wilington, Conn., Aug. 7, 1811. His education began at a tender age, and at the age of nineteen he graduated from Yale. Three years later he was appointed a tutor at that college, a post he retained for three years. A year was then spent in Paris, after which Loomis was elected to a professorship of mathematics and physics in Western Reserve College in Ohio. In 1844 he accepted a similar position in the University of the City of New York; and it was during his incumbency of this chair that Professor Loomis wrote the many text-books on mathematics, astronomy, natural philosophy, and meteorology that have made his name so well known. An extraordinary success attended this series, the total circulation coming to more than 500,000 copies. Some of these books were used abroad, and translations were made into even Chinese and Arabic. In 1860 Professor Loomis returned to Yale, where he remained till his death, devoting much time to his contributions to meteorology aside from his work as a teacher.

— The Delegates of the Clarendon Press have the following works ready for early publication; an edition, with notes for students, of Tertullian's "Apology," by Mr. T. H. Bindley of Merton College; "Selections from Burns," by Mr. J. Logie Robertson (uniform with "Selections from Clarendon," just published); Mr. Oliver Aplin's "Birds of Oxfordshire." In mathematics they will issue shortly the second volume treating of Electro-Dynamics of Messrs. Watson and Burbury's "Mathematical Theory of Electricity and Magnetism," and a new edition of the fourth volume on the dynamics of material systems (which has long been out of print) of Professor Bartholomew Price's "Treatise on Infinitesimal Calculus."

— The Washington Life Insurance Company reports a decided tendency to increase of suicides in recent years. Shooting is the means selected in about one-half the cases. It is more frequent among the young than among the old, and on this account the company's *a priori* expectation had been in the direction of a decrease in this cause. This expectation has been balked, and the writer of the report goes so far as to say that the increase in recent years has not been purely a matter of accident, and that the decisions of the courts have not been such as to discourage suicide among the insured.

— According to the London *Electrical Review* Dr. J. A. Fleming has designed an incandescent lamp slide-rule, by which any of the calculations with regard to lamps may be performed with readiness. Thus if we have given the current, the terminal volts, and the candle-power, the scale shows the watts per candle; or given the watts per candle-power, and the candle-power, we can find the current corresponding to any voltage; or from the volts and current we can read off the hot resistance; and finally, when we know the volts and current when the lamp is burning at normal brilliancy, the rule shows the approximate candle-power. We imagine that electric light engineers and their assistants will find this little device, which is issued by the Edison-Swan Company, very handy.

— The agents of the California State Board of Horticulture, says *Garden and Forest*, are now raising the Australian ladybird in such numbers that colonies are furnished to all applicants whose trees are infested with the cottony cushion scale. These imported insects have proved effective destroyers of the scale, and there seems to be a reasonable ground for hope that this most serious enemy of the orange, the lemon, and other trees of that family can now be held in check.

— Birds of the crow-tribe, especially the raven, the carrion-crow, the hoodie, and the magpie, are in ill-repute in England for stealing eggs, and, when opportunity serves, for murdering chickens, ducklings, etc., but in the north of Norway these depredators are much bolder. They will even attempt to carry away the eggs and the young brood of the eider-duck, and too often succeed in their foray; but if the drake is near at hand, they are frequently defeated. He siezes the crow by the wing or neck and plunges down with him into the sea. Being a good diver he feels no inconvenience, whilst the carrion-crow, however brave and strong in the air, is helpless in the water, and the end of the struggle is soon shown by his lifeless body floating on the surface. Sometimes even the raven is disposed of in the same manner. It is a curious fact that young sea-fowl, when swimming or diving in waters which literally swarm with cod, halibut, and other greedy and hungry fishes, are not often snapped up and swallowed. Yet veteran lobster fishermen, no small part of whose life has been spent in disembowelling such fishes, declare that they never find a young bird in the stomach of their prey.

— In commenting on the behavior of the machinery of the British war-ships during the recent naval display at Spithead, *Engineering* says that such a complication of machinery crowded into so small a space can only be run with success at the high duty demanded in war-ships by means of the most skilled attention. Want of room adds immensely to the difficulty of attending to machinery, and it is only by men being thoroughly conversant with all the ways of a ship that they can hope to keep things in good going order. We have nothing but admiration for the officers and men of the engineering branch of the navy, nevertheless there was perhaps not a single ship in all the vast fleet collected last week at Spithead which had a fairly competent engine-room staff. The reason is that the complements in many cases were not filled up, and even if they were filled up, the men are too new to the ships to know their way about. We can quite understand the fervour with which the chief engineer of one our leading armour-clads exclaimed, "Thank God they are *peace* manoeuvres and not war manoeuvres!" This war vessel was one-third short of her proper complement of artificers, and only the chief amongst the officers knew his way properly about the engine-room, and that was quite an accident.

— The trustees of the Hoagland Laboratory make the following announcement. Dr. George M. Sternberg, U.S.A., will continue as general director of the laboratory; George T. Kemp, Ph.D., Johns Hopkins University, will be associate director of the departments of physiology and experimental therapeutics; and Dr. B. Meade Bolton has been appointed director of the department of bacteriology, assuming charge of that department in September.

— At a meeting of the Russian Mineralogical Society, K. D. Chruschtschoff, it is said, demonstrated the existence of a new metal which he has just discovered and named "russium." The metal approximates closely in its properties to thorium, and its existence was predicted by Mendeléeff.

— In a letter to *Science Gossip*, Mr. T. A. Dukes writes: "I have always understood that a thunder-clap was a necessary result of the electrical discharge which caused a lightning flash, but last night, while watching those splendid natural fireworks — a thunder-storm — I thought there seemed to be many more flashes than thunder-claps. So, at the height of the storm, as indicated by the loudness of the thunder, and the position of the lightning nearly overhead, I began to count them, and while there were thirty-nine flashes there were only fourteen claps. Still unconvinced, I, with a pencil and paper, recorded each as it occurred — fifty-five flashes to nineteen claps; and again, during five minutes, there were fifty-six flashes to twenty-three claps, and yet I tried to favor the thunder. It was not the distant 'summer' lightning, but 'forked' lightning, some flashes consisting of as many as 4,075 simultaneous zigzag cracks in heaven; indeed it seemed to be steadily lightning all the while, yet the thunderings, though loud, were not prolonged. I would be obliged if some one would explain this, or show me my error. Many of the flashes were behind some clouds, for they lighted up their background and left them in relief; could it be that these clouds reflected the sound so that it did not reach me?"

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The World's Fair.			

OF THE PROGRESS toward the World's Fair of 1892, we have to report this week the first meeting of the finance committee. Of the twenty-five appointed on the committee by Mayor Grant, seventeen responded to their names on the call of the roll. These were William L. Bull, Calvin S. Brice, August Belmont, Samuel D. Babcock, Robert Dunlap, Henry B. Hyde, John H. Inman, Frederick A. Kursheedt, Jay Gould, Eugene Kelly, John McKesson, Hermann Oelrichs, William Rockefeller, Charles Stewart Smith, William Steinway, J. Edward Simmons, Jesse Seligman, Oswald Ottendorfer, the absentees being C. P. Huntington, H. O. Havemeyer, Morris K. Jesup, Ogden Mills, Joseph J. O'Donohue, Elliott F. Shepard, and Cornelius Vanderbilt. The last named sent a telegram expressing regret at his inability to attend the meeting, pledging his endorsement in any action taken, and promising to take a hand in the enterprise as early as possible. A motion by Mr. Bull to add the name of Mr. J. Pierpont Morgan was promptly carried. Mr. Babcock was elected chairman by a unanimous vote. He expressed the hope that the committee would be harmonious in its action, as had been the Plan and Scope Committee of the Centennial. He had been connected with that committee for eighteen months and they never had had a divided vote. The chairman suggested that the first business should be the election of a treasurer. His suggestion was promptly adopted, and J. Edward Simmons was chosen. The subject of permanent secretary was next

discussed. Secretary Wilson of the Chamber of Commerce was named by Mr. Smith and endorsed by Mr. Simmons. Mr. Belmont thought it was not well to act hastily, and believed it was of far more importance to get an executive committee of five or seven members. This committee, he said, could name a secretary, consider all the plans submitted to the Mayor, and be accountable to the general finance committee. Mr. Belmont finally made a motion for the immediate appointment of an executive committee of five by the chairman, and it was seconded by Mr. Bull. Mr. Smith withdrew his motion, and after some discussion the motion of Mr. Belmont was carried. Mr. Babcock named this executive committee: Messrs. Belmont, Morgan, Vanderbilt, Smith, Inman. On motion of Mr. Smith, Chairman Babcock and Treasurer Simmons were added to the committee. At the suggestion of Mr. Belmont, the chairmanship of the executive committee was transferred to Mr. Morgan. Mr. Belmont declared that his health would not permit him to do justice to the place. Mr. Smith offered the use of the Chamber of Commerce to the committee, and the place being convenient, it was accepted with thanks. The committee adjourned until 11 A.M. Wednesday at the Chamber of Commerce.

At the last meeting of the American Institute of Electrical Engineers it was decided to appoint a committee of fifteen to form a plan of organization for an international electrical convention to be held in this city coincident with the World's Fair of 1892. Secretary R. W. Pope was instructed to inform President Mascart of the electrical conference at Paris of this action, and to suggest that the unfinished work of the present conference be taken up at the proposed conference of 1892. The following were elected delegates to represent the institute at the Paris conference now in session: Thomas A. Edison, E. Wilbur Rice, jr., Carl Hering, Joseph Wetzler, and Nikola Tesla. All of them are now in France or on the way there. President Elihu Thompson will in a few days announce his appointments on the committee of fifteen and the work of organization will then be taken up. An invitation will be extended to all the electrical organizations of the country to participate in the proposed international conference.

ORGANIZATION OF THE AGRICULTURAL EXPERIMENT STATIONS.

THE Office of Experiment Stations in the Department of Agriculture was established Oct. 1, 1888. The Department can aid the stations in their relations to each other, in their use of the results of research, and in their connection with the agricultural public. To be first among the stations, the department should be the servant of them all. It should exercise not dictatorship, but leadership. Its influence should be powerful in bringing the stations together and in co-ordinating their work; in making the fruits of other research and experience, past and present, at home and abroad, available to them; in prosecuting lines of pioneer research which will in a measure relieve the stations of a difficult but necessary task, and enable them to apply their energies more fully and successfully to the study of the questions which bear directly upon the practice of agriculture, and will at the same time prepare the way for the abstract inquiry which earnest station workers aspire to, but which the public have not sufficiently learned to appreciate; in collating, condensing, and distributing their results, and in helping to carry the practical outcome to the farmer in a form in which he will appreciate and use it.

It is vitally important that the highest scientific ideal be maintained, and every effort be made toward its realization. The future usefulness of the stations will depend upon what they discover of permanent value, and this must come largely from the most abstract and profound research. To forget this will be fatal. The stations must also remember that it is their office not only to experiment, but to teach; that it is their duty to gather information as well from accumulated stores as from the fields in which they are working, and to bring it not "down to the farmer," but home to him. By thus using their most honest and earnest effort to

help the farmer, they will secure from him and from the public at large the support they need for their highest work.

Unquestionably the stations ought to make practical experiments in the study of the problems before them. But in the long-run, those stations will do best that plan their work most philosophically, and the prosperity of the enterprise as a whole will be proportioned to its success in the discovering of the laws that underlie the right practice of agriculture.

In brief, the ultimate success of the stations will depend upon the discovery of principles. This is accomplished only by patient, profound, costly research, no small part of which has to do with the finding-out of the best methods of investigation of special problems. But while this work is essential, the stations are confronted with the necessity of doing what will directly and immediately help the farmer. The need and value of abstract research are not understood. To show its usefulness and help, prepare the way for the stations to prosecute it, and at the same time do some of the things that are most immediately and pressingly needed in these directions, is one of the important ways in which the department may aid the experiment station enterprise.

THE NEW BUILDINGS OF THE SORBONNE, PARIS.

THE people of France have never doubted the utility and necessity of the Sorbonne. During the long and splendid history of the Sorbonne, to quote from *Nature*, they have had ample experience of the value of a great teaching body in the capital; and the result is that this is one of the institutions in which men of all parties take a common pride.

So long ago as 1855 it was decided that new buildings for the Sorbonne should be erected, but the scheme was not really complete until 1881. It was then estimated that the expense would be 22,000,000 francs—a formidable enough sum, but one which caused no serious difficulty, as the city readily undertook to contribute half of it. The foundation was laid in 1885, and now a considerable part of the work is finished. This was opened on Aug. 5, in the presence of President Carnot, and the ceremonies on the occasion may be regarded as affording fresh evidence of the enthusiasm felt by educated Frenchmen for all that represents and tends to develop the highest intellectual life of the nation. Every university had been asked to send delegates elected by the students to the celebration; and the State, and the city of Paris, agreed to look upon them as their guests during the ten days of festivity in honor of science. This part of the programme was well carried out, arrangements having been made with different hotels to board and lodge the foreign visitors at the expense of the Hôtel de Ville and the Ministry of Public Instruction. Russia and Germany did not accept invitations, but the universities of Great Britain, of the Scandinavian countries, of Belgium, Holland, Greece, Switzerland, Italy, Spain, and the United States were represented. There were about 700 delegates from these countries, besides a large number who went at their own expense.

The exercises began on Sunday evening with a gala performance of "Faust" at the Opera House, which the President attended. On Monday the 5th, 3,000 persons assembled in the new amphitheatre, an immense hall adorned with frescoes. Each delegation had a standard-bearer carrying the flag of his nation, and the members of the various groups were warmly greeted by the public as they advanced to the places appointed for them. At 3 o'clock President Carnot arrived, and took his seat on the platform, surrounded by ambassadors, statesmen, and academicians. M. Ferry, as the minister who made the arrangements for the enlargement, was much cheered.

M. Gréard, rector of the Academy, made the first speech. He sketched the history of the Paris University, extolled the events of 1789, and described study as a common fatherland, which had brought together delegates from nearly all the European and American universities. M. Hermite next reviewed the mathematical teaching of the Sorbonne since 1808. M. Chauvelins, President of the Municipality, vindicated democracy from the imputation of indifference to culture, and claimed credit for the body represented by him for having founded a chair of French revolution history and a chair of evolution. M. Fallières, Minister of Education, dwelt on

the efforts and sacrifices of the republic for the diffusion of culture. He referred to the moribund condition of the universities on the eve of the Revolution, and the want of cohesion between the colleges afterwards established, and eulogized the individuality now developed by the provincial universities.

THE MARINE CONFERENCE AT WASHINGTON.

THE following is the programme of subjects to be considered at the International Marine Conference which will meet at Washington on Oct. 16 of this year.

In General Division 1 will be considered marine signals or other means of plainly indicating the direction in which vessels are moving in fog, mist, falling snow, and thick weather, and at night; also rules for the prevention of collisions and rules of the road:—

1. Visibility, number, and position of lights to be carried by vessels,—(a) steamers under way; (b) steamers towing; (c) vessels under way, but not under command, including steamers laying cable; (d) sailing vessels under way; (e) sailing vessels towing; (f) vessels at anchor; (g) pilot vessels; (h) fishing vessels.

2. Sound signals, their character, number, range, and position of instruments,—(a) for use in fog, mist, falling snow, and thick weather as position signals; for steamers under way; for steamers towing; for sailing vessels under way; for sailing vessels towing (these signals to show the approximate course steered, if possible); for vessels at anchor; for vessels under way, but not under command, including steamers laying cable; (b) for use in all weathers as helm signals only; for steamers meeting or crossing; for steamers overtaking; for steamers backing; (c) whether helm signals shall be made compulsory or remain optional.

3. Steering and sailing rules,—(a) sailing vessels meeting, crossing, overtaking, or being overtaken by each other; (b) steamers meeting, crossing, overtaking, or being overtaken by each other; (c) sailing vessels meeting, crossing, overtaking, or being overtaken by steamers; (d) steamers meeting, crossing, overtaking, or being overtaken by sailing vessels; (e) special rules for channels and tideways where no local rules exist; (f) conflict of international rules; (g) uniform systems of commands to the helm; (h) speed of vessels in thick weather.

In General Division 2 consideration will be given to regulations to determine the seaworthiness of vessels,—(a) construction of vessels, (b) equipment of vessels, (c) discipline of crew, (d) sufficiency of crew, (e) inspection of vessels, (f) uniform certificates of inspection; in General Division 3 attention will be paid to the draught to which vessels should be restricted when loaded, and uniform maximum load mark; and in General Division 4 will be discussed uniform regulations regarding the designating and marking of vessels,—(a) position of name on vessels, (b) position of name of port of registry on vessels, (c) size of lettering, and (d) uniform system of draught marks.

In General Division 5 saving life and property from shipwreck will be considered:—

1. Saving of life and property from shipwreck at sea,—(a) duties of vessels after collision; (b) apparatus for life-saving to be carried on board ship (life-boats, life-preservers, life-rafts, pumps, and fire-extinguishing apparatus); (c) the use of oil and the necessary apparatus for its use; (d) uniform inspection as to (b) and (c).

2. Saving of life and property from shipwreck by operations from shore,—(a) organization of and methods employed by life-saving institutions; (b) the employment of drilled and disciplined crews of life-saving institutions; (c) the maintenance of a patrol upon dangerous coasts by night and during thick weather by day, for warning off vessels standing in danger, and for the early discovery of wrecks; (d) uniform means of transmitting information between stranded vessels and the shore; (e) life-boats, life-saving apparatus, and appliances.

3. Official inquiries into causes and circumstances of shipwrecks and other casualties.

In General Division 6 will come, necessary qualifications for officers and seamen, including tests for sight and color blindness,—(a) a uniform system of examination for the different grades; (b) uniform tests for visual power and color blindness; (c) general knowledge of methods employed at life-saving stations; (d) uni-

form certificates of qualification; in General Division 7, lanes for steamers on frequented routes, — (a) with regard to the avoidance of steamer collision; (b) with regard to the safety of fishermen; in General Division 8, night signals for communicating information at sea, — (a) a code to be used in connection with the International Code Signal Book; (b) or a supplementary code of limited scope to convey information of special importance to passing vessels; (c) distress signals; and in General Division 9, warnings of approaching storms, — (a) the transmission of warnings; (b) the uniformity of signals employed.

General Division 10 will cover reporting, marking, and removing dangerous wrecks or obstructions to navigation, — (a) a uniform method of reporting and marking dangerous wrecks and derelicts; (b) the division of the labor, cost, and responsibility among the several maritime nations, either by geographical apportionment or otherwise; or the removal of dangerous derelicts, and of searching for doubtful dangers with a view of removing them from the charts. General Division 11 will take in notices of dangers to navigation, and notices of changes in lights, buoys and other day and night marks, — (a) a uniform method of taking bearings, of designating them (whether true or magnetic), and of reporting them; (b) a uniform method of reporting, indicating, and exchanging information by the several maritime nations, to include the form of notices to mariners; (c) a uniform method of distributing this information. General Division 12 will be devoted to a uniform system of buoys and beacons, — (a) uniformity in color of buoys; (b) uniformity in numbering of buoys; and General Division 13 to the establishment of a permanent international maritime commission, — (a) the composition of the commission; (b) its powers and authority.

The programme, as above drawn up, is submitted over the signatures of Rear Admiral S. R. Franklin, U.S.N.; Commander W. P. Sampson, U.S.N.; S. T. Kimball, General Superintendent of the Life Saving Service; J. W. Franklin, master marine; J. W. Shackford, master, merchant marine; and W. W. Goodrich, councillor-at-law.

The Hydrographic Office desires to obtain the opinions and suggestions of interested parties on the various subjects to be considered, with a view to assisting members of the conference in formulating satisfactory rules. It is hoped, therefore, that those whose opinions are likely to have weight on any of the subjects mentioned, may give the benefit of their knowledge or experience.

BOOK-REVIEWS.

Thermodynamics of the Steam Engine and other Heat Engines.
By CECIL H. PEABODY. New York, Wiley, 8°. 85.

THE author of this book is associate professor of steam engineering in the Massachusetts Institute of Technology, and the book is intended mainly for the use of students in that and similar technical institutions. He presents in a clear manner, and with a minimum of mathematical expression, the general theory of thermodynamics; and his treatment of the properties of gases and vapors, and of the injector, presents several novel and interesting features, especially in the comparisons with experiments. More novel still, and more valuable to the student who intends to adopt steam-engineering as a profession, is the author's treatment of the steam engine. He has considered it advisable to leave untouched all approximate theories based upon the assumption of adiabatic changes of steam in the cylinder of the engine, making instead a systematic study of actual tests of engines in use, for which purpose a large number of test records have been collected, arranged, and compared. This will enable the student to learn what is actually known on the subject, and will point out to him the direction in which future investigations will give the best results, as well as show him how and where improvements may be made.

It will be gathered from the foregoing that this book differs, in some parts, either in substance or in manner of presentation, from other text-books on the subject; but in general, commonly accepted methods have been followed. The formal presentation of thermodynamics is the same as that employed by most authorities, and presents clearly the many difficulties of the subject, besides making plain the processes employed.

The author gives special attention to the investigations of the

action of steam in the cylinder of an engine, considerable space being given to the researches made by Hirn, as well as to the experiments which provided the basis for them. Directions and instructions are given for the designing and construction of simple and compound engines, and also for making accurate tests of their efficiency. Chapters are given on air-compressors and refrigerating machines, which important subjects may profitably be studied in connection with the theory of thermodynamics.

Though this volume, like all similar text-books, is largely an adaptation for a special educational purpose of the work of other authors and experimenters, more than a general acknowledgment of indebtedness to them would not under the circumstances be deemed necessary; still Professor Peabody has given references in foot-notes wherever direct quotations have been made, which will aid students materially in making more extended investigations

AMONG THE PUBLISHERS.

D. APPLETON & Co. call attention to the fact that "Christianity and Agnosticism" has gone into a second edition.

— Messrs. Houghton, Mifflin, & Co. announce for early publication, "Literary Landmarks: A Guide to Good Reading for Young People, and Teachers' Assistant." By Mary E. Burt, Teacher of Literature, Cook County Normal School, Englewood, Ill. 152 pages. Cloth, 75 cents.

— The *Modern Science Essayist* for July contains an essay on the "Evolution of Society," by James A. Skelton. In the August number, J. Sidney Sampson discusses the "Evolution of Theology."

"Useful Hints on Steam" is the title of a very attractive little volume of nearly a hundred pages, written and published by E. E. Roberts of 107 Liberty Street, New York. It is written in a popular vein, and is intended for beginners.

— Charles H. Kilborn, Boston, has just ready "Round the World with the Poets," selected and arranged by Mary Cate Smith and Sarah C. Winn, intended to afford a series of review exercises in the study of geography. The quotations are arranged beginning with physical features and then giving longer poems relating to particular countries, mountains, rivers, cities, etc. These are followed by an illustrative tour, giving in selections from well-known authors an interesting journey around the world.

— The September number of *Harper's Magazine* will contain two articles by Theodore Child, one describing the American fine art exhibition at the Paris Exposition, which Mr. Child does not hesitate to say is one of the strongest and most interesting of all the foreign departments, and the other giving features of Moscow life that escape the eye of ordinary travellers. In the same number Edmond de Pressensé gives an outline of the religious movement of the present day in France; "London Mock Parliaments," by John Lillie, illustrated by Harry Furness; the distinguished caricaturist, Caran d'Ache, will have a series of sketches of dogs in the "Editor's Drawer;" and Lynde Palmer contributes a story about electricity called "The Pendragon Trial."

— The next volume in the Badminton Library to be published in the autumn, is "Fencing, Boxing, and Wrestling," written by Messrs. Walter H. Pollock, F. C. Grove, Walter Armstrong, E. B. Mitchell, and M. Prévost. This will be followed later by "Golf," to which Mr. Horace Hutchinson, Mr. A. J. Balfour, and Sir William Simpson (among others) will contribute.

— In the September *Scribner's* Lieut. W. W. Kimball, U.S.N., United States Inspector of Ordnance, will describe the various types of magazine rifles which have been adopted by the leading European armies, including the Mannlicher, Hotchkiss, Lee, Mauser, and Vetterli. A number of illustrations will show the contrivances by which the cartridges are fed to the rifle. Andrew Lang will write of Alexandre Dumas. Harold Frederic will begin a new serial romance of the Mohawk Valley in the days of the French and Indian wars and the Revolution. H. G. Proust's article on "Safety in Railway Travel," is the twelfth and last in the very successful railroad series. It is announced that these articles, with

many additions to the text and illustrations, will be collected in a very handsome volume, to be published by Charles Scribner's Sons early in the fall.

—George H. Ellis, Boston, will publish shortly a book of social essays entitled "Problems in American Society," by Joseph Henry Crooker, the author of "Jesus Brought Back." The book will deal with the problems of charity, temperance, political conscience, moral and religious instruction in public schools, and also the problem of solving the question at issue between the Catholic Church and the secular schools.

—G. P. Putnam's Sons have published "Great Words from Great Americans," a neatly gotten up little book giving the Declaration of Independence, the Constitution of the United States, Washington's and Lincoln's inaugural and farewell addresses, etc.; and "Seven Thousand Words Often Mispronounced," by William H. P. Phyle.

—W. W. Pasko, 19 Park Place, New York, has issued the first number of *Old New York*, a journal relating to the history and antiquities of New York City. Mr. Pasko is also the editor. The periodical is intended to cover the entire range of events "from the discovery of the river and bay down to a period within the recollection of middle-aged persons." It will be published in monthly numbers containing sixty-four pages each. The editor invites the co-operation of all those interested and will be glad to be furnished with material. "Nothing will be inserted for sensation; truth, and truth alone, will be his purpose."

—A remarkable chapter of Napoleonic history will appear in the September *Century*, consisting of letters and journals of British officers describing Napoleon's voyage to Elba, also to St. Helena. The first part of the article is a letter written by Captain Ussher, who commanded the "Undaunted," which took the exile to Elba; the last part is by Lieutenant Miles, of the "Northumberland," and consists partly of a diary which the young lieutenant kept while on

the way to St. Helena in the same ship with the ex-emperor. Napoleon talked quite freely about some of his plans — especially with regard to the French navy — told a number of stories, and explained various points in his own career.

—D. Appleton & Co. announce for early publication "European Schools," by L. R. Klemm, which will be fully illustrated and included in the International Education Series; "A First Book in American History," by Edward Eggleston, which will be beautifully illustrated by eminent American artists; and Youmans' "Class-Book of Chemistry," thoroughly revised by Dr. W. J. Youmans, a brother of the author, and made quite up to date by including the latest developments of the science.

—Sir Charles Dilke is engaged upon a new work, entitled, "Problems of Greater Britain." "Though covering in some respects the same ground as 'Greater Britain,'" says the *Athenaeum*, "it will not be, like that book, a record of travel, but a study of comparative politics and a complete survey of the empire. Special attention will be paid to the question of Indian frontier defence, to the situation in Canada and South Africa, and above all to the many important problems which concern the present and future of Australia." The book will be published by Messrs. Macmillan & Co. in January.

—A "floral campaign," for the choice of a national flower, to correspond with the rose of England and the lily of France, is now in progress in many parts of the country, and is arousing considerable interest and discussion among flower loving patriots. Prang & Co. of Boston, who started the campaign, have just issued a little volume containing pictures of the two favorite candidates, the mayflower and the golden-rod, two poems reciting the claims of each, a history of the campaign, and a postal ballot for the use of those who wish to vote on the subject. The polls will close on Dec. 31, this year, when the results will be published. The result of the voting so far is as follows. For the golden-rod, 67 per cent;

Exchanges.

[Exchanges are inserted for subscribers free of charge. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

I want to correspond and exchange with a collector of beetles in Texas or Florida.—Wm. D. Richardson, P. O. Box 223, Fredericksburg, Virginia.

100 botanical specimens and analyses for exchange.—Send list of those desired and those which can be furnished, and receive a similar list in return. Also cabinet specimens and curiosities for the same. Scientific correspondence solicited.—E. E. Bogue, Orwell, Ashta, Conn.

I will sell to chapters or individual members of the Agassiz Association, 25 fine specimens of fossil plants from the Dakota group (cretaceous), correctly named, for \$2.50. Send post-office order to Charles H. Sternberg (author "Young Fossil-Hunters"), 1033 Kentucky Street, Lawrence, Kan.

One mounted single achromatic photographic lens for making 4 X 5 pictures, in excellent condition; also one "new model" double dry-plate holder (4 X 5), for fine geological or mineralogical specimens, properly classified.—Charles E. Fry, 109 West Lehigh Avenue, Philadelphia, Penn.

Drawings from nature — animals, birds, insects, and plants — to exchange for insects for cabinet, or I will send them in sets of ten each for ten cents in stamps. My drawings in botany are in detail, showing plant, leaves, flowers, seed, stamens, pistils, etc.—Aida M. Sharp, Gladblook, Io.

The undersigned wishes to make arrangements for the exchange of *Lepidoptera* of eastern Pennsylvania for those from other localities. All my specimens are named and in good condition.—Charles S. Westcott, 613 North 17th Street, Philadelphia, Penn.

California onyx, for minerals and coins not in my collection.—W. C. Thompson, 612 East 141st Street, New York, N.Y.

Any one who has a botanical box in good condition will please write. I will offer about 30 specimens in exchange.—C. B. Haskell, Box 826, Kennebunk, Me.

A few first-class mounted birds, for first-class birds' eggs of any kind in sets.—J. P. Babbitt, secretary Chapter 755, 10 Hodges Avenue, Taunton, Mass.

HEAVEN AND HELL, by EMANUEL SWEDENBORG, 416 pages, paper cover. Mailed pre-paid for 14 Cents by the American Swedenborg Printing and Publishing Society, 20 Cooper Union, New York City.

BOOKS THAT EVERY TEACHER SHOULD POSSESS.

METHODS OF TEACHING. A Hand-Book of Principles, Directions, and Working Models for Common School Teachers. By John Swett, Principal of the San Francisco Girls' High School and Normal Class. 12mo, Half Leather, \$1.00. "Every teacher may derive immediate practical benefit from its perusal."—F. Louis Solida, Principal St. Louis Normal School.

BROWNING'S EDUCATIONAL THEORIES. An Introduction to the History of Educational Theories. By Oscar Browning, M.A., King's College, Cambridge, England. 10mo, Cloth, 50 cents.

It is a concise and popular account of the main lines of thought that have been followed on educational subjects from ancient times to our own day. Mr. Browning gives a chapter on education among the Greeks; one to Roman education, to Humanistic education, the Realist, the Naturalist, English Humanists and Realists, Locke, the Jesuits and Jansenists, Rousseau, Pestalozzi, Kant, Fichte and Herbart, and finally, the English public school. He writes clearly and pleasantly.

GENTLE MEASURES IN TRAINING THE YOUNG. By Jacob Abbott. Illustrated. 12mo, Cloth, \$1.00.

There are few questions connected with the early education of children that are not discussed in the course of the volume, with reference to the leading principle of which it treats, each topic is illustrated by a variety of examples derived from practical life, and the whole treatment of the subject evinces the author's grasp of the subject, his deep insight into the juvenile nature, and his large experience in the work of education.

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MANUAL OF OBJECT TEACHING. With Illustrative Lessons in Metaphysics and the Science of Education. By N. A. Calkins, Supt. of Primary Schools of New York City. 12mo, Cloth, \$1.25.

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STUDIES IN ENGLISH LITERATURE. By William Swinton, author of "Harper's Language Series," and Gold Medalist, Paris Exp. situ, 1875. Embellished with portraits and Autographs. 8vo, Cloth, \$1.20.

It is a series of studies in the masters of English, from Shakespeare to the present time. The authors chosen are not only of the first rank, but they also represent epochs of literature, marked phases of a life, distinctive contributions to literary method.

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for the mayflower, 21 per cent; the laurel, 34; dandelion, 3; sunflower, 1; and daisy, 1.

— The *Fortnightly Review* for August opens with a paper on "Mr. Gladstone and the Civilized World," by Karl Blind, in which the writer reviews Mr. Gladstone's criticisms on home rule in other countries and applies the lessons to Ireland. Dr. Joseph Thomson, the noted explorer, writes on "Downing Street vs. Chartered Companies in Africa," giving the record of British official rule, by one who has had ample opportunities of personal observation. Mdlle. de Bovet contributes a series of conversations with the composer Gounod, embodying his views on art and artists, which have been transcribed by one of his companions, and include much interesting matter never before published. A paper on the "Fortress of Paris," illustrated with a map, explains the great political and strategical importance of the city, which it is claimed is unsurpassed in these respects by any capital in Europe. J. D. Bourchier describes the "Great Servian Festival," the anniversary of the fall of Servia's greatness on the battlefield of Kasso, in 1389. Walter Pater writes on Giordano Bruno, whose works have received new attention from scholars since the unveiling of his monument in Rome. W. D. Hogarth contributes an article on the "Present Discontent in Cyprus," condensing the history of the island since 1878, when it was taken under the protection of England. W. L. Courtney tells the story of the life of Roger Bacon, with special reference to his life at Oxford, and presents an interesting study of a much neglected figure in English history. Oswald Crauford draws a picture of Spanish and Portuguese bull-fighting; and Professor Tyrell contributes a brief note on Mr. Browning's late attack on Edward FitzGerald. The number concludes with "Some Truths about Russia," by a former resident.

— Messrs. E. & F. N. Spon announce as nearly ready "Practical Electric Bell Fitting: a Treatise on the Fitting-up and Maintenance of Electric Bells and All the Necessary Apparatus," by F. C. Allsop; "A Dictionary of Electric Words, Terms, and Phrases," by E. J. Houston; "Practical Gold Mining, a Comprehensive Treatise on the Origin and Occurrence of Gold-Bearing Gravels, Rocks, and Ores, and the Methods by which the Gold is extracted," by C. G. Warnford Lock; "Egyptian Irrigation," by W. Willcocks, M.I.C.E., with introduction by Lieut.-Col. J. C. Ross, R.E., C.M.G.; and "The Engineer's Sketch-Book of Mechanical Movements, Devices, Appliances, and Contrivances," by Thomas Walter Barber, containing details employed in the design and construction of machinery for every purpose, collected from numerous sources and from actual work, classified and arranged for reference for the use of engineers, mechanical draughtsmen, managers, mechanics, inventors, patent agents, and all engaged in the mechanical arts, with nearly two thousand illustrations, descriptive notes, and memoranda.

— The *Contemporary Review* for August opens with an article on the papacy, which has attracted much attention abroad. The writer says that to re-establish the temporal power, the church must be Anglicized or Americanized. This is illustrated by the startling statement that the papal rescript against the plan of campaign was launched by the pope under the pressure of the English government, against the advice of Persico, who has hitherto been held responsible for that blunder. Sir Morell Mackenzie contributes a valuable paper on the voice, treating of song. The address by Frederick Harrison before the Positivist Society on the centenary of the Bastille is reproduced entire, and presents a graphic picture of some of the more exciting episodes of the French revolution. Sir W. W. Hunter presents a plea for a female medical profession for India, which is, he says, the only hope of reaching Indian women. Canon Cheyne argues for reform in the teaching of the Old Testament, and looks for an idealized church in the future. Incidentally he touches on the agnostic controversy, and the more important of recent theological writings. Frederic MacKarness reviews some of the recent experiments in governing South Africa by the English authorities; and George J. Romanes writes a scholarly and interesting paper on "Mr. Wallace and Darwinism." Mr. Romanes is a Darwinian, and does not follow Mr. Wallace in some of his recent theories. Managers of picture exhibitions will find much of interest in the paper by M. H. Spielmann

on the "Proposed Royal Academy Reform," in which the writer tells what the proposed reforms are, and what they should be. Philip H. Wickstead presents a study of Ibsen's "Peer Gynt," and affords an instructive insight into the methods of a master who is the literary sensation of the day in England, and who is looked upon by many critics as the greatest dramatist of the age. The number closes with an article on the "Civil List and the Grants to the Royal Family," by Dr. Henry Dunkley, who goes into the subject historically, and gathers many curious and little known facts in a subject which is just now agitating England, and which has attracted no little attention in this country.

— Professor Henry C. McCook of the Academy of Natural Sciences, Philadelphia, is now prepared to issue his natural history of the habits and industry of our orb-weaving spider fauna, under the general title "American Spiders and their Spinning Work." It embraces studies extended over more than fifteen years, and will be printed in three volumes, quarto. Volumes I. and II. will contain the author's personal observations, studies, and illustrations of the habits and industry of spiders. The studies are particularly directed to the spinning habits of the great group of spiders known as orb-weavers; but these are expressed in their relations to all the other tribes in both hemispheres. Volume III. will contain the systematic part of the work, and embrace descriptions of the orb-weavers of the United States, illustrated by a number of fine lithographic plates painted by hand in the colors of nature. The volumes will be profusely illustrated, wholly from nature, the number of engravings in the first volume alone exceeding two hundred. The language is as free as possible from technical terms, and, as the matter principally concerns the life-history of the animals, the chief contents of the work can be readily followed by any intelligent and sympathetic reader. This is especially true of Volume II. The publication of such a considerable work has involved a large expense, and as the circulation is necessarily limited to important scientific societies, leading public libraries, and a small circle of private individuals, the author has been compelled to undertake the entire work and charges of publication. The number of prints will be absolutely limited to five hundred, but an edition of two hundred and fifty copies, which will be known as the "Author's Edition," will now be issued; and the price of the volumes has been fixed, as nearly as could be estimated, at the simple cost of publication. The price for the entire set of three volumes will be \$30 for colored plates, or \$25 for uncolored plates. No volume will be sold separately. All persons subscribing within three months from Aug. 1, 1889, will receive the entire set with colored plates for \$25, delivered, postage paid, in any part of America. The price postpaid for Europe and all foreign countries is £5 4s., English money. After the limited time, no books will be sold for less than the full price, with postage added. Payment will be expected as follows: \$10 on the delivery of Volume I., \$10 on delivery of Volume II., and \$5 on delivery of Volume III. Full payment may be made, if preferred by subscribers, on delivery of Volume I. The first volume will be delivered in the autumn of this year; the second volume, shortly thereafter; and the third volume, which is already in a good state of progress, in the early part of 1890. The several volumes will be mailed with uncut edges in suitable form for library binding. Societies, libraries, and individuals who may purpose to subscribe will materially forward the author's plans by acting promptly.

— The *Nineteenth Century* for August contains papers by an imposing list of writers. Frederic Harrison opens the number with "A Breakfast in Paris," giving the views of a number of representative Parisians on the Exhibition and the political state of France. L. Atherly Jones writes on "The New Liberalism," which, with home rule, he believes to be destined to succeed, though possibly not for some time to come. Dr. Burney Yeo presents some valuable suggestions on "Change of Air," which he regards as almost imperative for city people. He also gives an analysis of the ocean cure, with suggestions as to places of resort for invalids. Sir Joseph Fayer begins a description of the deadly wild beasts of British India, a subject of great importance when it is remembered that 2,618 persons and 61,021 head of cattle perished in 1887 by animals alone, not counting snakes, which caused

the death of 19,740 persons in addition. The Rev. Father Barry argues for a "Gospel for the Century," claiming that the church, like the age, must be progressive. Walter Frewen Lord describes the life and writes of Henrik Ibsen, the Norwegian dramatist whose works are exciting so much attention in England. Lord Brabourne replies to Mr. Gladstone's article on the Irish union in the July number, in a paper in which he takes the great statesman to task for not accounting for the actual condition under which the cruelties he censured so severely were practised. Lord Ribblesdale has a light though interesting study on the "Art of Conversation," relating his own experience in acquiring that difficult accomplishment. Mr. Gladstone neglects politics this month, and returns to his classical studies in a paper on the "Phoenician Affinities of Ithaca," a much argued question among Greek scholars, which he endeavors to answer. Professor Geffcken contributes a paper on "The French in Germany," reviewing the history of French treatment of Germany and Germans in the last few centuries. Germany, he claims, has suffered more in that time from France than she did from the war of 1871, and he therefore argues that the treaty of Frankfort should be regarded as final. Frederick Greenwood presents an interesting essay on love and men and women, entitled "Wool Gatherings;" and John Morley, W. S. Lilly, R. E. Prothero, Sir Frederick Bramwell, H. G. Hewlitt, Frederic Myers, and the Hon. Hallam Tennyson review some noticeable books. The number closes with a rejoinder on female suffrage, by Mrs. Creighton, and a long list of signatures to the protest against suffrage printed in the June number.

— The Clark Electric Company, 192 Broadway, New York, have issued a new catalogue of their arc light apparatus. In this is given, with illustrations, some account of their arc dynamo, with a view showing the interior field and others of the armature, automatic regulator, etc. The single and double arc-lamps are described. The pamphlet closes with a description of their new automatic regulator.

— The current number of the *American Journal of Psychology* is strong in four original papers. The first, by Dr. William Noyes, contains a further account of an interesting paranoiac described by him in an earlier number of the journal (May, 1888). The patient, an artist of talent and originality, has continued his painting, and latterly busied himself with the composition and illustration of a manuscript book of two hundred pages. The six plates accompanying this article reproduce nearly fifty pictures, of which three are taken for comparison with his pre-asylum work, and two-thirds of the rest are pen-and-ink drawings from the book. Considerable extracts, both of prose and verse, are given, the latter especially showing the same mixture of facility and imperfect finish that characterizes his pictures. It is rare that an alienist has the opportunity of observing a case where the disordered mind has such varied and delicate means of expressing itself. The next article is an experimental study, by Dr. C. F. Hodge, of the effect of electrical stimulation upon ganglion cells. The outcome of these careful experiments is a method "by which changes due to functional activity can be as easily and certainly demonstrated in a ganglion as in a gland." Electrical stimulation noticeably decreases the size of the nucleus, makes it jagged in outline, obscures its reticulation, and makes its stain darker. In the cell protoplasm it causes vacuolation and slight shrinkage, and makes its stain less readily. The nuclei of the cell capsule are also shrunken. These changes are figured in an accompanying plate. In the third article, Dr. E. C. Sanford concludes his series on personal equation, taking up especially the amount and cause of personal differences under the simplest conditions of observation. He brings together the contributions of the astronomers and physiological psychologists, and considers the theories of Bessel, Wolf, and others. A bibliography of a hundred titles or more is appended. Dr. W. H. Burnham furnishes a very interesting paper on the illusions and hallucinations of memory, or, as the phenomena have been termed, paramnesia. An example of a single class is the not uncommon feeling of strange familiarity in totally unfamiliar circumstances. Other kinds are rarer, but by no means unknown. Important contributions have come from the alienists, notably from Kraepelin, whose classification Dr. Burnham follows. The author

has been fortunate in collecting a number of illustrative cases (such tricks of memory seem frequent in dreams, with some people at least), which parallel in normal life the grosser cases of the insane. The subject has also a practical bearing; for Hughlings-Jackson, while admitting that the feeling of reminiscence above mentioned does occur in normal people, would regard its frequent occurrence as a confirmatory symptom of a certain form of epilepsy. In persons of somewhat defective memory and judgment, as children and old people, a skilful lawyer can, by proper manipulation, create, entirely without the consciousness of the witness, a memory of events that never happened; and, like Professor Royce, the author would account for many cases of presentiments, telepathy, etc., reported by trustworthy people, as cases of pseudo-memory. The number contains, as usual, reviews and abstracts of literature on the nervous system and experimental and abnormal psychology, besides miscellaneous notes. In the abnormal section is included also a paper of practical suggestions to physicians in asylums, hospitals, etc., for the observation of patients suffering from mental and nervous diseases, by Dr. H. H. Donaldson. The suggestions are accompanied throughout by references to the literature.

LETTERS TO THE EDITOR.

*. * Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

The editor will be glad to publish any queries consonant with the character of the journal.

Twenty copies of the number containing his communication will be furnished free to any correspondent on request.

Sunset Glows.

We have just been enjoying a re-appearance of sunset glows like those following the Krakatoa eruption of 1883, though much less bright. The phenomenon was first noticed here after sundown of July 13. On the 14th and 15th it seemed to increase in intensity. After this it declined, and I think could not be clearly distinguished after the 20th.

I noted a whitish glow around the sun, occupying a space of about fifteen degrees' radius, as in "Bishop's ring." The outer colored ring characteristic of that corona seemed to be entirely lacking.

I have remarked the following peculiarities in which these differ from the Krakatoa glows: they are very much less bright, perhaps like those after a lapse of several months.

A notable difference is in a beautiful tertiary glow. This consisted of a rich and delicate rosy flush occupying a tract of sky in the west, say of sixty degrees horizontally, and from five down to ten degrees of altitude. At the edges this melted into purple upon the clear blue of our North Pacific sky. A faint purple tint extended along the horizon quite to the south: no color in the north. There are islands a little north of west, intercepting reflections. This third glow failed to gather down and deepen upon the horizon like those preceding it. I think its tint the most beautiful I have ever seen in the heavens, like that of some rare and perfect jewel.

A very marked peculiarity is the early time at which the primary and secondary glows take place. The primary glow gathers soon after the sun is down, and is at its height while daylight is yet strong. Hence it is less conspicuous, although its broad streaming radiations of glowing surface are very remarkable.

The secondary glow promptly follows, and makes the grand display. It is nearly finished before any stars are visible. The Krakatoa secondary began in a somewhat darkened sky, — as dark as when the late tertiary appeared, — and lingered until after full darkness, slowly settling down into a low, dense, blood-red stratum, which simulated the reflection of a remote conflagration.

That strange dull-red glow was entirely absent from the late appearances. The secondary gathered and settled away in a bright orange glow. Both at its close and throughout its course, this secondary substantially resembled the Krakatoa primary as seen several months after the eruption. Like that, it presented at its close a well-defined and serrated upper edge, bordered by dark sky. The serrations of the latter, however, were small and numer-

ous, apparently the inverted shadows of cumuli upon a very remote horizon. In this, on the contrary, the serrations are large, as if caused by the intervention of cloud-masses upon a near horizon.

It seems evident that the reflecting stratum of haze in these late glows was very low down as compared with the Krakatoa haze. The shadow of the horizon was projected upon a haze-canopy quite close at hand. Hence also the early production of the primary glow, and the rapid following of the secondary. For the same reason, the extent of lower atmosphere traversed by the sun's rays during the repeated reflections was greatly reduced; less of red was consequently shown, the other colors being only partially intercepted. Again, the twice reflected rays still retained force for a slight but definite third reflection, in which a pure though faint red appears.

We have as yet no cable, though in strong hope of one soon. No foreign mail has reached us since the 6th instant. One is due to-morrow, and we hope to hear of some adequate cause to which this remarkable phenomenon may be owing.

Honolulu, July 25.

SERENO E. BISHOP.

"Suggestion."

A FEW evenings ago I went to a friend's house to hear the phonograph. It was reproducing with fidelity the music of a band. To promote the illusion, I closed my eyes. Presently an air was played that sounded familiar, though I failed to recognize it. Neither did I strive to, for my attention was concentrated on the quality of the sound. As I listened, however, I became conscious of a set of surroundings: a pair of eucalyptus trees opposite, a large domed building to my left, a street of white flat-roofed houses on which I looked down, even a familiar sign-board caught my eye (the inscription ought to have been "Biblioteca Pública"), the strains of the military band in the plaza coming through the star-lit night. Involuntarily my eyes opened, and I caught my breath at sight of the lamps and assembled company of a drawing-room; for I had been listening, from the *azotea*, or roof, of my former residence in the little Mexican city, to a favorite *danza* air played by the regimental band in the neighboring plaza. The change was so very startling that it made my heart pump. I closed my eyes, and though I did not again lose consciousness of where I was, the Tropic picture materialized again as vividly, and with all the detail that could have been present to the eye of sense. I requested that the air (the *danza*) might be again put through the instrument, and while it played, I still held the picture, and had wandered off into a brown study, a thousand Mexican images and incidents rising of their own accord and passing before the imagination. While this was going on, and without my becoming conscious of any change in the source of suggestion, the picture became blurred, faded, and indistinct, and the train or procession of incidents broken and desultory. This led to my consciousness that a different air — a German one — that I had never heard from a Mexican band, was now proceeding from the apparatus. W.

San Francisco, Cal., Aug. 10.

Minute Aeronauts.

DURING the year 1875, while engaged in some scientific investigations in Contra Costa County, Cal., my attention was attracted to the numerous webs floating in the air. Some were wound to-

gether so as to resemble small pledgets of cotton, others were long streamers. After having made several inquiries as to their cause but gaining no satisfaction, I sat about an investigation. I started up a high hill from which all these webs seemed to have their origin. During my ascent I noticed that my hat and clothing began to be covered with webs, and finally I discovered a small spider spinning a web from my hat brim to the ground. When it reached *terra firma* I sat down to watch it and to study its movements. It immediately searched out a slender stalk of a weed and made its way to the top. It remained there for a few moments perfectly still, as if it was taking observations. Then it began spinning web, and by a peculiar motion of its legs it would roll or gather the web in a mass, and when enough had been accumulated in this manner to carry the little creature, it would let the flaky mass flow out to the winds. When it had thus formed a little parachute, or balloon, it would swing itself out in the air and sail in obedience to the winds. Continuing my journey up the hill I noticed scores of these spiders rigging their aerial ships preparatory to visiting some distant place. When near the top of the hill I was surprised to see webs sailing hundreds of feet above the summit. I turned my field glass in a direction toward the sun, where I could best discern them, and as far as my aided eye could reach I could still see them. They probably came from a great distance, as they were five or six hundred feet above the crest of the hill. When these little aeronauts came near the ground in their travels, they would descend on a web and abandon their balloon. I watched these spiders for hours, and none of them ever made a mistake as to the quantity of the web that would carry them. They could in this way travel hundreds of miles in a day.

R. I. BROMLEY, M.D.

Queries.

47. WHAT BIRDS ARE THESE?—(1) Head and back, black; breast and belly, rich reddish brown; length, seven inches; from tip to tip of extended wings, ten inches; sides of bill, slate; legs, black; Inessorial; bird seen in orchard. (2) Breast, yellow; back, yellowish olive-green; throat of male, black; male larger than female; bill, conical; length, medium or rather long; size of bird described above or smaller; song similar to bird described above. Nests in orchard, top of tree; nest composed of grass, not placed in fork of branches, but suspended, — in which it deposits three cream-colored eggs, black-blotched at the larger end; food, worms. (3) Breast of male, yellowish with black spot; back, dark brown and white; striped or mottled; bill rather large, short, conical. Of two nests seen, one was in a meadow, about eight inches from the ground, supported by the grass, and the other three feet high, in a roadside hedge: both contained four blue green eggs. Size of wood-pewee; song, short; seen in fields; female rather smaller and duller colored, and lacking the black spot on breast. There is a yellowish stripe above the eye. L. W. N.

Answers.

47. THE first and second birds described are orchard orioles (*Icterus spurius*), the brown and black one being an old male; the yellow olive one with black throat the male in its first year. The last bird is the black-throated bunting or dichicissel (*Spiza americana*).

INDUSTRIAL NOTES.

The Union Electric Car Company.

CARS operated on the system controlled by the Union Electric Car Company of Boston, Mass., will soon be running between the towns of Beverly and Danvers, Mass. One of this company's cars was run on the West End Railroad in Boston for eighteen months, never failing to do what was expected of it. This company uses dynamo and motors of the United States Electric Light Company's make, and intend to use either the storage, overhead, or conduit system, or a combination of all three, as may be found expedient. One of the peculiar features of the Union company's

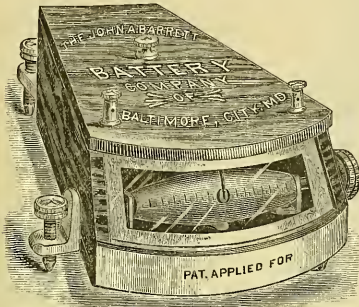
system, for which they hold a patent, is the charging back, while using a series motor, into the battery or line, while stopping the car or holding it back in going down grade, the motor being converted into a dynamo for the time, deriving its power from the momentum of the car.

Another feature of this system, also patented, is the use of a peculiarly formed cut gearing for transmitting motion from the motor to the wheel-axle. The gearing is inclosed in a dust-proof case, partly filled with oil, so that the gearing runs in an oil-bath, insuring thorough lubrication and decreasing the friction and wear, of the gear-teeth. The company claims that this one feature saves a large percentage of power besides greatly increasing the life of the gearing.

The Barrett Mil-Ammeter.

The mil-ammeter shown in the accompanying sketch has been designed especially to meet the wants of the medical practitioner, and, with this end in view, has been made as compact and uncomplicated as is consistent with accuracy.

The question of accuracy has to be carefully considered in in-



THE BARTLETT MIL-AMMETER.

struments of this kind, for the present tendency in the application of electricity to medicine and surgery is to obtain results based upon such systems of measurement as shall be comparable at any locality.

The John A. Barrett Battery Company's mil-ammeter is believed to be an important improvement over most instruments of its class, and it embodies in its construction several features which are entirely novel.

Of these, the most important is the manner of rendering the metre capable of measuring currents of very great differences in value. This is secured by a system of shunts which are automatically thrown into circuit simultaneously with a corresponding change of the scale. The instrument is provided with three independent scales, whose ranges are respectively 0-5, 0-25, and 0-250 milli-amperes. By turning a screw at the side of the case, these scales are made visible one after the other, and at the same time the corresponding shunt is put in action, so that correct readings may be taken at once.

The metre is also provided with a screw-clamp, which removes the pivoted needle (the needle having a jewel pivot) from its bearing; and when this is adjusted, the instrument can be carried around with little care and with almost perfect safety.

Recently the range of these metres has been extended, so that they now read up to 1,000 milli-amperes.

Electrical Train Heating.

The Burton Electric Company, of Richmond, Va., have recently been making some experiments with their electric heaters for railway cars, a Sprague electric car being used for the purpose. An 80 volt current was used. Each heater had a resistance of 35 ohms, and required $2\frac{1}{2}$ ampères of current to raise the temperature 200 degrees Fahrenheit. The heater is composed of a resistance coil, inclosed in a cast iron case provided with projections for increasing the radiating surface. The wires of the resistance coil are covered with powdered clay, to absorb the heat and prevent the wires from being burnt out. In the experiments mentioned fourteen heaters were used, absorbing three and a half electrical horse-power. The heaters were connected in multiple arc. In practice it is proposed to generate currents on trains under way by means of dynamos driven from the car-axles, the cars to be heated before starting out by currents from stationary dynamos at the stations.

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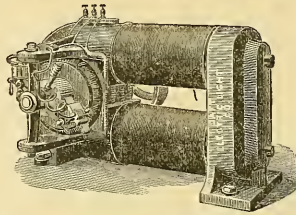
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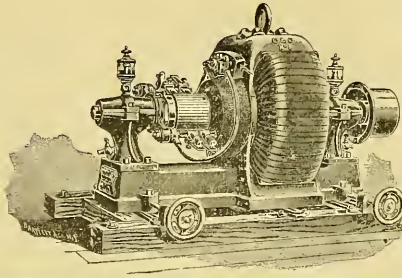
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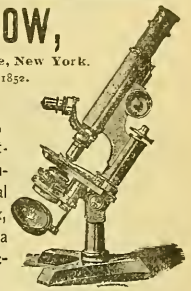
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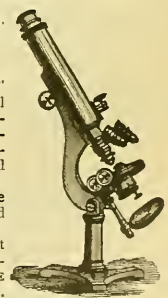
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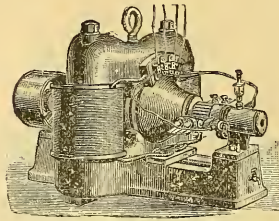
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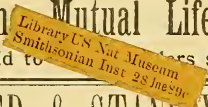
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SEVENTH YEAR.
VOL. XIV. No. 343.

NEW YORK, AUGUST 30, 1889.

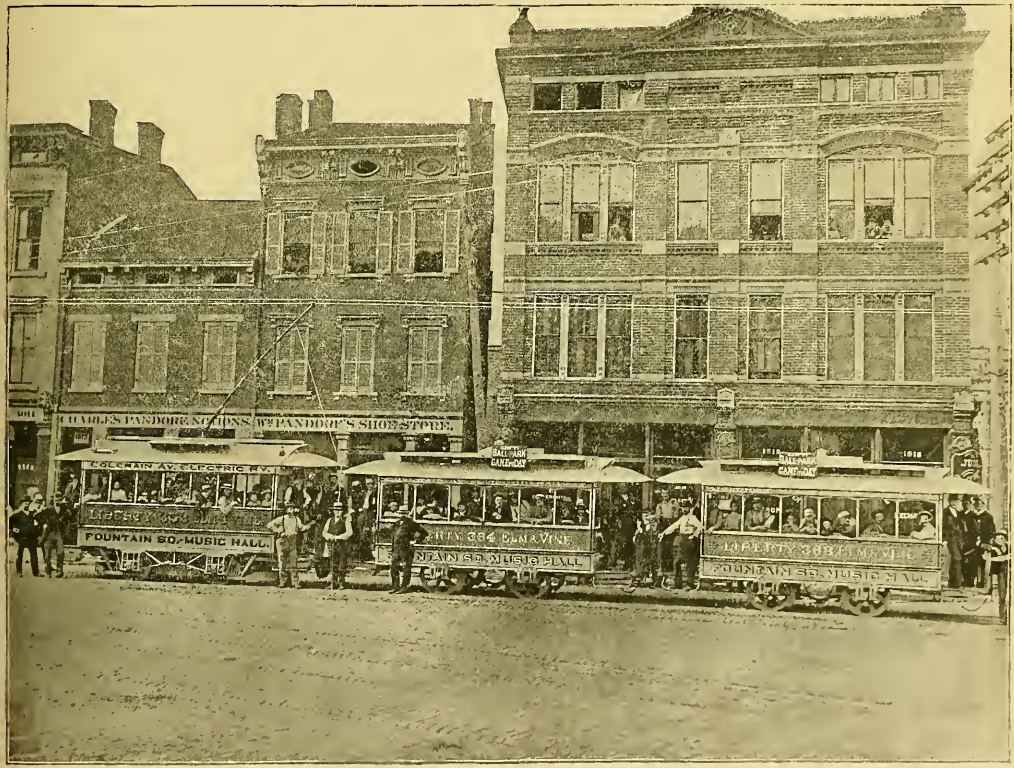
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A CINCINNATI ELECTRIC RAILROAD.

THE initial trip of the electric cars on Route 18 of the Consolidated Street Railroad Company of Cincinnati, was made on Wednesday, Aug. 6, in the presence of the president and directors of the company, and was a decided success. The system decided upon by the officers of the railroad is that of the Thomson-Houston Com-

road until two private corporations had demonstrated the feasibility and practicability of cables to enable cars to climb the steep hills which surround Cincinnati. In the same way they have gone about testing and selecting a system for electric motive power.

The company have as consulting engineer Mr. B. L. Baldwin, a young, energetic, and practical mechanic who prefers facts to theories. Mr. Baldwin studied long and carefully the various systems



THOMSON-HOUSTON ELECTRIC CARS OF THE CONSOLIDATED RAILROAD COMPANY, CINCINNATI.

pany. Elmer P. Morris, superintendent of construction, had charge of the party. The start was made from the car-barns at four o'clock in the afternoon, with fifty people in the car, all of whom were interested in the result.

The Consolidated Railroad Company are very conservative, and are not apt to spend much on experiments to improve their lines, unless assured of satisfactory results. They did not build a cable

before giving his opinion, and when he chose that of the Thomson-Houston Company, the railroad company did him the honor to close a contract with that company at once.

The present plant consists of one Corliss engine of four hundred horse-power, two Ball engines of two hundred horse-power each, and three Thomson-Houston electric generators of a capacity of 6,500 watts each. These generators furnish sufficient current to

operate eight motor cars of thirty horse-power each, and to light four horse-stables, three car-barns, and the generating station, — about five hundred lights of sixteen-candle power each.

The road as at present equipped is two and eighty-five one-hundredths miles long, and has three grades, each about sixteen hundred feet long with a three per cent rise. On the day of trial a motor car with a trailing car attached, loaded very heavily, made the distance in twelve minutes, and while on the grades the speed obtained was as high with the car added as that of the motor car by itself, showing conclusively that the Thomson-Houston motors are of sufficient capacity to do in the most satisfactory manner the work cut out for them. There is no unpleasant jerk or jar in starting the car, such as is found in many systems, and no scientific or mechanical knowledge is necessary to handle the car, which is controlled with ease.

The road when finished will be nearly six miles in length, making a round trip of twelve miles; and this, if proven successful, will be but a start in the rapid-transit line by the Consolidated Street Railroad Company. They have under way the plans for a one thousand horse-power plant for the hills, and the present plant will be enlarged to accommodate at least two more down-town lines. They also contemplate the equipment of from fifty to seventy-five cars, and expect to have the whole completed and in running order by the first of next year.

The recognition by this company of the merits of the Thomson-Houston electric railroad system is a very strong point in favor of that company; and as they gave practical demonstrations of their ability to fulfil their promises, they undoubtedly merit the honor thus paid them.

THE PEITSCH FREEZING PROCESS IN MINING OPERATIONS.

A BRIEF description of the freezing process devised by Herman Peitsch for sinking shafts in quicksands and other difficult ground was given in these columns in April last. The process has been successfully applied in sinking a shaft for the Chapin Mining Company at the Iron Mountain mines in Michigan. In this case, so thoroughly and effectively was the freezing done that, although the shaft was finished some two months ago, the earth surrounding it is still frozen solid in places.

The following description of the difficulties overcome and the methods employed in sinking the shaft mentioned is furnished us by the Peitsch-SooySmith Freezing Company of this city, who control the patents covering the process in this country.

A shaft fifteen and a half by sixteen and a half feet was to be excavated through quicksand to a ledge about a hundred feet below the surface. The mining company put the freezing pipes into the ground three feet apart, in a circle twenty-nine feet in diameter, and, with the exception of two of the pipes, down to the ledge. This proved to be a difficult task on account of the many boulders encountered. A ten-inch casing pipe with flush joints was first drilled down by various means, a drill being worked within the pipe when necessary and the material removed by jetting or by a sand pump. The casing pipe being once down to the ledge, a freezing pipe was placed inside, and the outer casing pipe drawn up and used for the next pipe. The freezing pipes left in the ground were eight inches in diameter, the lower ends being closed. Inside of these eight-inch pipes were placed pipes one and a half inches in diameter, open at the bottom. These inner pipes, as well as the outer pipes, were connected together at the top of the ground, as shown in the pipes at the left of the illustration, forming a complete circuit, through which a cold brine was circulated.

The brine used was a solution containing about twenty-five per cent of calcium chloride, which has a very low freezing point. The brine was cooled with an ice machine, having a refrigerating capacity of fifty tons of ice per day. The ammonia was compressed to about 135 pounds per square inch, and cooled by passing through coils immersed in water kept cold by pumping from a brook. Then the ammonia was allowed to expand through coils immersed in the brine and finally returned to the compressor.

The temperature of the expanded ammonia was such as to cool the brine to a few degrees below zero, Fahrenheit. This brine,

being circulated through the ground pipes, was raised in temperature about 2° F. After forty days' freezing, an ice wall ten feet thick was formed around the shaft. The excavation, commenced soon after starting the ice machine, had in the meantime reached a depth of forty feet. Thirty days more sufficed to reach the ledge. The shaft was, for convenience, curved as the excavation proceeded. This was, however, not necessary, as the walls would have stood vertically throughout the whole depth very well. The temperature of the air within the shaft was generally below the freezing point, and there was no indication of the exposed material thawing. The curbing was made of horizontal sets of timbers, sixteen inches square, placed two feet apart, with four-inch vertical plank behind the timbers. The cross walls were put in place afterwards.

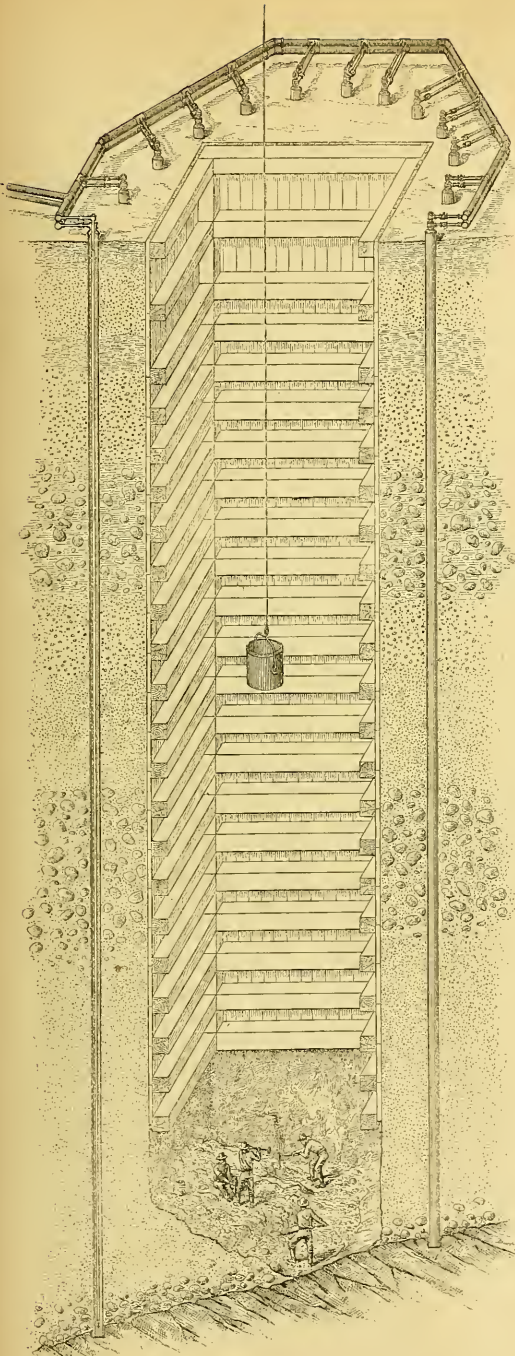
The timbering was supported from one set to another by bolts placed near the corners of the shaft, the whole system being suspended from cross timbers at the surface of the ground. The unfrozen area within the shaft grew less as the actual running time of the freezing machine increased. By the time a stratum of boulders was encountered, the frozen area reached nearly across the shaft; but when quicksand containing a large percentage of water was passed through, the unfrozen area was greater. The reason of this is readily understood when it is remembered that the specific heat of water is about five times as great as that of any of the other materials, and therefore the strata containing most water would require more cold and would be longer in freezing.

The hardness and appearance of the fractures of the frozen quicksand approached those of sandstone. Granite boulders embedded in it showed a decided tendency to fracture across rather than break loose. The tensile strength of the frozen ground, as determined by a cement-testing machine, was equal to that of the best neat Portland cement, and varied from 350 to 450 pounds per square inch, and its strength against crushing, as determined from inch square cubes, was 850 pounds per square inch. This furnishes data from which the strength of the surrounding frozen wall may be computed as an arch. An ice wall ten feet thick will be found sufficiently strong for any case likely to occur. Near the bottom the freezing extended within the circle solidly ten feet from the pipes. It is not known how far it extended outside, as no borings could be made through it. A test pit was sunk outside the shaft as far as the water would permit (some fifteen feet), and from this it appeared that the freezing extended outwardly from the pipes about three-fourths as far as within the circle.

The material was mostly loosened by picks and chisel bars. Powder was used for blasting for a considerable time, but this was discontinued for fear the concussion might injure the pipes or fracture the wall. The material was hoisted out by an iron bucket, which also took out the water that stood in the unfrozen centre. There was no appreciable inflow of water until the excavation had reached nearly to the ledge, when a small amount was noticed.

On reaching the ledge, it was discovered that it was so fissured and disintegrated as to allow water to come in under the frozen wall at a corner in the vicinity of one of the pipes that did not extend to the ledge. The shaft was allowed to flood, water being pumped into it at the same time to prevent as much as possible the flow of water through the opening. An eight-inch freezing pipe was put in place in the shaft, the foot being directly at the opening, and earth was piled around it, the purpose being to freeze the leak off. Then cold brine was circulated through the whole system of freezing pipes for ten days uninterruptedly, when the water was pumped out, and the seam was found to be quite closed; but there was still a small amount of percolation through the ledge, requiring occasional pumping to clear the shaft; ice had collected several inches thick on the side shaft, and several feet in the corner, where the extra freezing pipe was placed.

The work of removing the earth which had been thrown in and the clearing up of the bottom continued for two weeks, when the water from the ledge increased at such a rate that it was decided to lay short auxiliary freezing pipes against the leaks and freeze the ledge itself. This was done, the shaft was flooded again, and the brine circulated thirty days. When the water was pumped out, the leakage was found to be small, and excavation was proceeded with. The soft, shaly rock was removed till a hard bear-



POETSCH FREEZING PROCESS, IN SHAFT SINKING, AS APPLIED AT THE CHAPIN MINE.

ing was obtained for the timbers, and the timbering was completed from the surface of the ground to the excavated depth.

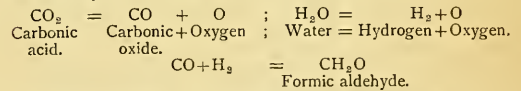
The obvious remedy for inflow from the rock will be in the future to put the pipes far enough into the ledge to freeze off the surface seams. Pipes are now being put down for a coal mining shaft at Wyoming, Pa., and they will be put several feet into the rock, which will no doubt intercept all troublesome percolation.

This operation of this process was the first application on any considerable scale in the United States. Water is the engineer's most troublesome enemy, and its conversion into a barrier of defence is a triumph of engineering as effective as it is novel. This process can be applied to excavations for bridge piers, to tunnels, and to other general work of a difficult and expensive character as well as to shafts. But in shaft work alone it should be invaluable, as by it numerous valuable deposits of coal and other minerals, now inaccessible on account of overlying strata of water-bearing materials, can be reached, as in the case of the Chapin mines, and in those Belgian coal mines which first led Mr. Poetsch to devise his process.

THE PRODUCTION OF SUGAR.

YESTERDAY the formation of sugar by plants, says Ward Coldridge, in *Knowledge*, was one of the mysteries of nature. Chemists and botanists, while they knew that ordinary chemical attractions must be the cause, were yet completely in the dark as to how these forces worked. They realized that plants started with carbonic acid and water, and from these waste products of animal existence built up in some unknown way the complex compound, sugar. From the deadly choke-damp to the luxury sugar was a great transformation. The plants could thus build, but men of science could not comprehend the process.

To-day, as the result of some brilliant researches, the explanation has been found. A simple compound, the formation of which by the plant can be readily accounted for, has been transformed into a sugar. To understand the process, it must be realized that abundant evidence proves that plants promote processes which are the opposites of combustion or oxidation. Plants liberate oxygen from its compounds, and absorb that with which it was previously combined. They can liberate oxygen from so stable a compound as carbonic acid, and in water find a source for the hydrogen which is essential to their development. The products which could thus be formed are, respectively, from carbonic acid, the lower oxide of carbon and oxygen; from water, the gases hydrogen and oxygen. Experiments have shown that under the influence of the silent electric discharge, and even without it, carbon monoxide and hydrogen combine to form a simple compound, formic aldehyde, which is immediately connected with the formic acid of the ant and of the stinging-nettle. So the changes which occur in the plant under the combined influence of sunlight and chlorophyl may be represented in symbols as follows:—



This formic aldehyde was the substance experimented on. When it was suitably treated in the presence of the hydrate of lime, Ca (HO)₂, it was induced to combine with itself and to form another compound. The latter is composed of the same ultimate indivisible particles (atoms) and in the same proportions; but they are now differently arranged side by side, and with a larger number in the unit aggregation which chemists call molecules. This compound has now been finally proved to contain not one, but at least two or three members of the family of substances, carbohydrates, to which sugar belongs. Thus in our laboratories can now be imitated the process of which plants previously held the secret.

While, however, the fact is marvellous that a sugar has been obtained artificially, it must be remembered that the process is absolutely uneconomical, for the yield is very small. This remark, too, applies to another process of artificial production. The sweet viscid liquid, glycerin, and its stinking, irritating offspring, acrolein, which gives the nasty smell of burning fat, have both been transformed into sugar; but the quantity obtained is very small in pro-

portion to the glycerin or acrolein used. The importance of these researches lies in the fact that they show how the chemical changes which characterize the vital action of the plant can be imitated with dead matter, and that, further, they shed a bright gleam of light on the hitherto obscure question of the arrangement of the indivisible particles, atoms, within the compound particles, the molecules of these substances.

Our supply of sugar will always be drawn from the vegetable kingdom, the synthetic laboratory of nature. Many plants work hard and economically at the production of sugar, and form it in quantity. It occurs in all parts of plants, — root, stem, leaves, flower, fruit, and seed. In some grasses it is very abundant, in the sugar-cane, in the sorgho grass, and in the young shoots of the maize. In the common carrot and parsnip, and especially in the fleshy beet, large quantities are contained. But for its commercial extraction two sources are chiefly used — the sugar-cane and the beet-root, and a third is of growing importance, the sorgho grass.

The sugar-cane has far greater natural advantages than the beet-root. At one time the former held the field without a rival. But during the Napoleonic wars, France was deprived of her supply of sugar, and she was driven to produce her sugar at home. This resulted in the commencement of the beet-sugar industry, and thus amongst the secondary results of war must be reckoned bounty-fed sugar. To judge of the economic aspects of the two industries, many factors have to be taken into account. When that has been done, this balance will be found distinctly in favor of the cane. Sugar-canes contain sufficient sugar to yield seventy to eighty per cent of their weight of juice, in which there is some twenty per cent of sugar. Beet-roots, as an extended series of investigations have shown, possess a percentage of sugar varying from seven to a maximum of under fourteen, and on the average about eleven. Now an acre of land which can be used for beet-growing will be rented for, say, £4 per annum, while in the colonies an equal area of cane-producing land will be rented for about one-tenth of that amount.

Further, a great divergence is found in the quantity of beet and cane which two equal areas can grow. For instance, in the environs of Magdeburg, an acre will yield about ten hundred-weight of sugar; whereas, in the home of the sugar-cane, some forty to fifty hundred-weight can be obtained. Then other items in the cost of production have to be considered; the difference in wages in the two regions, the difference in the cost of fuel, — in Europe where coal is necessary, in the colonies where the waste matter of the cane supplies the whole, or nearly the whole, of the fuel required. One can thus realize the grounds on which the Brazilian commission on the sugar industry reported, that, in their opinion, "the cost of production may be reduced in Brazil to such a degree as to defy competition, and the struggle between cane and beet-root must become ominous to the latter, which thrives only by the artificial advantages which European countries have devised."

Hitherto the artificial advantages have been on the side of the European countries; but now the greatly improved means of transit, and the diffusion of knowledge, are raising the colonists to a position nearer equality in these respects, of course excluding bounties. And by this time the colonial sugar planter has learned a severe lesson. He understands that, while nature has showered her gifts on him with a lavish hand, she mercilessly punishes him for carelessness and lack of promptitude. For if he cuts his canes, they must within a few hours be crushed and extracted; if he is negligent, and leaves them for only two days, fermentation rapidly ensues under the conditions of tropical temperature, and the canes turn sour and must be thrown aside for fuel. In this way nature has fined men whole fortunes.

FATTENING LAMBS.

At the Cornell Agricultural Experiment Station some experiments have been carried out recently on the effect of different rations on fattening lambs, under the direction of Professors J. P. Roberts and Henry H. Wing. These experiments were, in the main, a continuation of those carried on at this station one year ago, and very nearly the same foods were used, none of them being out of the reach of the general mass of farmers.

The period of feeding lasted five full months, from November 25, 1888, to April 25, 1889. The lambs, twelve in number, were selected from a lot that had been picked up in the surrounding country for shipment. They were coarse wool grades, Shropshire or Southdown, dropped late the previous spring, and had evidently been scantily fed during the summer. They were not such animals as would have been selected to give the best financial results, but being thin in flesh and fairly uniform, were well adapted to the purposes of the experiment. The twelve were closely shorn, and then divided into four lots of three each, in such a manner as to have as nearly as possible an equal weight in each lot. Three lambs were used in each lot, so that if for any reason there should be an accident to one there might be two left at the end, from which to gather data in regard to the effects of the rations.

The lots were numbered respectively III, IV, V, and VI, and each lamb was labelled with a separate numbered ear-tag, so that data in regard to increase in weight, etc., could be collected individually and by lots. The experiment progressed satisfactorily from beginning to end, with but two exceptions.

Lot III was fed what may be called a carbonaceous ration. The lambs were given all the timothy hay and whole corn they would readily eat, and in addition about a half pound of roots each per day. Turnips were fed as long as the supply lasted, after that mangels were used.

Lot IV was fed a nitrogenous ration, although it was not so excessively rich in nitrogen as that used by some experimenters in trials of this kind. The grain ration was made up of two parts wheat bran and one part cotton-seed meal. A pound per day per lamb of this mixture was fed at first; afterward it was somewhat increased or diminished, as the needs of the case required, the object being to feed about all that would be readily eaten. This lot received clover hay instead of timothy, and roots, as lot III.

Lot V was fed an intermediate ration. The grain part was composed of three parts corn and one part each of wheat bran and cotton seed meal. It was eaten in about the same quantity as lot IV. Timothy hay was used for this lot, and roots were fed as in each of the others. Lot VI was fed the same as lot V, except that they received no roots at all.

The lambs had access to water the whole time. In the winter it was warmed to about 80° before being offered them. The weight was obtained in the following manner. A pail of water was weighed and placed in the pen, where it remained till the next morning, the sheep drinking whenever they wished. Each morning the pail, with whatever water remained in it, was weighed back, the difference in weight being the amount consumed. A fresh pailful was then weighed out, and the process repeated. This was kept up during the whole course of the experiment. The water was warmed when it was first put in, and during the cold weather the lambs soon learned to take nearly all their water as soon as fresh water was given them. From the first a marked difference was seen in the amount of water consumed by the different lots, and this difference continued through the whole course of the experiment. The total amount of water drank was as follows: Lot III drank 308 pounds, or 1.03 pounds per lamb per day; lot IV drank 1,185 pounds, or 3.95 pounds per lamb per day; lot V, 735 pounds, or 2.45 per lamb per day; lot VI, 847 pounds, or 2.82 per lamb per day.

The very much larger quantity of water consumed by the lambs fed a highly nitrogenous ration is at once apparent. It will be seen that lot IV drank nearly four times as much as lot III (fed carbonaceous food), and about 60 per cent more than lot V. These three lots were all fed roots in equal kind and quantity, so that it would seem that the different amounts of water consumed must be due to the nitrogen in the ration.

Lots V and VI were fed on the same ration, except that lot VI had no roots. Probably for this reason they drank about 15 per cent more water. The lambs fed on nitrogenous food, or lot IV, made much the largest average gain, and those fed on carbonaceous food, lot III, made the smallest gain, though not very much smaller than lot VI. Animal individuality, a very perplexing consideration in all work of this kind, showed its influence very strongly.

Notwithstanding the gain in live weight was very markedly in

favor of the lambs fed on nitrogenous food, it is when we come to compare the amount of gain in relation to the amount and cost of the food consumed that the most striking figures are brought out. Both in the amount of food consumed for one pound of gain, and the cost of gain per one hundred pounds, the advantage is very markedly in favor of lot IV, the lot fed on nitrogenous food. It costs a little more than a cent and a half per pound, or twenty-six per cent more to put a pound of gain upon the lambs that were fed on corn, timothy hay, and roots than it did to put a pound of gain on those that were fed wheat bran, cotton-seed meal, clover hay, and roots.

The lambs were shorn Nov. 15, or ten days before the beginning of the experiment. They were shorn again the day before they were slaughtered, so that the wool obtained was the growth of 160 days. The weight of the wool from both lambs in each lot was, lot III, 4.25 pounds; lot IV, 7.31 pounds; lot V, 6.63 pounds; lot VI, 6.19 pounds;—the last three lots showing an increase over lot III of 72, 56, and 46 per cent respectively. This coincides with the results of the experiments last year, in that nitrogenous food seems to largely affect the growth of wool. It seems to show further that even a small increase in the nitrogenous matter of a ration has a decided influence on the growth of the wool, for lots V and VI, whose ration was intermediate in character, gave very nearly as much wool as lot IV. In the experiments of 1888, already referred to, the percentage was not so great in favor of the lambs fed on nitrogenous food.

The lambs were slaughtered on April 25. The blood was carefully caught in a clean pail, and it and all the important internal organs were weighed. The carcasses were hung up in a cool place to stiffen for two days, and were then cut up, and the parts carefully examined. Before they were taken down, however, they were weighed and most carefully inspected by the different members of the staff. The most striking difference that was apparent, as the carcasses hung upon the hooks, and after they were cut up, was the evident leanness of the two belonging to lot IV, which had been fed nitrogenous food. The kidneys were not covered, and there was very little loose fat next the skin, while in all the other carcasses the kidneys were more or less completely covered, and there was a layer of tallow of greater or lesser thickness between the skin and body. The carcasses of lot III had the most of this tallow. The same thing is shown in the amount of caul fat and kidney fat. While an expert butcher would have undoubtedly selected the carcasses of lots V and VI as furnishing the most saleable mutton, the carcasses of lot IV had little or no unpalatable adipose matter, and those of lot III showed much the largest percentage of waste fatty matter about the root of the tail and in the flanks.

The weight of evidence of all of the experiments at Cornell, together with results obtained by other experimenters in the same field, seems to show: that corn, as an exclusive grain ration, does not give the best results, either in amount, quality or economy of production, when fed to growing or fattening animals; that the amount of water drank, especially in the case of these lambs, is a pretty certain indication of the rate of gain; and that the production of wool is very greatly dependent upon the nitrogen in the ration.

The value of the manure made from the animals fed is a matter of prime importance, to all eastern farmers at least. And often the manure left on the farm represents a large part, if not the whole, of the profit made from feeding a lot of animals. For this reason there were calculated the manurial value of the rations fed the different lots. From this it appeared that while the first cost of the ration of the nitrogenous fed sheep was larger than that of the carbonaceous, yet when the value of the manure is subtracted, the cost of the former is less than half of the latter.

PEARL OYSTERS.

THE presence of nodules or tubercles on the interior surface of the shells or valves of lamellibranch (bivalve) mollusks is of frequent occurrence. These excrescences are nacreous or otherwise, according to the character in this respect of the shell in which or upon which they occur. They are found alike in fresh-water and marine species. In the pond and river mussels they are chiefly due to interior causes; in marine forms, like the cockles, mussels, the

scallops, etc., these formations are generally traceable to exterior causes. It is often the case that specimens of the large scallop of the New England coast are so burrowed into by a species of sponge that nearly the entire inside surface of the valves will be roughened with sharp, thickly-set pustule. In all the marine species in which those nodules occur it will usually be found that the substance of the shell has been bored into from the outside by either a species of pholad or lithodomus.

Neither of these forms are, properly speaking, either parasites or commensals. They are, more definitely, "domiciliares," as stated by Mr. Robert E. C. Stearns of the Smithsonian Institution, and excavate their burrows, not for the purpose of getting at the softer parts of the mollusk upon whose shell they have "squatted" in order to use said softer parts as food, but solely for the purpose of a residence or domicile.

The burrows of these shell-boring pholads and lithodomi are at first quite small, increasing in size in the same ratio as the burrower increases in age or in growth. After a while the depth of the boring is equal to the thickness of the shell in which it has been made, and the occupant of the latter, in order to keep his own shell intact and maintain the integrity of his own domicile, commences depositing layer upon layer of nacreous or porcellaneous matter, as the case may be. In keeping pace with the continued encroachments of the domiciliary squatter upon the outside, this deposit finally becomes a more or less conspicuous protuberance.

Sometimes these nodules or tubercles are due to some foreign inorganic matter, a particle getting in between the mantle of the mollusk and the inner surface of its shell. In such cases it, we may say, at once plastered over, and thus fixed upon the surface of the valve. Free concretions, i.e., unattached or non-adherent nodules, are, as is well understood, caused by some particle, organic or inorganic, becoming in some way lodged exclusively in the soft parts of the body of the mollusk, and so far away from the surface of the shell as not to admit of its being cemented to it.

No doubt many of the mollusca, both gastropod and lamellibranch, contain or are inhabited by true parasites. In certain species of fresh-water mussels a species of water mite has been detected, and sometimes thread worms and other forms occur.

A small species of crab, an epicurean no doubt, finds a salubrious habitation in the common oyster, but parasites of any considerable size appear to be rather rare. Besides the species above referred to, another small crab is sometimes found in the common mussel and the large scallop before mentioned. It is doubtful, however, whether these crabs are really parasites or only commensals, though probably the former.

There is, however, evidence of the occurrence of fishes of two species as parasites in the true pearl oyster, or mother-of-pearl shell, not by the presence of the living fish, or even by dead specimens of "fish in the flesh," if we may use so convenient a paradox, but by their entombed remains in the form of nacreous nodulae or tubercles on the shells or valves of the said mollusk.

At a meeting of the Zoological Society of London June 1, 1886, Dr. Günther exhibited a specimen of a small fish of the genus *fierrasfer* embedded in a pearl oyster, and said: "This specimen is an old shell, in which there is imbedded, behind the impression of the attractor muscle, a perfect individual of a fish belonging to the genus *fierrasfer*. The fish is covered by a thin layer of pearl substance, through which not only the general outlines of the body but even the eye and the mouth can be seen. The parasitic habits of *fierrasfer* are well known. The fish, instead of introducing itself into the cavity between the two halves of the mantle, penetrated between the mantle and the shell, causing irritation to the mollusk, which the latter resented by immediately secreting the substance with which the intruder is now covered. It is remarkable to note that the secretion must have taken place in a very short time, at any rate before the fish could be destroyed by decomposition."

After entering the shell, which of course must be at such time as the valves are partially open or gaping, these fishes find no obstruction to their course as they push their way towards the interior between the mantle and the smooth inner surface of the valves until they approach the adductor muscle, and here they find a barrier which most likely causes them to expend somewhat greater ac-

tivity or energy, and consequently in a correspondingly increased degree disturb the serenity if not the structural economy of the oyster.

Having reached thus far, the invader is in the immediate vicinity of, if not the seat of intellect, the centre of sensitiveness. The deposit of nacre in such instances must be very rapid; and it is quite possible that the unwelcome explorer is not only enshrouded and entombed in pearl, but previously drowned in a pearly flood, for it may be reasonably presumed that the annoyance caused by its presence must be exceedingly great, and likely to induce a copious flow of nacreous lymph at the point and in the region of greatest irritation. It is evident that the deposition and induration are sufficiently rapid to inclose the parasite before decomposition has taken place.

THE WORLD'S FAIR OF 1892.

AMONG those who have volunteered suggestions as to the scope of the exhibition to be held in 1892, is Mr. Edward Atkinson. Although it may be said that Mr. Atkinson overlooks the main cause for the holding of such an exhibition, which is that it serves merchants and manufacturers with a good means of advertising, yet as his letter contains so many good suggestions likely to improve the tone of the exhibition we quote literally from it. Mr. Atkinson writes:—

I have watched with some interest the course of the discussion on the exhibition proposed for 1892. I have had a little experience in such matters, and have given some thought to the subject. . . . It seems to me that the day has gone by for a great world's fair or bazaar, in which all kinds of goods and wares may be displayed, largely for purposes of advertising them, without much system or method and without any distinctive purpose in the general scope or plan of the exhibition, except to make a great show. Any one who desires to study or observe such goods and wares can find a better exhibition in the shop windows than has ever yet been put together in a world's fair or bazaar. Such fairs are cumbersome, costly, tiresome, and unsatisfactory. The time was when they were novel, interesting, instructive, and useful. The diplomas are, as a rule, of little or no value. I exhausted the dictionary at the Centennial of 1876 in trying to vary the diplomas which we gave substantially to every one who made an exhibit in our group, and the few who were refused afterwards appealed to the higher powers, and obtained their diploma or certificate of excellence. . . . There was, however, one conspicuous exception in the Centennial to the generally commonplace character or want of distinct purpose in the method of exhibiting. The Kansas and Colorado exhibit of natural products and resources laid the foundation of the progress of agriculture and mining in that section.

When I was called upon to advise how the exhibition at Atlanta should be laid out and directed, my first conception was to bring together every thing that could be exhibited or made known in regard to cotton, not only in respect to the fibre but in respect to the seed and the plant. Presently it became apparent to me that such an exhibition would tend more and more to the concentration of Southern efforts upon cotton only and would stand in the way of the diversity of industry which that special section especially needed; I therefore conceived the plan of imitating the Kansas and Colorado exhibit, and advised the directors to interest the Southern railroads, the owners of land, and the owners of mining property in bringing together that wonderful collection of timber, minerals, and the products of the soil which really formed the most important part of the so-called Cotton Exposition. . . . When such men as the Inmans and others assure me that the effect of that exhibition and the carrying out of that specific suggestion made the real starting-point in the progress of the South in all the arts which are now gaining so rapidly, and made known to the Southerners themselves, as a body, the magnitude of their own resources, which had hardly been conceived even by the few, I can no longer resist the conclusion that mine was a happy thought, and that I did contribute in considerable measure to the progress and prosperity of the Southern States. Of course, in the nature of the case, the progress would ultimately have been made, but the great and early start is dated from the Atlanta Exposition.

The motive of the exhibition in 1892 is that the year recalls the

date of the discovery of America by Europeans four hundred years ago. Ought not the motive of such an exhibition to be the progress in human welfare in four hundred years, through the application of science and invention to the pursuits of peace? Ought not such an exhibition to illustrate the interdependence of nations, the growth of commerce, and of modern industry,—prophetic of the time when war shall be forbidden at the command of commerce? Four hundred years ago the invention of gunpowder had only begun to promote equality in the conditions of men; it had only begun to make the power of the serf equal to that of the seignior; it had only begun to do away with the dominion of privilege, and to establish the dominion of human rights; it had only begun to alter the relations of men in the exchange of services from distribution according to status to distribution according to contract. The invention of printing had only begun to diffuse intelligence; it had only begun to make possible and to establish a system of common law; it had only begun to make known to the poor and feeble that He who created the world ruled all things well and recognized no difference among men because of race, birth, condition, or color. The long struggle for equal rights, first taking the form of resistance to superstition, and of wars waged nominally on religious grounds, was soon converted into a system of war waged by nations in order that the so-called civilized nations of Europe might each on its own behalf dominate sections of the new world, and control by force and by colonization the commerce of the continents or of parts of continents secured by war for the sole benefit of the European countries, each for itself, by whom this dominion had been gained.

It is only within the last century of the four, or only since the physiocrats of France first entered upon the study of the relation of men to each other, and since the publication of the "Wealth of Nations," by Adam Smith in 1776, that the true function of trade and commerce has begun to be conceived among civilized men. Even at the present time the continent of Europe, which, if we separate the uninhabited portions of Norway, Sweden, and Russia, is about equal in area to the area of the United States, omitting Alaska, is divided up into substantially nineteen separate empires or States, each cut off from the other by barriers to mutual service and restrictions upon their traffic, at which barriers taxes are levied upon commerce; the avails of such taxes being more than expended in the support of armies and navies which, except for these barriers to mutual service, would not be required. Witness on the other hand, the growth and progress of this nation. The freedom from obstruction to mutual service among its citizens which was established in our organic law, in that provision of the Constitution which forbids any interference with commerce between the States, is without question the rule to which we owe more than to anything else, the preservation of the Union and the freedom from the blood tax, as well as the money tax of a standing army.

My ideas run away with me in trying to give my conception of what the exhibition of 1892 might be. My conception is yet somewhat vague. My general idea is that either by way of examples, of pictures, of graphic illustrations, and of figures, one and all combined, so far as may be, the exhibition should show the progress of modern art and industry from the pre-historic type, or from the type of 1492, down to the present day.

For instance, the art of weaving is older than history. The pre-historic loom was the same as the loom on which nine-tenths of the material for clothing the people of China is now woven—the same as the hand-loom which even to-day is in operation in the southern mountain valleys of "the land of the sky," in Kentucky, in Tennessee, and in the Carolinas—the same as the hand-loom on which the French *habitans* of Lower Canada still choose to make the fabrics with which they are clothed. It would be easily possible to give the examples in action of the whole art of weaving within the limits of a small section of a great exhibition building, the Chinese, African, South American, homespun American, and the modern, all in contrast; the Arab weaving shawls, the Daghestan carpets, the Navajo Indian blankets, etc., on the walls of which section could be pictured geographically the relative demand and supply of the different sections of the globe for the products of the loom.

The art of spinning could be illustrated in the same way; . . .

and the same conception might be adopted with respect to the art of milling, preparing grain, and making bread.

It is sometimes affirmed that there is no science of political economy. Such an exhibition as I have sketched in this somewhat visionary way would show in a concrete form the very object-lessons with which the political economy must deal; and I think one would soon predicate on the record of the past four centuries the possibilities of the next, yet it has only been within the last century that covers the existence of this nation that the chief part of this progress has been made. This has been the century in which an abundance of metals, which lie at the foundation of all arts, have been placed at the disposal of the science of metallurgy. It has been the century in which heat has been converted into power by methods which are even yet crude and imperfect; it has been the century in which time and distance have ceased in a great measure to obstruct the mutual services on which human welfare depends. We stand at the beginning of the century in which known agencies or new directions of energy—new inventions of which we can only dimly perceive and forecast in the future—will alter, change, and ameliorate the conditions of men in even greater measure than the inventions of the past, the only conditions precedent and necessary to such progress in welfare being that there shall be commensurate progress in the general intelligence of the people, especially of those who are chosen to legislate for them, equal in its measure to the progress in the arts.

Therefore the final objective point of this proposed exhibition of 1892 might well be to make it an object-lesson illustrating the interdependence of men and of nations, and their power to serve each other, in all the arts of peace which make for plenty. . . . It goes without saying that if any such comprehensive plan should be undertaken, a specific call would be made upon each State to make an exhibit of its power of serving others, by bringing together its minerals, its timbers, and the products of its soil and its forests, in a thoroughly systematic way,—after the manner of the exhibits of Kansas and Colorado in the Centennial, and after the manner of the exhibits of the Southern minerals and timber at Atlanta.

ELECTRICAL NEWS.

ATMOSPHERIC ELECTRICITY. — A study of the electric phenomena produced by solar radiations was presented at a meeting of the French Academy on Aug. 5 by M. Albert Nodon. Numerous observations made at the laboratories of the Sorbonne and the Collège de France show that on meeting an insulated metallic or carbon conductor the solar rays communicate to it a positive electric charge; that the amplitude of this charge increases with the intensity of the rays and decreases with the hygrometric state of the air, the phenomenon attaining its maximum value in Paris about 1 P.M. in summer, when the atmosphere is pure and dry; lastly, that the effects cease during the transit of clouds across the face of the sun. If these results can be extended to non-metallic bodies, then solar radiation may be regarded as one of the causes of the electrification of the clouds.

A NEW LAMP. — M. Henri Pieper, of Liège, has just invented a new incandescent lamp of very simple construction. It consists of two horizontal rods of copper placed about four millimetres apart. A thin pointed rod of carbon, placed vertically, rests on the copper rods and forms a bridge between them. The current passes through the copper rods through the carbon, which it renders incandescent. The copper rods are mounted on springs, which cause them to rise slightly when the carbon is totally consumed, and bring them against two contact pieces, thus preventing the rupture of the circuit.

HEALTH MATTERS.

THE KOLA-NUT. — The value of the kola-nut (seeds of *Sterculia acuminata*) as a dietetic and therapeutic agent has been recently tested by surgeon R. H. Firth, according to the *Lancet*. These nuts are allied in composition to cocoa, coffee, and tea, but contain a relatively large amount of caffeine. The properties ordinarily assigned to kola are those of a strong tonic and stimulant to the nervous system, counteracting and removing the sense of

exhaustion after fasting and fatigue; it has also been credited with having an antagonistic action to alcohol, and it has been said to purify water. From his observations surgeon Firth concludes that kola is in no sense a food; that it increases the total urinary water with a slight reduction of its total solids, and a marked reduction of the extractive; that it has a peculiar stimulant action on the nervous system, temporarily strengthens the heart-beat, and increases the arterial tension. In times of exertion and fasting it wards off the sense of mental and physical depression and exhaustion. As a therapeutic agent in convalescence, and as an antagonist to alcoholic sequelæ, kola has not yielded any positive results in surgeon Firth's hands. For the purification of water it does not appear to be superior to other mucilaginous seeds, its action being purely mechanical. In this report due prominence is given to the importance of separating seeds which contain no caffeine, such as *Garcinia kola* and *Sterculia cordifolia*, as these would speedily discredit the employment of kola by the troops under conditions when it might possibly be of service. It appears that an infusion, from its astringent action, might be used for those suffering from diarrhœa.

NEAR-SIGHTEDNESS. — Dr. Duclaux has communicated to the Academy of Sciences, in the name of Dr. Boucheron, says the Paris correspondent of *The Medical Record*, a note relative to hereditary myopia and its treatment in adolescence. The children of myopes are not born myopes; they become so, but at an age more and more young, according as generations succeed. Thus, a grandfather who became myopic at twenty years, having a son myopic at fifteen years, they would both have a slight myopia, and would be able to read without spectacles in their old age; but their grandchildren will become myopic at twelve years, and will already have been so to a great degree. The great-grandson will be a myope at eight years, will arrive at six dioptics of myopia at fifteen years, at eight dioptics at thirty years, will lose an eye at thirty-five years, and will have great difficulty in preserving his second eye to the end of his days. It is therefore necessary that this state of things should be more rigorously attended to. Dr. Boucheron remarked that in children somewhat the same thing happens with the muscles of the eye as what occurs in writer's cramp. The child strains in writing, contracts himself, and there is produced cramp of the accommodation of the eye, and this abnormal accommodation tends to become permanent in myopic pupils. Dr. Boucheron examined one hundred lycéens, and took the measure of their myopia. He instilled atropine into their eyes, and their myopia was modified. Hence, beyond the principles of hygiene, so easy to institute, he recommends the employment, in feeble doses, of atropine, duboisine, or simply cocaine.

EAU DE COLOGNE TIPLING. — It is said that the practice of drinking cologne is becoming very common both in Europe and in this country, and, as an indication of this, that the sale of the perfume has increased greatly of late years. Women are more addicted to the habit than men, and a writer in the *Quarterly Journal of Inebriety* says that the presence of obscure and complex nervous disorders in a woman who uses cologne externally should always suggest the possibility of its internal use.

HYGIENE CONGRESS. — The Hygiene Congress at Paris brought its labors to a close on Aug. 10. Among the subjects discussed during the week was that of the pollution of rivers. The congress decided, says *Nature*, that the pollution of underground water-courses and of rivers by the residue of factories should in principle be forbidden, and that water from factories should not flow into a stream till it had been proved to be absolutely free from all injurious substances. The congress was strongly of opinion that the most perfect method of purification was by irrigation. This, of course, must, in certain cases, be preceded by such mechanical and chemical processes as would render the water fit for agricultural purposes. It was related that many manufacturers had benefited by the application of the law, as in their efforts to prevent the pollution of watercourses they had made discoveries enabling them to utilize waste products. The difficulty was with the smaller manufacturers, who were not rich enough to take the necessary measures. The congress decided that where persistent resistance was displayed

the authorities should themselves execute the works prescribed for the purification of the water, and compel the persons interested to pay the cost.

NOTES AND NEWS.

THE United States Hay Fever Association held its sixteenth annual meeting on the 27th of August, at Bethlehem, N.H.

— The Congress of Physiological Psychology held in Paris recently is considered to have been very successful. It was decided that a second meeting should be held in 1892, either in London or in Cambridge, during the month of August.

— A company has been organized in Brussels for the purpose of constructing a railway from Matadi to Stanley Falls on the Kongo. The road, as projected, will have a length of about 270 miles, and is intended to surmount the difficulties of traffic on the cataract region of the lower Kongo.

— Captain Phythian, the Superintendent of the Naval Observatory, Washington, states that the preparations for the expedition to Africa to observe the total eclipse of the sun, which occurs in December next, are being actively pushed forward. The smallness of the appropriation by Congress for this work, \$5,000, necessitates careful expenditures, and it will be impossible to send the expedition to St. Paul de Loando, where the observations will take place, except on a Government vessel. The expedition will sail about Oct. 1.

— An ancient treatise on anatomy has been unearthed at the Royal Library at Berlin. It was written in Latin in 1304, by Henry de Mondeville, professor of surgery at Paris and Montpellier, and body-surgeon to Philip le Bel. Surgeon de Mondeville was at one time on English soil as an army surgeon, and his death took place in 1318. The book has never been printed. It is valuable as throwing light upon a period concerning whose medical history there is but little known.

— A. J. Drexel, banker, of Philadelphia, proposes to purchase land, construct the necessary buildings, and provide for the maintenance of instructors and all things necessary for the establishment of an industrial institute for young men and women that will be capable of accommodating a thousand of each sex. This plan is a substitute for one proposed some time since, to establish an industrial college for girls in the country, near Philadelphia. It was found that there were several serious obstacles to such a project, and in its stead Mr. Drexel undertakes to establish and maintain this larger and more general institute. The institute will probably be modeled somewhat after the Cooper Institute of New York, and it is expected that the cost will be about a million and a half of dollars.

— A new Austrian patented process for silvering articles of iron is thus described: The article is first plunged in a pickle of hot dilute hydrochloric acid, whence it is removed to a solution of mercury nitrate, and connected with the zinc pole of a Bunsen element, gas carbon of platinum serving as the other pole. It is rapidly covered with a layer of quicksilver, when it is removed, washed, and transferred to a silver bath and silvered. By heating to 572 degrees F. the mercury is driven off, and the silver firmly fixed on the iron. To save silver the wire can be first covered with a layer of tin; 1 part of cream of tartar is dissolved in 8 parts of boiling water, and one or more tin anodes are joined with the carbon pole of a Bunsen element. The zinc pole communicates with a well-cleaned piece of copper, and the battery is made to act till enough tin has deposited on the copper, when this is taken out and the ironware put in its place. The wire thus covered with tin chemically pure and silvered is much cheaper than any other silvered metals.

— Mr. M. E. Allison of Hutchinson, Kan., in a letter to *The American Field*, says, "An experience I had lately with a quail (Bob White) was so interesting to me, I thought it might interest some of my brother sportsmen who are better acquainted with the habits of the quail than I am. In the corner of our coursing park there was a quail's nest, and it was so near to the road that when

we would be passing by it, to and from the park, the old quail would fly away, and it was always the male bird. My never seeing the female around there is what attracted my attention; and I noticed that the male was crippled in one leg, and only used one in hopping about, and appeared to be crippled otherwise. There were twelve eggs in the nest, and after ten or twelve days from the time I first noticed it the young brood all hatched, and the old male bird took them and left the nest. The female bird was never seen anywhere in that neighborhood by myself or any of the men at work there, and some of us were there every day; but we never failed to find him on the nest. I came to the conclusion that someone had killed the female while she was laying the eggs, and at the same time wounded the male; and he, knowing his companion was gone, took charge of the nest and set on the eggs, hatched them, and is now raising the little orphans on his own hook. If these are the facts, and it seems to be so, is it not a very remarkable case?"

— At a recent meeting of the Paris Geographical Society, M. G. Rolland contributed some valuable data to the discussion, recently carried on between him and M. E. Blanc, on the subject of the yield of artesian wells in north Africa. After expressing his agreement with M. Blanc regarding the fundamental principles which regulate artesian basins generally, he proceeded to controvert the latter's assertion that in the case of the Ued Rir he admitted gain in the yield of water was not in proportion to the number of new wells sunk. M. Rolland adduced a table, recently compiled by him and M. Jus, showing the number of French wells in the Ued Rir, their total output per minute, and the average output of each well for the nine years ending in June, 1889. In 1880 there were 64 wells, with a total yield of 22,865 gallons a minute, or an average of 357; in 1889 there were 127 wells, with a total yield of 44,908 gallons a minute, or an average of 354, showing that while the number of wells had doubled, the yield had very nearly doubled also. He admitted that in certain parts of the Ued Rir, notably the central part, the limit of yield had been reached. He concluded by suggesting that there should be some authority to regulate the number and position of all new wells to be sunk.

— Henry L. Bolley, assistant botanist at the Indiana Agricultural Experiment Station, Purdue University, thus sums up the results of some investigations on wheat rust recently made by him. The rusting of wheat is due to the attacks of several species of minute fungi. The disease is propagated by means of various spores, one form of which is developed upon various determined and undetermined plants, mostly weeds. This side form is not, as yet, proved to be essential to the continued life of the parasites, but its destruction decreases the danger from serious attacks of the disease. One species (*P. rubigo-vera*) in its uredo stage is able to pass the winter in the tissues of the young wheat plant. In warm weather, any conditions of the soil or atmosphere which tend to keep the wheat leaves constantly wet are conducive to the rapid spread of the disease. Low-lying, rich soils are most subject to the disease. No variety of wheat is known to be rust proof, yet some possess greater powers of resistance than others. Though not proved, an excess of nitrogen in the soil is to be considered, probably, as liable to produce wheat easily affected by rust. If fertilizers are to be applied to such lands, those containing only inorganic elements are most advantageous so far as immunity against rust is concerned. In districts liable to severe visitations of the disease, early-ripening wheats are to be preferred.

— Henry Shaw, a well-known philanthropist of St. Louis, died on Aug. 25 in that city. He was an Englishman, and at the age of nineteen years he came to this country, settling in St. Louis in 1819, where he embarked in the hardware business. After twenty years of commercial life he amassed a sufficient fortune to enable him to retire from business. He made a tour of the world, occupying about ten years in travel. On his return to St. Louis he began the study and cultivation of plants and flowers, and it was in the prosecution of these studies that the botanical gardens containing fifty acres, near Tower Grove Park, had their origin. He made the park and gardens free to the public, and now, with his death, the gardens become the property of the State of Missouri. Tower Grove Park, comprising 350 acres, becomes the property of the

city. The Shaw estate is estimated to be worth \$2,500,000, and it is thought the greater part will be left to St. Louis in various bequests.

— The Royal Danish Academy of Sciences invites research on the following among other subjects: Compounds of alcohol radicals with copper, silver, or gold, and compounds of polyvalent alcohol radicals with metals (all unknown at present): prize, a gold medal. The fatty acids in the fat of butter; to be isolated and determined, and relations indicated especially between the quantities of oleic acid and those of palmitic acid and their higher homologues: prize about \$160. The *Mycorhiza* of the beech; are they different in different kinds of humus? does the structure of the mycelium give a basis for classification? is there a reciprocal symbiosis, the fungus preparing food for the plant, etc.: prize, about \$160. Memoirs to be sent to Professor Zenthen of Copenhagen before Oct. 31, 1890, except in the last case, for which the date is Oct. 31, 1891.

— The dwarf trees which the Japanese horticulturists are showing at the Paris Exhibition are attracting much attention. Pines, tujuas, and cedars, said to be one hundred or one hundred and fifty years old, are only eighteen inches high, and with such specimens, as *Garden and Forest* says, it would be easy to have a coniferous forest on a balcony. These arboreal deformities are produced by great labor, and, if the truth is told about their ages, this work of arresting the tree's development and forcing it into contorted forms must be persisted in by several generations of foresters. All this painstaking is hardly paid for by the beauty of the resulting abortions, but, as has been suggested, a look at these trees will explain where the fantastic forms come from which serve as models for the plants we see on the lacquered trays, bronzes, and embroideries which come from Japan.

— Until recently very little was known of the fossil flora of Japan. The first systematic treatment of it is found in the work of Dr. H. T. Geyler who, in 1877, described and figured twelve species of jurassic plants collected by Dr. J. Rein in the valley of the Tetorigawa in Kaga. Three years later the same author referred to the occurrence of *Carpinus grandis Unger* in the tertiary formation of Mikawa in Honsha. This was the only literature relating to the fossil flora of Japan down to the year 1881, when for the first time, Professor A. G. Nathorst of Stockholm published a preliminary communication on more than seventy species of tertiary plants collected by Professor Nordenskiöld on his visit to Japan during the famous Vega expedition around the Asiatic continent. This work was soon followed by a more complete one, in which leaves collected by Hilgendorf are also described. The work principally treats of the young pliocene, or, perhaps, the oldest quaternary flora of Mogi, a very important group, from which the author was able to draw interesting conclusions as to the origin and climatic relations of the recent flora. In this work he also mentions twelve species of the older tertiary plants from Ezo (Hokkaido) and Honshu determined by Leo Lesquereux, but which were up to that time yet unpublished. During the last two years the Geological Survey has sent to Professor Nathorst a large collection of tertiary plants for investigation, on a part of which he has already drawn up a brief preliminary report. These were exclusively from northern and central Japan. For the most part they belonged to the older tertiary, corresponding in age to the floras of Sachalin and Alaska. Professor Nathorst mentions in this paper plants collected by Mr. Petersen at Nagasaki. About these, and the plants last sent, chiefly including those of Shikoku and Kyushu, he will write other memoirs. By the study of these fossils quite a comprehensive idea may be formed regarding the tertiary flora of Japan; but as to the mesozoic flora nothing further has been done since the publication of the work by Dr. Geyler. Since Dr. Rein's discovery of jurassic plants, the valley of the Tetorigawa has been twice visited by geologists. The first visit, a very short one, was made in 1880 by Dr. B. Koto. On his return he made a brief report, accompanied by a sketch-map of the river valley and four geological sections. The second and more extensive visit was undertaken by Mr. Tatsuog Kochibe. In 1883 the Imperial Geological Survey undertook the reconnaissance of various parts of central Japan, one of which was a region including the provinces of Kaga, Hida, Echizen, and Etchu, between the parallels of 35° and 37° north lati-

tude. The survey was conducted by Mr. T. Kochibe as geologist and Mr. K. Kodari as topographer. This survey, which lasted three months, brought back many interesting fossils, some of which, together with those formerly collected by Dr. Koto, form the subject of a paper, by Matajiro Yokoyama, recently published in the *Journal of the College of Science of the Imperial University of Japan*. As a detailed account of this survey will appear in future reports of the Geological Survey, the gentleman mentioned merely indicates briefly the general outline of the geographical and geological features of this part of Japan.

— In February of this year, the *Deutsche Heeres-Zeitung* gave some interesting particulars of the new, almost smokeless powders which are being made by the united Rhine and Westphalian factories. With a 0.5-centimetre Krupp gun, 35 calibres long, an initial velocity of 527 metres was given to a projectile of 18 kilograms, with 3.9 kilograms of the powder, under a pressure of 1,955 atmospheres. It is now reported that, at a subsequent trial with the same gun, a projectile of 18.15 kilograms received an initial velocity of 542 metres, with a pressure of only 1,942 atmospheres, 4 kilograms of the powder being used, while, when the charge was increased to 4.5 kilograms the velocity was 586 metres, and the average pressure 2,300 atmospheres. The following are the results with another variety of the same large-grain powder. With a 12-centimetre gun and projectile of 26.2 kilograms: Charge, 5 kilograms; velocity, 472 metres; pressure, 1,240 atmospheres. Charge, 7.5 kilograms; velocity, 621 metres; pressure, 2,270 atmospheres. Gun of 13 centimetres, and projectile of between 30.01 and 30.27 kilograms: Charge, 5.5 kilograms; velocity, 512 metres; pressure, 1,340 atmospheres: Charge, 6.5 kilograms; velocity, 625 metres; pressure, 2,010 atmospheres. Gun of 15 centimetres, and projectile of 51.5 kilograms: Charge, 10 kilograms; velocity, 501 metres; pressure, 1,630 atmospheres. Charge, 14 kilograms; velocity, 617 metres; pressure, 2,550 atmospheres.

— In summing up the Maybrick case, Justice Stephen's remarks were rather severe upon expert testimony, medical and other. He warned the jury about the uncertainty of medical science, or rather art, and reminded them of the old saying which described a doctor as "a man who passed his time in putting drugs of which he knew little into a body of which he knew less." He also had a fling at the experts in other fields who appear before parliamentary committees and the like. He said a man going on the stand, and "calling himself this, that, or the other, by no means qualified him to receive unhesitating belief." "A great deal of what he might call scum had to be taken off the testimony of skilled witnesses, for — of course, probably insensibly to themselves — they were apt to become advocates rather than witnesses."

— Some new light on the subject of indirect vision, i.e., vision with the lateral parts of the retina, is thrown by recent experiments made by Kirschmann, and reported in *Nature*. The common idea that the sensitiveness of the retina diminishes outwards to the periphery appears to be incorrect. There is an objective diminution of light-action when a source of light is moved away laterally from the middle of the field of vision, for the mass of penetrating light gets less. Hence, were the diminishing sensitiveness a fact, a luminous surface should seem to lose brightness when moved to the side; but it does not, though it appears less distinct in outline and modified in color. Kirschmann placed two rotatory disks made up of moveable black and white sectors, giving any degree of brightness, before the observer; who shut one eye, and looked at the middle of one disk, about a metre and a half from him, while he gave his attention to comparing the brightness of the second disk, seen at different angles, by indirect vision. The figures from numerous experiments prove that in the horizontal meridian the sensibility to brightness has a maximum at 22° to 25° from the centre, while in the vertical direction the maximum is at 12° to 15°. The growth of sensibility is much greater in the horizontal than in the vertical direction, and the upper part of the retina is superior in this respect to the lower. This corresponds to the needs of vision. Indirect vision with lateral parts of the retina is more important than that with the upper and lower regions, and the upper half is more important than the lower.

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ON MONDAY OF THIS WEEK the executive branch of the committee on site and buildings for the World's Fair held its first meeting in the committee rooms in the *Times* building. The members present were Charles A. Dana, chairman; John Foord, secretary; ex-Mayor Grace, Henry R. Towne, Isidor Straus, Samuel Gompers, C. F. Chandler, and John H. Starin. On motion of Mr. Towne it was resolved that Central Park, as a site for the fair, be excluded from immediate consideration. It was also decided to lay aside, for the present at least, all suggestions in regard to sites not on or near Manhattan Island, and to divide the water front and inland site propositions into two groups for separate consideration. Accordingly the secretary was requested to organize two excursions for a personal inspection by the committee of all the sites deemed worthy of examination. The first trip was on the water, starting from the foot of East Thirty-second Street at 12 o'clock Wednesday, Mr. Starin supplying the steamer. As Randall's, Blackwell's, and Ward's Islans have been suggested for consideration, the committee decided to invite the presidents of the board of charities and correction and the board of emigration to join the excursion party. The trip was continued up to Pelham Bay Park and other available water-front plots. The second excursion was fixed for Thursday, but the hour and place were left open. The New-York Central Railroad Company has offered a special car for the use of the committee on its inland trip, which will probably be largely devoted to

the annexed district. Whatever conclusions the committee reach will be reported to the main committee for approval or rejection. While the committee was in session Mr. Erastus Wiman called to recommend certain sites on Staten Island. The committee spent considerable time in looking over the scores of suggestions as to sites. The work of sorting was not an easy task, but the sifting process resulted in a list of a dozen or twenty.

IT IS ONE of the self-evident truths that the grounds of neat and painstaking farmers and gardeners should not be permitted to become annually seeded with weeds from the lands of their more slovenly neighbors. It seems that in Wisconsin there is on the statute books a law intended to prevent this injustice, and which needs only to be enforced to accomplish much good. This law does not, as is pointed out in a recent bulletin of the agricultural station of the University of Wisconsin, demand the destruction of all pernicious weeds, but it is aimed at the principal offenders, and if these can be kept under subjection by its means, the damages from these pests on the farm will be materially reduced. It is a matter of interest that all the weeds condemned in the law were introduced into this country from Europe. There are, it is true, native species of the cocklebur, but Dr. Gray believes that the one that has become a troublesome weed, and has very justly been included in the weed law, is not native, but has been naturalized here. The fact that these troublesome weeds have invaded our country from other continents, and, despite the efforts that have been put forth for their destruction, have spread themselves over so many of our farms, illustrates how great is their power to cope with conditions, and emphasizes the importance of vigorous concerted action to keep them under subjection.

MR. WALLACE ON DARWINISM.¹

TO ALL who have read the life and letters of the late Mr. Darwin it must appear that, over and above the personal and scientific interest which attaches in so high a degree to that admirable biography, there is what may be termed a dramatic interest. The antecedents of Charles Darwin, the Sir Isaac Newton of biology, in Charles Darwin, the undergraduate at Cambridge—hitherto unconscious of his own powers, and waking up to a love of science under the guiding influence of a beautiful friendship; the delight and the diffidence which attended his nomination by Professor Henslow as a suitable naturalist for the "Beagle" expedition; the uncertainty which afterwards marked the course of negotiations between his family on the one hand, and the Admiralty on the other, wherein issues of incalculable importance were turning and re-turning in the balance of chance, determined this way and that by the merest featherweights of circumstance; the eventual suddenness of a decision which was destined to end not only, as his father anticipated, in an "unsettling" of his own views, but also, and to a never paralleled degree, in the unsettling of the views of all mankind; the subsequent dawning upon his mind of the truth of evolution in the light of his theory of natural selection, and the working out of that theory during twenty years of patient devotion in the quiet retirement of an English country life; the bursting of the storm in 1859, and all the history of the great transformations which have followed;—these in their broadest outlines are some of what I have ventured to call the dramatic elements in the records of Mr. Darwin's life.

Now, not least among these dramatic elements is the relation in which Mr. Darwin's work stood to that of Mr. Wallace. For assuredly it was in the highest degree dramatic, that the great idea of natural selection should have occurred independently and in precisely the same form to two working naturalists; that these naturalists should have been countrymen; that they should have agreed to publish their theory on the same day; and last, but not least, that, through the many years of strife and turmoil which followed, these two English naturalists consistently maintained towards each other such feelings of magnanimous recognition, that

¹ From the Contemporary Review.

it is hard to say whether we should most admire the intellectual or the moral qualities which, in relation to their common labors, they have displayed.

Now, I have sought to lay emphasis on this the dramatic side of "Darwinism," because in the work which under this title I am about to review, it appears to me that Mr. Wallace has added yet another scene, or episode, which, in the respects we are considering, is quite worthy of all that has gone before. I do not allude merely to the fact that in this work we have the matured conclusions of the joint-originator of Darwinian doctrine, published most opportunely at a time when biological science is especially anxious to learn his views upon certain questions of the highest importance which have been raised since the death of Darwin; nor do I allude merely to the further fact that in now speaking out, after nearly a decade of virtual silence on scientific topics, the veteran naturalist has displayed an energy of investigation as well as a force of thought which is everywhere equal to, and in many places surpasses, anything that is to be met with in all the solid array of his previous works. That these facts present what I call the dramatic side I fully allow; but the point which in this connection I desire to bring into special prominence is the following.

It is notorious that, from the time when they published their joint theory of evolution by natural selection, Darwin and Wallace failed to agree upon certain points of doctrine, which, although of comparatively small importance in relation to any question of evolution considered as a fact, were, and still continue to be, of the highest possible importance in relation to the question of evolution considered as a method; i. e., in relation to the causes or factors which have been concerned in the process. It was the opinion of Mr. Darwin that natural selection has been the chief, but not the only, cause of organic evolution; while, in the opinion of Mr. Wallace, natural selection has been the all and in all of such evolution, — virtually the sole and only principle which has been concerned in the development both of life and of mind from the *amœba* to the ape, — although he further and curiously differs from Darwin in an opposite direction, by holding that natural selection can have had absolutely no part at all in the development of faculties distinctively human. Disregarding the latter and subordinate point of difference, — a re-presentation of which in the concluding chapters of his present work, I may however remark, appears to me sadly like the feet of clay in a figure of iron, marring by its manifest weakness what would otherwise have been a completed and self-consistent monument of strength, — let us first clearly understand to what it is that the major point of difference amounts. This may best be done by quoting from each of the authors in question parallel passages, which occur in the concluding paragraphs of their latest works.

Mr. Darwin writes: "I have now recapitulated the facts and considerations which have thoroughly convinced me that species have been modified during a long course of descent. This has been effected chiefly through the natural selection of numerous successive, slight, favorable variations, aided in an important manner by the inherited effects of the use and disuse of parts; and in an unimportant manner, that is in relation to adaptive structures, whether past or present, by the direct action of external conditions, and by variations which seem to us in our ignorance to arise spontaneously. It appears that I formerly underrated the frequency and value of these latter forms of variation, as leading to permanent modifications of structure independently of natural selection. But as my conclusions have lately been much misrepresented, and it has been stated that I attribute the modification of species exclusively to natural selection, I may be permitted to remark that in the first edition of this work, and subsequently, I placed in a most conspicuous position — namely, at the close of the introduction — the following words: 'I am convinced that natural selection has been the main, but not the exclusive, means of modification.' This has been of no avail. Great is the power of steady misrepresentation; but the history of science shows that fortunately this power does not long endure."

Mr. Wallace writes: "While admitting, as Darwin always admitted, the co-operation of the fundamental laws of growth and variation, of correlation and heredity, in determining the direction of lines of variation or in the initiation of peculiar organs, we find

that variation and natural selection are ever-present agencies, which take possession, as it were, of every minute change originated by these fundamental causes, check or favor their further development, or modify them in countless varied ways according to the varying needs of the organism. Whatever other causes have been at work, natural selection is supreme, to an extent which even Darwin himself hesitated to claim for it. The more we study it, the more we are convinced of its overpowering importance, and the more confidently we claim, in Darwin's own words, that it 'has been the most important, but not the exclusive, means of modification.'"

Now, in the latter quotation it is manifest that the "co-operation" which is spoken of takes cognizance only of factors which are themselves either necessary conditions to, or integral parts of, the process of natural selection; and, therefore, the approval which Mr. Wallace bestows upon Mr. Darwin's emphatic reservation — "but not exclusive means of modification" — can only be understood to have reference to the development of those distinctively human faculties which he immediately proceeds to consider, and touching which, as already indicated, Mr. Darwin's reservation was certainly not intended to apply. Thus, in brief, at the time of Mr. Darwin's death the state of matters was this: while Mr. Wallace held persistently to his original belief in natural selection as virtually the sole and only cause of organic evolution, the whole body of scientific opinion, both in this country and abroad, had followed Mr. Darwin in holding that, while natural selection was "the main" factor of such evolution, nevertheless it was largely supplemented in its work by certain other subordinate factors, of which the most important were taken to be the inherited effects of use and disuse, together with the influence of the environment in directly producing alterations both of structure and of instinct.

Shortly after Mr. Darwin's death, however, this state of matters underwent a very serious change. For it was shortly after Mr. Darwin's death that Professor Weismann began to publish a remarkable series of papers, the effect of which has been to create a new literature of such large and rapidly increasing proportions that, with the single exception of Mr. Darwin's own works, it does not appear that any publications in modern times have given so great a stimulus to speculative science, or succeeded in gaining so influential a following. The primary object of these papers is to establish a new theory of heredity, which has for one of its consequences a denial of the inherited effects of use and disuse, or, indeed, of any other characters which are acquired during the lifetime of individuals. According to this theory, the only kind of variations that can be transmitted to progeny are those which are called congenital.

For instance, there is no doubt that in his individual lifetime the arms of a blacksmith have their muscular power increased by constant exercise or use of the muscles in hammering; and therefore, if there were a thousand generations of blacksmiths, it seems reasonable to suppose that the children of the last of them would inherit somewhat stronger arms than those of average children, — or, *à fortiori*, than those of children born of a similarly long line, say, of watchmakers. This was the supposition that constituted the basis of Lamarck's theory of evolution, and, as we have seen, it was sanctioned by Darwin; although, of course, he differed from Lamarck in not regarding this supposed transmission of the effects of use and disuse as the sole factor of evolution, but merely as a factor greatly subordinate to that which he had himself discovered in survival of the fittest. Nevertheless, he unquestionably did regard this subordinate factor as one of high importance in co-operation with survival of the fittest, and, as Mr. Herbert Spencer has shown in detail, he apparently attributed more and more importance to it the longer that he considered its relation to the greater principle.

But, as we have just seen, according to the school of Weismann it is only variations of a congenital kind that can be inherited. No matter what adaptive changes may be induced in the individual by suitable use and disuse of its several parts, and no matter what adaptive changes may be directly caused by environing agencies, these all count for nothing in the process of evolution. The only adaptive changes that can count for anything in this process are those which can be transmitted to progeny; i. e., according to this

school, those which arise fortuitously as congenital variations, for the accidental occurrence of which natural selection is always, so to speak, waiting and watching. The human hand, for example, considered as a mechanism, owes nothing to its continued use through numberless generations as an instrument for the performance of functions which it is now so admirably adapted to discharge; on the contrary, its evolution has throughout been exclusively dependent on the occurrence of fortuitous variations, which, whenever they happen to occur in a profitable direction, were preserved by natural selection, and passed on to the next generation. Now, it is evident that, according to this theory, natural selection is constituted the one and only cause of organic evolution; and for this reason the followers of Weismann are in the habit of calling his doctrine "pure Darwinism," inasmuch as without invoking any aid from the Lamarckian principles above described, it constitutes the Darwinian principle of natural selection the sole, and not merely as he said the "main, means of modification."

Obviously, without going further than this quotation, which I have already made from the last edition of the "Origin of Species," it is a misnomer to designate the doctrine in question "pure Darwinism." That quotation presents the only note of bitterness which is to be met with in the whole range of Mr. Darwin's writings, and it is a note which has express reference to this very point. Notwithstanding the multifarious directions in which his doctrines were abused, the only protest against "steady misrepresentation" that he has ever allowed himself to lodge, he lodged against those who imputed to him this so-called doctrine of "pure Darwinism." On the other hand, it is no less manifest that this doctrine, although not pure Darwinism, assuredly is, and always has been, pure "Wallaceism." In point of fact, it is with reference to this very doctrine of natural selection as the sole cause of organic evolution that the opinion of these two renovators of biology has been from the first divided. It is upon this point, and upon this point alone, that there has ever been any serious difference between them,—for, as we shall presently find, every other point in which they failed to agree, save with respect to the origin of man, has a direct logical reference to this one, or grows out of this one by way of logical consequence.

And here we arrive at what seems to me the dramatic interest attaching to Mr. Wallace's latest work. On the present occasion I am not going to consider the pros and the cons of the momentous question which has always divided his teaching from that of his great compatriot. But, whether he is right or whether he is wrong, he has lived to see a most extraordinary revolution of biological thought in the direction of opinions which have always been distinctively his own, and which for a large part of a lifetime he has been virtually alone in maintaining.

Yet, notwithstanding the gratification with which Mr. Wallace must have watched this remarkable change within the last few years, there is in his recently published book no sound of exultation. On the contrary, his aim everywhere appears to be that of concealing his personal interest in this matter; and so well does he succeed that, after having finished his book, not one in a hundred of his readers will be in a position to surmise that for more than a quarter of a century their author has steadily maintained the opinions which are now being adopted by an influential and rapidly increasing body of evolutionists. Therefore, it is partly for the sake of drawing attention to a claim which Mr. Wallace characteristically abstains from making on his own behalf that I ventured to write this review of his latest work. If ever there was an occasion when a man of science might have felt himself justified in expressing a personal gratification at the turning of a tide of scientific opinion, assuredly such an occasion is the present; and in whichever direction the truth may eventually be found to lie, historians of science should not omit to notice that in the very hour when his lifelong belief is gaining so large a measure of support Mr. Wallace quietly accepts the fact without one word of triumph.

To me individually it does not appear that the recent movement of scientific opinion in the direction of "Wallaceism" is scientifically justifiable; and therefore I remain an adherent of "Darwinism," as this was left by the matured judgment of Darwin. For, on the one hand, I cannot find that the school of Weismann has

added anything of importance to the body of facts previously known; while, on the other hand, I do find that Professor Weismann himself is put to the sorest straits while trying to maintain his theory in the presence of some of these facts. So that, while fully recognizing the extraordinary ability with which he has marshalled his evidence,—and also, it may be added, the great service which he has rendered to biological science in raising certain questions of the highest possible importance in the acutest possible form,—I must still confess that to my mind there does not seem to have been hitherto shown any adequate reason to pass from the theory of evolution as this was always held by Darwin, to the theory of evolution as it has always been held by Wallace. Therefore I am free to conclude this article by briefly considering the points upon which Wallace, in his matured publication on "Darwinism," expressly differs from the teachings of Darwin.

As already stated, all these points of difference, with the one exception as to the origin of man, arise by way of logical necessity from the great or radical difference which we have hitherto been considering; viz., as to whether natural selection is only the "main" or actually "the exclusive means of modification." Nevertheless, it is desirable to consider what Mr. Wallace has to say upon these secondary or sequent points of difference, because, by examining them in the light of the diverse facts which they severally involve, we may obtain valuable material for guiding our judgment upon the larger issue.

Sexual Selection.

Against Mr. Darwin's theory of sexual selection,—i.e., selection which depends on the superior power which males may be supposed to present in the way of charming their females,—Mr. Wallace urges the following objections, which, in his opinion, are sufficient to dispose of the theory *in toto*.

In the first place, he argues that the principal cause of the greater brilliancy of male animals in general, and of male birds in particular, is that they do not so much stand in need of protection arising from concealment as is the case with their respective females. Consequently natural selection is not so active in repressing brilliancy of color in the males, or, which amounts to the same thing, is more active in "repressing in the female those bright colors which are normally produced in both sexes by general laws."

Next, he argues that not only does natural selection thus exercise a negative influence in passively permitting more heightened color to appear in the males, but even exercises a positive influence in actively promoting its development in the males, while, at the same time, actively repressing its appearance in the females. For heightened color, he says, is correlated with health and vigor; and as there can be no doubt that healthy and vigorous birds best provide for their young, natural selection, by always placing its premium on health and vigor in the males, thus also incidentally promotes, through correlated growth, their superior coloration.

Again, with regard to the display which is practised by male birds, and which constitutes the strongest of all Mr. Darwin's arguments in favor of sexual selection, Mr. Wallace points out that there is no evidence at all of the females being in any way affected thereby. On the other hand, he argues that this display may be due merely to general excitement; and he lays stress upon the more special fact that movable feathers are habitually erected under the influence of anger and rivalry, in order to make the bird look more formidable in the eyes of his antagonists.

Furthermore, he adduces the consideration that, even if the females are in any way affected by color and its display on the part of the males, and if, therefore, sexual selection be conceded a true principle in theory, still we must remember that, as a matter of fact, it can only operate in so far as it is allowed to operate by natural selection. Now, according to Mr. Wallace, natural selection must wholly neutralize any such supposed influence of sexual selection. For, unless the survivors in the general struggle for existence happen to be those which are also the most highly ornamented, natural selection must neutralize and destroy any influence that may be exerted by female selection. But obviously the chances against the otherwise best fitted males happening to be likewise the most highly ornamented must be many to one, unless, as Wallace supposes, there is some correlation between embellishment and general perfection, in which case, as he points out, the theory

of sexual selection lapses altogether, and becomes but a special case of natural selection.

Once more, Mr. Wallace argues that the evidence collected by Mr. Darwin himself proves that each bird finds a mate under any circumstances, — a general fact which in itself must quite neutralize any effect of sexual selection of color or ornament, since the less highly colored birds would be at no disadvantage as regards the leaving of healthy progeny.

Lastly, he urges the high improbability that through thousands of generations all the females of any particular species — possibly spread over an enormous area — should uniformly and always have displayed exactly the same taste with respect to every detail of color to be presented by the males.

Now, without any question, we have here a most powerful array of objections against the theory of sexual selection. Each of them is ably developed by Mr. Wallace himself in his work on tropical nature; and although I have here space only to state them in the most abbreviated of possible forms, I think it will be apparent how formidable these objections appear. Unfortunately the work in which they are mainly presented was published several years after the second edition of the "Descent of Man," so that Mr. Darwin never had a suitable opportunity of replying. But, if he had had such an opportunity, as far as I can judge, it seems that his reply would have been more or less as follows: —

In the first place, Mr. Wallace fails to distinguish between brilliancy and ornamentation — or between color as merely "heightened," and as distinctively decorative. Yet there is obviously the greatest possible difference between these two things. We may readily enough admit that a mere heightening of already existing coloration is likely enough — at all events in many cases — to accompany a general increase of vigor, and therefore that natural selection, by promoting the latter, may also incidentally promote the former, in cases where brilliancy is not a source of danger. But clearly this is a widely different thing from showing that not only a general brilliancy of color, but also the particular disposition of colors in the form of ornamental patterns, can thus be accounted for by natural selection. Indeed, it is expressly in order to account for the occurrence of such ornamental patterns that Mr. Darwin constructed his theory of sexual selection; and therefore, by thus virtually ignoring the only facts which that theory endeavors to explain, Mr. Wallace is not really criticizing the theory at all. By representing that the theory has to do only with brilliancy of color, as distinguished from disposition of colors, he is going off upon a false issue which has never really been raised. Look, for example, at a peacock's tail. No doubt it is sufficiently brilliant; but far more remarkable than its brilliancy is its elaborate pattern, on the one hand, and its enormous size, on the other. There is no conceivable reason why mere brilliancy of color, as an accidental concomitant of general vigor, should have run into so extraordinary, so elaborate, and so beautiful a pattern of colors. Moreover, this pattern is only unfolded when the tail is erected, and the tail is not erected in battle, as Mr. Wallace's theory of the erectile function in feathers would require, but in courtship. Obviously, therefore, the design of the pattern, so to speak, is correlated with the act of courtship, — it being only then, in fact, that the general design of the whole structure, as well as the more special design of the pattern, becomes revealed. Lastly, the fact of this whole structure being so large, entailing not only a great amount of physiological material in its production, but also of physiological energy in carrying about such a weight, as well as of increased danger from impeding locomotion and inviting capture, — all this is obviously incompatible with the supposition of the peacock's tail having been produced by natural selection.

And such a case does not stand alone. There are multitudes of other instances of ornamental structures imposing a drain upon the vital energies of their possessors, without conferring any compensating benefit from a utilitarian point of view. Now, in all these cases, without any exception, such structures are ornamental structures which present a plain and obvious reference to the relationship of the sexes. Therefore it becomes almost impossible to doubt, first, that they exist for the sake of ornament, and next, that the ornament exists on account of that relationship. If such structures were due merely to a superabundance of energy, as Mr. Wallace

supposes, not only ought they to have been kept down by the economizing influence of natural selection, but we can see no reason, either why they should be so highly ornamental, on the one hand, or so exclusively connected with the sexual relationship, on the other.

For these reasons I think that Mr. Wallace's main objection falls to the ground. Passing on to his subsidiary objections, I do not see much weight in his merely negative difficulty as to there being an absence of evidence upon hen birds being charmed by the plumage or the voice of their consorts. For, on the one hand, it is not very safe to infer what sentiments may be in the mind of a hen; and, on the other hand, it is impossible to conceive what motive can be in the mind of a cock, other than that of making himself attractive, when he performs his various antics, displays his ornamental plumes, or sings his melodious songs. Considerations somewhat analogous apply to the difficulty of supposing so much similarity and constancy of taste on the part of female animals as Mr. Darwin's theory undoubtedly requires. Although we know very little about the psychology of the lower animals, we do observe in many cases that small details of mental organization are often wonderfully constant and uniform throughout all members of a species, even where it is impossible to suggest any utility as a cause.

Again, as regards the objection that each bird finds a mate under any circumstances, we have here an obvious begging of the whole question. That every feathered Jack should find a feathered Jill is perhaps what we might have antecedently expected; but when we meet with innumerable instances of ornamental plumes, melodious songs, and the rest, as so many witnesses to a process of sexual selection having always been in operation, it becomes irrational to exclude such evidence on account of our antecedent prepossessions.

There remains the objection that the principles of natural selection must necessarily swallow up those of sexual selection, as the fat kine swallowed up the lean in the dream of Pharaoh. And this consideration, I doubt not, lies at the root of all Mr. Wallace's opposition to the supplementary theory of sexual selection. He is self-consistent in refusing to entertain the evidence of sexual selection, on the ground of his antecedent persuasion that in the great drama of evolution there is no possible standing-ground for any other actor than that which appears in the person of natural selection. But here, again, we must refuse to allow any merely antecedent presumption to blind our eyes to the actual evidence of other agencies having co-operated with natural selection in producing the observed results. And, as regards the particular case now before us, I think I have shown, as far as space will permit, that in the phenomena of decorative coloring, as distinguished from merely brilliant coloring, of melodious song, as distinguished from merely tuneless cries, of enormous arborescent antlers, as distinguished from merely offensive weapons, and so forth, — I say that in all these phenomena we have phenomena which cannot possibly be explained by the theory of natural selection; and, further, that if they are to be explained at all, this can only be done, so far as we can at present see, by Mr. Darwin's supplementary theory of sexual selection.

I have now briefly answered all Mr. Wallace's objections to this supplementary theory, and, as previously remarked, I feel pretty confident that, at all events in the main, the answer is such as Mr. Darwin would himself have supplied, had there been a third edition of his work upon the subject. At all events, be this as it may, we are happily in possession of unquestionable evidence that he believed all Mr. Wallace's objections to admit of fully satisfactory answers. For his very last words to science — read only a few hours before his death at a meeting of the Zoological Society — were, "I may perhaps be here permitted to say, that, after having carefully weighed, to the best of my ability, the various arguments which have been advanced against the principle of sexual selection, I remain firmly convinced of its truth."

Inherited Effects of Use, Disuse, and Direct Action of Environment.

We have just seen that one of Mr. Wallace's strongest arguments against sexual selection consists in representing *à priori*

that there can be no room for the operation of such a principle in the presence of natural selection: the greater principle must swallow up the less. This *à priori* argument he extends to all the other supplementary principles which have ever been suggested, and appears to regard it as "a short and easy method" with the Darwinists. He urges it with special vehemence against the so-called Lamarckian principles, and therefore it is suitable that under this head we should consider more carefully the value of such an argument.

In the present connection this argument is that, even admitting the abstract possibility of Lamarckian principles, in the presence of natural selection they could never have an opportunity of acting, inasmuch as the needful changes would be effected by a natural selection of fortuitous variations more rapidly than they could be by an inheritance of the effects of use and disuse. Now this argument admits of two rejoinders. First, it is surely conceivable that in many cases where slight (because initial and afterwards finely graduated) improvements are concerned, such improvements need not have been, in every stage of their progress, matters of life and death to the organisms presenting them. Yet, unless at every stage of their progress they were matters of life and death, they could not have been produced by the unaided influence of natural selection. Now it is just in such cases that the supplementary or Lamarckian principles are supposed by Darwinists to come in; for to the operation of these principles it is not necessary that at each stage of the process every slight improvement should be a matter of life and death to the organisms presenting it. To me it appears that we have here a consideration of the highest importance. Nowadays no one disputes the supremacy of natural selection over all other principles of organic change hitherto suggested, or even, it may be predicted, suggestable. But this acceptance of natural selection as supreme by no means necessitates (as Mr. Wallace appears to imagine) acceptance of natural selection as unique. Nor is there any incompatibility between our acceptance of natural selection as supreme and a further acceptance of any other principles as subordinate or co-operative. What we all agree upon is, that no such other principles can act, save in so far as they are allowed to act by natural selection; but to maintain that there can be no room for the action of any other principle hitherto suggested, or in the future suggestable, appears to me extravagant. At all events, the burden of proof must lie with any one who affirms that no adaptive improvement — or, indeed, change of any kind — can ever take place unless every stage in the gradual process has been a matter of life and death to the organisms presenting it, a burden of proof which it is obviously impossible that any one can ever be in a position to discharge.

In view of this consideration it seems to me that Mr. Wallace's *à priori* objection to the abstract possibility of Lamarckian principles falls to the ground, although of course the question remains whether there is any sufficient evidence *à posteriori* of their operation in actual fact. And a virtual answer to this question appears to me to be involved in the second consideration, which, as above stated, remains to be adduced.

Long ago Mr. Herbert Spencer pointed to the facts of co-adaptation within the limits of the same organism as presenting the strongest possible evidence of Lamarckian principles working in association with Darwinian. Thus, taking one of Lamarck's own illustrations, Mr. Spencer showed that there must be thousands and thousands of changes — extending to all the organs and even to all the tissues of the animal — which in the course of numberless generations have conspired to turn an antelope into a giraffe. Now the point is that, throughout the entire history of these changes, their utility must have always been dependent on their association. It would be useless that an incipient giraffe should present a tapering down of the hind-quarters, unless at the same time it presented a tapering up of the fore-quarters; and as each of these modifications entails innumerable subordinate modifications throughout both halves of the creature concerned, the chances must be infinity to one against the required association of so many changes happening to arise by way of merely fortuitous variation. Yet, if we exclude the Lamarckian interpretation as adopted by Darwin, which gives us an intelligible cause of co-adaptation, we are required to suppose that such a happy concurrence of innumerable

co-adaptations must have occurred by mere accident, and this thousands and thousands of times in the bodies of as many successive ancestors of the existing species; for, at each successive stage of the improvement, natural selection (if working alone) must have needed all, or at any rate most, of the co-adaptations to occur in the same individual organisms.

Against this formidable consideration Mr. Wallace adduces the following rejoinder: "The best answer to this objection may, perhaps, be found in the fact that the very thing said to be impossible by variation and natural selection has been again and again effected by variation and artificial selection." This analogy he then enforces by special illustrations, etc., but does not appear to perceive that it really misses the whole point of the difficulty against which it is brought.

The point of the difficulty is, not that the needful variations do not occur, but that they occur associated in the same individual, and that unless they thus occur associated in the same individual they must be useless; i.e., cannot fall under the sway of natural selection. Therefore the analogy of artificial selection is here irrelevant, seeing that it fails in respect of the very point which it is adduced to meet. The difference between natural selection and artificial selection is, that, while the former acts with exclusive reference to the utility (or life preserving character) of variations, the latter acts without such reference. Hence, there is obviously no difficulty in understanding how artificial selection is able to choose this, that, and the other congenital variation as each happens to occur in so many different individuals, and, by suitable pairing, to blend them together in any required proportions. But artificial selection is able to do this simply because the selected individuals do not depend for their lives upon presenting the blended characters which it is the object of such selection to produce. Natural selection, on the other hand, if working alone must wait until the blended characters happen to arise fortuitously in the same individuals; in all cases, that is, where utility depends on the co-adaptation of characters, which are the only cases now under consideration. Thus the two forms of selection present absolutely no point of analogy in the very respects where it is necessary that they should, if Mr. Wallace's appeal from one to the other is to be logically justified. In the one case the association of characters is purposely produced by the selection; in the other case it must arise by chance before its resulting utility can be offered to the selection.

Natural Selection as a Cause of Sterility Between Species.

After matured deliberation Mr. Darwin came to the conclusion that natural selection could not be a cause of sterility between species. Mr. Wallace now furnishes an argument to show that in this respect also Mr. Darwin "underrated" the powers of natural selection. The argument, however, is too abstruse to admit of reproduction here. On the present occasion, therefore, I will merely remark that it does not seem so much as to try to meet the considerations which determined Mr. Darwin's judgment in the opposite direction. Nevertheless the theory is profound as well as ingenious, and, although it fails to convince me, I am glad to note that in the course of its exposition Mr. Wallace appears to sanction the essential principle of my own hypothesis of "physiological selection;" viz., to quote his own words, "it is by no means necessary that all varieties should exhibit incipient infertility, but only some varieties; for we know that of the innumerable varieties that occur but few become developed into distinct species, and it may be that the absence of infertility, to obviate the effects of intercrossing, is one of the usual causes of their failure." The words which I have italicized very tersely convey the whole gist of "physiological selection."

Later on, however, he criticises adversely what I have written upon this subject, and also represents me as having misunderstood Mr. Darwin's views with respect to the utility and inutility of specific characters. On both these points I shall have an answer to make on some future and more suitable occasion. In this article I have confined attention to points wherein Mr. Wallace differs from Mr. Darwin; and although in so doing it has been necessary for me to express uniform disagreement with the author of "Darwinism," this has been due only to the limitations of my project, and

in no way prevents my cordial appreciation of his work as a whole. Indeed, with the exception of those differences from Mr. Darwin, which it has been my object on the present occasion to consider, it appears to me that Mr. Wallace's latest work is one of the most interesting and suggestive in the whole range of Darwinian literature. And even these points of difference, it will be remembered, all arise out of the single difference before stated, namely, whether natural selection is to be regarded as the main, or as the exclusive, means of modification. Therefore, notwithstanding all that I have said on the Darwinian side of this momentous question, the fact that it still remains an open question compels us to recognize that Mr. Wallace's views with regard to it may eventually prove to be right; while, in any case, he is certainly to be congratulated on having lived to see the great movement which has recently taken place in the direction of those views. But to many of us it still appears that Mr. Darwin's judgment on this matter is the sounder one to follow. When a great generalization has been fairly established, there is always a tendency to exaggerate its scope; and, perhaps, in no respect was the wonderful balance of Mr. Darwin's mind so well displayed as it was in the caution with which he abstained from assigning to his vast principle of natural selection a sole prerogative. Moreover, as previously stated, the longer that he pondered the question, the more he became persuaded that the problem of organic evolution as a whole was too complex and many-sided to admit of being resolved by the application of a single principle. This conclusion, I believe, will eventually be justified by the advance of biological science; and, therefore, until some better reason is shown than has yet been shown for departing from it, I cannot help feeling that naturalists will do well to suspend their judgments, even if they are not so sure as they used to be touching the doctrines of "Darwinism," as these were left by Darwin.

GEORGE J. ROMANES.

BOOK-REVIEWS.

Stellar Evolution and its Relation to Geological Time. By JAMES CROLL. New York, Appleton. 12°. \$1.

THE basis of the theory advanced by Mr. Croll is that it is just as possible for the universe to have been created with a given amount of energy due to the motion of the created masses of matter, as with a given amount of matter; i.e., Mr. Croll would have the initial state that of a great number of cold bodies moving with high velocities. No one can deny the possibility of the truth of such a hypothesis, and many will find in Mr. Croll's deductions much that is suggestive. As it is not so probable that such initially moving bodies would collide as it is that bodies would if possessed only of motion of translation due to gravity, Mr. Croll thinks he sees in this universe created in motion a universe the better provided against the dissipation of its energy.

If we are to criticise the book, we would call attention to the unsatisfactory nature of all discussions of problems in mechanics, — and many of those in stellar physics are such, — by one who makes no pretence of being a mathematician. Yet as the mathematicians have not given the geologists all the time they call for that the solar system may have reached its present state with at least one planet built up of well ordered crystalline and fossiliferous rocks, it is to be expected that some flaw may be found in the calculations of the one or the theories of development of the other; and such suggestions as Mr. Croll has to offer will help in bringing the two parties to an agreement.

AMONG THE PUBLISHERS.

A. S. BARNES & Co. announce that the long-promised "The Three Germans," by Theodore S. Fay, has now been issued.

— Callaghan & Co. will publish, on Oct. 1, Vvol. 6 of Von Holst's "Constitutional History of the United States."

— "King's Annotated Vest-Pocket Map of Massachusetts" is the most perfect small map of the State that has ever appeared.

— John C. Yorston & Co., Cincinnati, have just ready Henry A. Shepherd's "The Antiquities of Ohio," reprinted from the "Popular History of the State of Ohio."

— The Pacific Press Publishing Company have just issued "The Federal Government of Switzerland," by Bernard Moses, professor of history and political economy, University of California.

— John Ireland, 1197 Broadway, has the market for a new cookbook, "What One Can Do with a Chafing-Dish," just published by the author, H. L. Sawtelle. Experimenters in "light-house-keeping" will find the book just the one they have been in search of for so many years.

— Foruds, Howard, & Hulbert have ready a new contribution, by a new writer, to the present all-absorbing discussion of the future of the negro in America, entitled "An Appeal to Pharaoh." The author confidently indorses it as "a radical solution of the negro problem."

— "Recollections of the Court of the Tuilleries," by Madame Carette, is a recent book of reminiscences of the court of the last Napoleon, which is being widely read in France. It contains many memoirs of the Empress Eugénie. A translation is in hand, and will be published immediately by D. Appleton & Co.

— P. Blakiston, Son & Co., Philadelphia, have just ready a revised and enlarged edition of "Obstetric Nursing," by Theophilus Parvin, M.D., the Professor of Obstetrics and Diseases of Women and Children in the Jefferson Medical College, and Obstetrician to the Philadelphia Hospital.

— The *Journal of Pedagogy* enters upon its third volume with the September issue. Dr. A. D. Mayo of Boston, the well known educational lecturer, stated in the annual address at the Ohio University, June 20, 1889, that "the *Journal of Pedagogy* is one of the two or three real educational papers in this country." It is published at Athens, Ohio.

— The author of the "Rise and Fall of the Confederate Government," Mr. Jefferson Davis, is not satisfied with the limited sale his work has had. He has complained so loudly of its failure as compared with the works of Grant and Sherman, that D. Appleton & Co., his publishers, have gained his consent to the appointment of arbitrators to decide the points at issue between them. The Messrs. Appletons attribute the slow demand made in the North for the book to the intense sectional spirit in which it is written.

— The *Lounger* writes in *The Critic*: "I heard the other day from an authority which I cannot dispute that 'The Century Dictionary' has cost the Century Co. over \$500,000, and my informant added parenthetically that when the undertaking was begun, the company had no idea that it would swallow up a sum approximating this. But like Topsey it 'grow'd.' It has taken nearly seven years of the time of some of the best experts and specialists in the country, at an annual expense of not very much less than \$100,000. This, I believe, is the first time the cost of making this great dictionary has been stated with any degree of accuracy."

— Mr. Paul Leicester Ford, whose address is No. 97 Clark Street, Brooklyn, N.Y., will have ready in September "American Bibliography: A Check-List of Bibliographies, Catalogues, Reference Lists, and Lists of Authorities of American Books and Subjects," a quarto volume printed on alternate pages, and containing 1,070 titles, arranged by subject under 19 divisions and 150 subdivisions, with a classification of contents and an author's index. At the same time Mr. Ford will bring out his "Franklin Bibliography: A List of Books written by or relating to Benjamin Franklin," an edition of 500 copies uniform in size with Bigelow's octavo edition of Franklin's Works. No fewer than 1,500 titles and references are promised, the list of works wholly or in part written by Franklin numbering 600, and his pseudonyms amounting to 60. There will be chronological, classical, and general indices, and mention of the libraries where the works may be consulted.

— "The Dominion of Canada is a device to keep the peace between those to whom Nature has allotted an irrepressible conflict." So says the writer of an article called "La Nouvelle France" in the September *Atlantic*, which will be the subject of discussion in the United States, and of something more than discussion in Canada. It shows how the French Canadian party is steadily gaining Canada to itself, and how by its consummate organization,

it is reconquering it from its nominal English rulers. The paper is an interesting pendant to that on French-Canadian literature in the August number; and it will, as has been said, no doubt call out some rejoinders. "The Isthmus Canal and American Control," by Stuart F. Weld, is a consideration of the policy promulgated by the United States government in its desire to control the inter-oceanic canal, with (as eighteenth century writers would put it) "some animadversions thereon." In fact, the magazine runs toward political questions, since Mr. Frank Gaylord Cook has an article on "James Wilson," a Scotchman who settled in Pennsylvania, and whose services in behalf of the Constitution of the United States are too little known. Still another sketch, of the "Americans at the First Bastille Celebration" (by J. G. Alger), completes the more important articles.

—Ginn & Company have just published "The Irregular Verbs of Attic Prose; their Forms, Prominent Meanings, and Important Compounds, together with Lists of Related Words and English Derivatives," by Addison Hogue, Professor of Greek in the University of Mississippi. The material treated in this book is much fuller than in the lists of irregular verbs in the grammars, and more accessible than in the lexicons. The book contains after the regular verbs, — pure, mute, and liquid, — the irregular verbs of Attic prose in alphabetical order. Prominent meanings and special uses of frequent occurrence are given, often illustrated by translated examples. The most important compounds are added, and also many related words, — forming a very practical sort of introduction to word-formation. The first declension alone is represented by about four hundred substantives, and this indicates the range of vocabulary. The English derivatives, of which there are over 450, should prove an attractive feature to teachers and students alike. To the latter they will be an additional support in learning some five or six hundred Greek words, and will broaden their knowledge of their own tongue.

—In the September *Magazine of American History* Mr. Robert Stiles, of Richmond, tells of "Lincoln's Restoration Policy for Virginia," which Admiral Porter, with whom Lincoln went to Richmond on its evacuation, represented differently in his "Incidents of the Civil War." The evidence here given for the first time to the public corrects even Grant's account of the matter in his "Memoirs," which is believed to have been written from hearsay. The illustrated feature of the magazine this month is the third chapter in Mrs. Lamb's "Historic Homes and Landmarks," the scene being the site of the Damen farm, between Wall Street and Maiden Lane, which for nearly half a century was outside the walled city of New York. Many new facts and figures have been exhumed by the accom-

plished historian, the most consequential landmarks are described, events are vividly portrayed which made the ground historic, and never before were the wonderful contrasts between the past and the present so sharply defined. A second illustrated paper, by T. H. Lewis, of St. Paul, is "The Old French Post at Trempealeau, Wis.," a recent discovery. Gen. J. W. De Frey pays a tribute to the late "John W. Hammersley," whose portrait in steel forms the frontispiece to the issue. Milton T. Adkins writes the "Growth of a Great National Library," giving the history in brief of the library of Congress. William Seton contributes an article of interest on "St. John de Crèvecoeur, the First French Consul in New York after the Revolution." There is a sketch of "New York's Great Landholder, George Clarke," and a tribute to the late Mrs. Amasa J. Parker.

—A number of years ago Mr. J. C. Pilling undertook the compilation of a bibliography of North American languages. In the course of his work he visited the principal public and private libraries of the United States, Canada, and northern Mexico, carried on an extensive correspondence with librarians, missionaries, and others interested in the subject, and examined such printed authorities as were at hand. The results of these researches were embodied in a single volume. Since its issue he has had an opportunity to visit the national libraries of England and France, as well as a number of private ones in both these countries, and to revisit a considerable number in this country and Canada. A sufficient amount of new material has thus been collected to lead to the belief that a series of catalogues may well be prepared, each referring to one of the more prominent groups of our native languages. Of this series three have been published, relating respectively to the Eskimauan, the Siouan, and the Iroquoian families. The fourth has just been issued by the Bureau of Ethnology, and relates to the Muskogean languages; the fifth, now in preparation, will relate to the Algonquian. There are in the present catalogue 521 titular entries, of which 467 relate to printed books and articles and 54 to manuscripts. Of these, 469 have been seen and described by the compiler, — 429 of the prints and 40 of the manuscripts, — leaving as derived from outside sources 38 printed works and 14 manuscripts. Of those unseen by the writer, titles and descriptions of more than one-half have been received from persons who have actually seen the works and described them for him. In addition to these, there are given a number of full titles of printed covers, second and third volumes, etc., all of which have been seen and described by the compiler; while in the notes mention is made of 69 printed and manuscript works, 43 of which have been seen and 26 derived from other (mostly printed) sources.

INDUSTRIAL NOTES.

Guaranty Investment Company.

THE Guaranty Investment Company has adopted the policy of sending each year a committee of its investors to visit Kansas and Nebraska and report upon its loans and methods of business. The first report was made in 1888 and the second in 1889. The committee of 1888 consisted of Professor A. H. Berlin, principal of the high school, Montrose, Penn. (recently removed to Wilmington, Del.), and Major Theodore L. Poole, ex-United States pension agent, Syracuse, N.Y. They commenced their labors on Monday, June 18, 1888, by an examination of the books and statements submitted to them by the Western general manager, F. H. Wilson. Later, accompanied by the inspector of the company, they began an examination of some of the loans made by the company. This examination was commenced in Atchison County, Kan., on Tuesday, June 19, ending with Franklin County, Kan., Saturday, June 30. During this time they drove about four hundred miles and travelled by railroad seven hundred miles, and examined over forty loans made by the company. While they examined in detail over forty loans they also looked at many others in different counties that they did not have time to compare with the records. From their investigation and observations they recommended the loans made by the Guaranty Investment Company of Atchison, Kan., as a safe investment.

The committee for 1889 consisted of Dr. Francis W. Boyer, a

physician of Pottsville, Penn., M. H. Olin, president of the Citizens' Bank, Perry, N.Y., and Irving H. Tiff, Esq., a lawyer of New York City. From the report, dated Atchison, Kan., June 29, 1889, it appears that their work began on Thursday, June 6, and ended on Friday, June 28. During this period they travelled over 2,150 miles, 665 of which were by carriage, and visited a large portion of Kansas and Nebraska. The trip took them through twenty-eight counties in Kansas and twenty-six in Nebraska, besides a large number of cities and towns in both States. Before commencing the journey they made an examination of the books and records of the company, submitted for inspection by the Western general manager, Mr. Frank H. Wilson. In conclusion they say that it is their opinion that Kansas and Nebraska are on the high road to prosperity, and do not see how it is possible for carefully placed farm mortgages in these States to be otherwise than safe, and they regard those of the Guaranty Investment Company to be of this character.

Any persons desiring further information upon points in the reports are requested to correspond with any member of either committee, and copies of testimonials received from persons who have made investments in these mortgages will be sent to any address. The company keeps on hand at its New York office at all times a large number of seven per cent guaranteed mortgages equal in security to any examined by the committees, and full information will be gladly given to any one, by Henry A. Riley, general Eastern manager, 191 Broadway, New York.

Publications received at Editor's Office,
Aug. 5-24.

BROWN, K. L. The Interstate Second Reader. Chicago and Boston, Interstate Publ. Co. 108 p. 160.
 FLAGG, I. (Ed.). Euripides' Iphigenia (College Series of Greek Authors). Boston and London, Ginn. 197 p. 8". \$1.50.
 HOGUE, A. The Irregular Verbs of Attic Prose. Boston Ginn. 268 p. 16". \$1.50.
 KENT, C. W. (Ed.). Elene, an Old English Poem (Library of Anglo-Saxon Poetry, Vol. III.). Boston and London, Ginn. 149 p. 12". 65 cents.
 MILL, H. R. An Elementary Class-book of General Geography. London and New York, Macmillan. 391 p. 12". 90 cents.
 PUFER, W. H. P. Seven Thousand Words Often Mispronounced. New York and London, Putnam's. 497 p. 16". 75 cents.
 RICHARDS, John. A Manual of Machine Construction for Engineers, Draftsmen and Mechanics. Philadelphia, Lippincott. 153 P. 4". 85.
 SYMONDS, B. A Manual of Chemistry for the use of Medical Students. Philadelphia, Blakiston. 154 p. 8". 82.
 TILLMAN, S. E. Elementary Lessons in Heat. Philadelphia, Lippincott. 160 p. 8". \$1.80.
 WARD, H. M. Timber and some of its Diseases (Nature Series). London and New York, Macmillan. 295 p. 12". \$4.75.
 WARREN, I. An Elementary Treatise on Mechanics. London and New York, Longmans, Green & Co. 144 p. 12". \$1.
 WEINMANN, A. Essays upon Heredity, and kindred Biological Problems. Authorized Translation (Ed. by Penlon, Schonland and Shipley). Oxford, Clarendon Pr. 455 p. 8". \$4.

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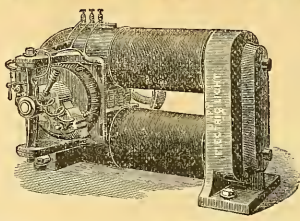
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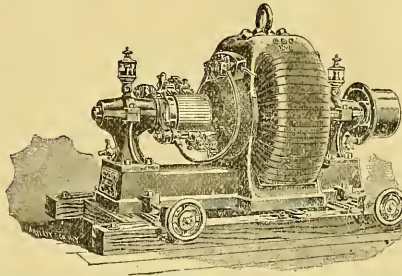
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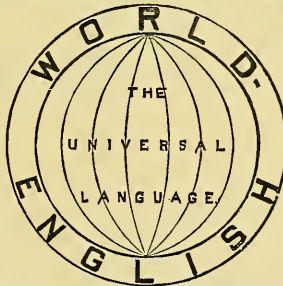
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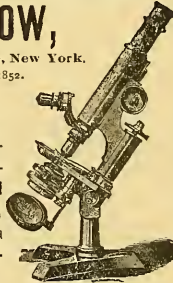
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VOL. XIV. No. 344.

NEW YORK, SEPTEMBER 6, 1889

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THE JULIEN ELECTRIC TRACTION SYSTEM.

THE Julien electric cars have now been in regular passenger service for a little over two years in Brussels; and a report has just been prepared of the cost of motive power during that time, including the renewal of batteries, the wear and tear on motors and machinery, the generating and storing of the energy, and repairs and replacements generally, — in fact, every element that can be understood by an engineer to be motive power. It is found that the cost of motive power has been a trifle less than three cents per kilometer, or about five cents per car-mile; in this, the cost of

three and five-tenths cents per car-mile net, including depreciation on battery, cost of generating current, and handling of batteries.

The car shown in the accompanying illustration, Fig. 3, has been in constant use in this city for several months, and is of the type selected by the Julien Company as the standard for their service. It has a sixteen-foot body mounted on a rigid truck with a six-foot wheel base, which carries two ten horse-power electric motors, — the truck being entirely independent of the car body, and may be removed if necessary. The weight of the car, with motors, gearing and battery in position, is between six and seven tons. The motors are geared direct, one to each axle, and are accessible from

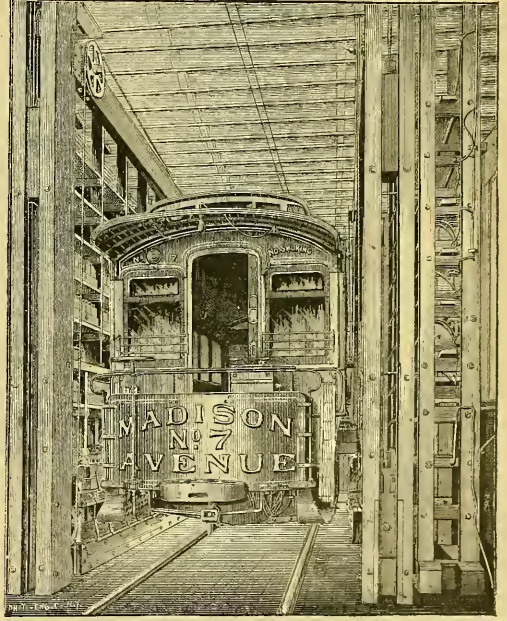
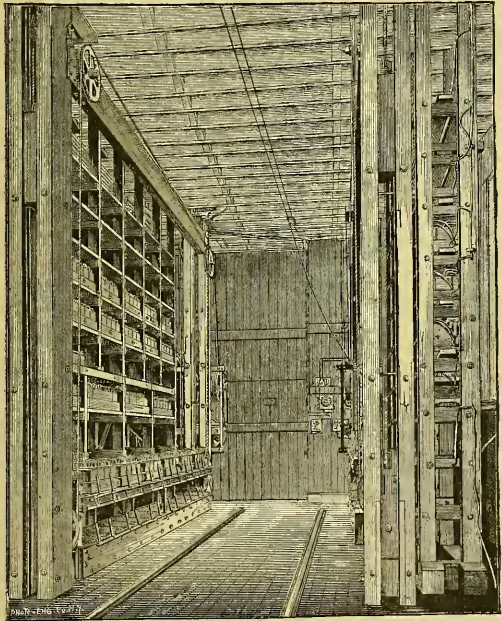


FIG. 1 AND 2.—STORAGE BATTERY CHARGING RACK, JULIEN ELECTRIC CAR STATION.

maintaining the batteries has amounted to a cent and six-tenths per car-mile.

It may be of interest to know that the estimate of the cost of motive power as based on the experiences of the Julien Electric Traction Company on the Fourth and Madison avenues, and prepared prior to the report at Brussels, and without any knowledge of the cost there, is within a fraction of being the same. The Julien Company find the cost of motive power on Madison Avenue to be five and three-tenths cents per car-mile. In the cost of motive power as estimated in New York, however, was included interest on investment, amounting to one and eight-tenths cents, or

the car floor by trap-doors. The battery consists of 108 cells, which are placed in six trays of nine each on each side of the car under the seats; these trays are placed in the car by dropping the side panels.

The chief difficulty encountered in the operation of the Fourth Avenue line was the handling of the batteries, but recent improvements have entirely overcome this difficulty. First, a flexible connector was devised, by which it is possible to couple up cells with great rapidity. Next a battery rack was constructed large enough to store batteries for ten or twelve cars. This rack is shown in Figs. 1 and 2. This rack makes it possible to remove the batteries from

a car and replace them by another set in from two to three minutes. When the car enters this rack, its panels are dropped down on either side and thus form bridges over which the batteries are withdrawn from and replaced in the car. While this change is being made, a competent person inspects the regulators of the car. The motors, gearings, and connections are only inspected once a day, and that at the end of the day's work.

GOLD EXTRACTION BY A NEW PROCESS.

IN many places where gold-bearing quartz is found containing a sufficient percentage of the metal to pay for working it, there is either an entire absence of the water necessary to work the process at present employed for its extraction, or it can only be obtained at great expense and trouble, in many cases only part of the year.

which he could quickly determine whether any specimens of quartz contained gold, by simply crushing it with a hammer and running it through the machine. The mechanism of this apparatus consists of an inclined ladder with fine wire cloth upon one side and silk upon the other. A blast of air is passed up and down through the two meshes, blowing off the light particles of dirt and quartz and allowing the free gold to be retained simply by gravity. Another machine is adapted for concentrating various metals from rock, such as sulphates of copper, lead, zinc, and antimony, making the future separation of the valuable metals from the metallic mass, by roasting or chemical processes, an easy matter. During the exhibit an interesting experiment was made to show the value of the machines, and the thoroughness with which they performed their work. The machine used in the experiment weighed about five hundred-weight, and was so compact that it could be readily



FIG. 3.—STANDARD ELECTRIC CAR, JULIEN STORAGE BATTERY SYSTEM.

Hitherto the processes used for extracting the gold from the alluvial deposit or from crushed quartz have required large quantities of water to flush the fine, pulverized material containing the gold, and even with the best methods large quantities of gold were carried off with the earth and quartz and lost before it reached the mercury.

The need of some ready method for the dry extraction of the gold has long been felt, but until recently the various machines proposed have not been found equal to the old processes. The various difficulties in the way of dry extraction have apparently been overcome in a new machine which was exhibited in London a few weeks ago. By this process, as described in *Iron*, the use of mercury is dispensed with, and the gold is extracted readily from alluvial deposits or quartz. The process is also applicable to the extraction of any combination of metals from refractory ore. One of the machines exhibited weighed but six pounds, and was intended to form part of the outfit of the prospector, by the use of

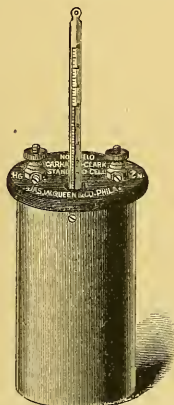
transported from one place to another. A quantity of gold in minute particles, weighing six drams, and two small nuggets, were put into a large pan with two hundred-weight of gravel and grit, and the whole mass put into the machine, which was operated with about a quarter-horse power, or, as an equivalent, two-man power.

The principle of the machine is similar to the small separator used for prospecting purposes, with the blast of air driving off the fine particles of extraneous material, while "oscillating riddles containing shot shake off the heavier grit and stones, allowing free gold to sink by gravity into the shot, where it is retained, and in turn falls to the bottom of the shot." In about a minute after the mixture was placed in the machine the whole treatment was completed, and of the amount of gold originally put into the machine 96.3 per cent was recovered. With more time devoted to the separation, a considerably smaller percentage of loss would doubtless have ensued.

AN IMPROVED STANDARD CLARK CELL WITH LOW TEMPERATURE COEFFICIENT.¹

LORD RAYLEIGH'S form of Clark cell, described in the Philosophical Transactions for 1885, is the best one hitherto made. The objections to it are, first, that it has a high and variable temperature coefficient; second, it is not constructed in such a way as to keep the mercury away from the zinc when shaken in transportation; and third, an important chemical defect is the local action taking place by which zinc replaces mercury in the mercury salt and the zinc becomes amalgamated, the amalgam often creeping up so as to reach the solder at the copper wire. These difficulties I have, I think, perfectly overcome. I have made cells which have been tested for several months with the low coefficient, at 15° C., of 0.000386 per degree C. At higher temperatures a peculiarity is that this coefficient decreases slightly, while that of Lord Rayleigh's increases very appreciably. The cell is so made that the mercury is confined to the bottom of the cell, or at least, if it does move at all it cannot reach the zinc. These cells have been found to stand transportation exceedingly well.

The same arrangement or device removes the zinc from the mercury salt and perfectly prevents local action. The sealing of the cell is also effected with a more perfect compound. Further,



IMPROVED STANDARD CLARK CELL.

in the preparation of the mercury salt I have succeeded in making mercurous sulphate so free from the mercuric form that it shows no yellowing when washed free from acid. It also remains white upon admixtion with zinc sulphate, and indefinitely, after the cell is set up, provided it be kept out of the light. The light darkens it.

One of these cells has been heated up to 53° C., and the following day it returned to its precise former value of electromotive force at the same temperature. The temperature coefficient given holds at the above high temperature. As indicating the uniformity attained, the last two cells made never differ in electromotive force by more than one part in ten thousand, and usually by only half this, at the same temperature.

THE WENSTROM DYNAMO.

The Wenstrom dynamo, of which Fig. 1 is a perspective view and Fig. 2 a cross section, is well known in Europe, especially in Sweden. It was invented by Jonas Wenstrom, an eminent Swedish engineer, and differs in some respects from other dynamos in the market. It is of simple and substantial construction, as may be seen by the illustrations, and utilizes the magnetic forces to a remarkable degree. It is of the iron-clad type, the armature and field coils being protected by a cast iron shell, parts of which per-

form the function of pole-pieces. There are four poles, opposite ones being of the same sign, all four being energized by one pair of field-coils, which surround the cores of the inner or horizontal pole-pieces, and are surrounded by the shell which serves as annular cores for the top and bottom field-pieces. Ventilation is provided

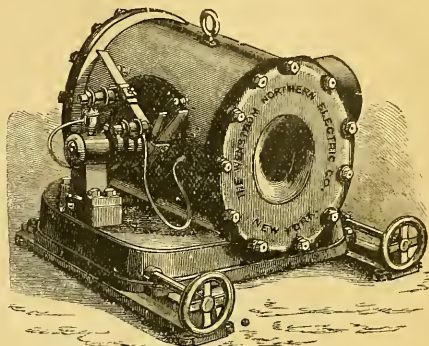


FIG. 1.—WENSTROM DYNAMO.

for by the circular apertures in the shell through which the armature is put into place.

The armature is of the drum pattern, built up in the usual way of thin disks of iron, well insulated, so as to prevent heating from eddy currents. These disks are perforated near the periphery, the perforations being round, ovoid, or hexagonal in shape, and connected with the periphery by a slit, narrowest at the outer part, and only wide enough to admit the winding, one wire at a time. In the grooves formed by these perforations the wire is wound. This peculiar construction admits of the armature revolving in very close proximity to the pole-pieces, materially reducing the resistance of the magnetic circuit, and affording a protection to the armature winding from the effects of centrifugal force, no binding wires being required. A new method of winding is employed, and diametrically opposite sections are connected together, making necessary only two brushes, which are set 90 degrees apart.

The one hundred light machine absorbs eight horse-power, run-

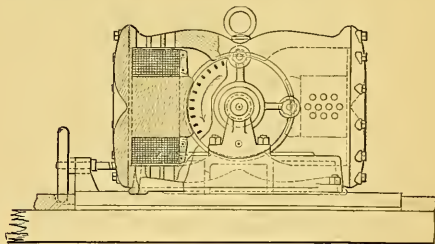


FIG. 2.—WENSTROM DYNAMO.

ning at a speed of nine hundred revolutions per minute. The total weight of the dynamo is eleven hundred pounds, mainly cast-iron, the weight of copper wire on the armature being only thirteen pounds, and on the field magnet cores ninety-four pounds, or one hundred and seven pounds of copper in all. The two hundred and thirty light machine runs at a speed of seven hundred revolutions per minute, its total weight being twenty-five hundred pounds, of which thirty-six pounds are of copper on the armature, and three hundred and eight on the field magnets. The eight hundred light machine runs at a speed of five hundred revolutions per minute.

The advantages claimed for this construction are that there is no waste field, all the magnetic lines of force being utilized in the armature in producing work; neither is there any field outside of

¹ Abstract of a paper read before the American Association for the Advancement of Science, at Toronto, by Professor H. S. Carhart.

the machine which would be liable to affect watches, etc., all the field being contained within the outer iron shell forming the yoke. Low speed in running is obtainable without increasing the size and weight of the machine, and the whole is cheap to construct, and combines features of mechanical strength and solidity with high electrical efficiency. Finally, the machine is remarkably free from any heating when running constantly and under full load. These machines are manufactured by the Wenstrom Northern Electric Company, of this city, of which Dr. J. B. De Lery is president; B. Blum, general manager, and B. J. Sturges, secretary and treasurer. This company intend to introduce their system for light and power in the Eastern, Middle, and Western States. The Wenstrom people have already installed during the past year several thousand lights in Baltimore and Annapolis.

THE NORTH AMERICAN MESOZOIC.¹

It has become customary upon such occasions as this for the speaker to select a theme from subjects which he is supposed to have specially studied; and I have therefore chosen for mine the mesozoic division of the geological record as it is exhibited on this continent. This theme is so comprehensive that I propose only to select from it certain topics which pertain to the distinguishing characteristics of the principal subdivisions of the mesozoic that have been recognized in different portions of North America; to their interdelimitation and to the delimitation of the division as a whole from the carboniferous system beneath, and the cenozoic above. I shall also make the discussion of these topics the opportunity of expressing certain views which I hold concerning them.

To bring these discussions within the time allotted me they must be confined to three general sections of the mesozoic formations, one of which occurs within each of three regions of the continent, namely, the Atlantic coast, the Pacific coast, and the interior regions. Proceeding upon this plan, let us first consider the general section which is to be observed in the Atlantic coast region.

The rocks which in this region are now generally regarded as of triassic age are found occupying limited isolated districts from Prince Edward Island on the north to the State of South Carolina on the south. If they extend further to the south, or south-westward, they are covered from view by later formations. They are found to rest unconformably upon various formations from the archæan to the carboniferous inclusive; except perhaps in Prince Edward Island, where they are reported as resting conformably, or nearly so, upon reputed Permian strata. Still, no intimate stratigraphical or paleontological connection between the Permian and the trias has been shown to exist there; and the hiatus between them is doubtless as great as it is farther southward, where the unconformity is so conspicuous.

In this latter portion of the region it is evident that the great uplift which involved the paleozoic rocks, including the reputed Permian, took place long before the deposition of the earliest of those triassic beds. These stratigraphical conditions indicate that the hiatus in the geological record between the latest of the carboniferous, and the earliest of the triassic deposits is equal to at least the earlier half of the triassic, as that period is represented in Europe.

The only known paleontological evidence which appears to bear upon this subject agrees with the stratigraphical indications just mentioned. That is, the results of investigations by Professor Newberry upon the fishes and plants of the strata in question, and of Professor Fontaine upon the plants of the same, indicate that they represent the later trias of Europe. But if triassic fishes had not survived to the present day; and if we knew more concerning the developmental stages in the vegetable kingdom from the later paleozoic to the later mesozoic inclusive, a good degree of uncertainty which is naturally felt upon this point would doubtless disappear.

Our knowledge of the land vertebrate fauna which existed at the time these deposits were formed is derived mainly from footprints; and it is therefore more than usually imperfect. The character of

this evidence as indicating triassic, rather than earlier Jurassic age, seems to be far from unquestionable.

Very few invertebrate fossils have been found in the trias of the Atlantic coast region; and the few that have been discovered are of little or no value as indicating the age of the strata containing them.

As to the relation of these deposits with the carboniferous system, only stratigraphical evidence has thus far been obtained, and this shows only the bare fact that the former are of considerably later age than the latter. That is, no direct, or even approximately close, biological relationship between them has yet been discovered, the biological hiatus being apparently quite as great as the stratigraphical one. It may be mentioned here also that we have no evidence that the trias of the Atlantic coast was ever continuous, or that it was exactly contemporaneous, with the reputed trias of the interior region, which will be presently referred to.

Intermediate between the triassic beds and the undisputed cretaceous deposits of the Atlantic coast region there is a series of strata, evidently of littoral and estuary origin, but, at least in part, of doubtful age, to which the name of Potomac formation has been applied. These deposits reach at most only a few hundred feet in thickness, and although frequently covered from sight by later formations, they seem to have been originally continuous from New Jersey to the State of Mississippi. They have no known representative west of the Mississippi River, unless it shall be shown that they are represented by some sandy beds at the base of the Texas cretaceous section. These Potomac beds are usually found resting upon the archæan, and at only a few points are they found to rest directly upon the triassic rocks, when they are plainly unconformable. They seem to be constantly present beneath the marine cretaceous strata just mentioned, and no representative of another formation has yet been observed between them.

Invertebrate fossils are exceedingly rare in the Potomac formation, and the few that have been found give no direct indication of its geological age. Professor Whitfield, however, has suggested that the Raritan clays, together with the Amboy clays, which by some geologists are included in the Potomac formation, but which are probably of later date, are of Jurassic age because of the similarity of his new lamellibranchiate genus *Ambonicardia* with certain European Jurassic shells.

Large collections of fossil plants have been obtained from the deposits here provisionally grouped together under the name of Potomac formation, at numerous and widely separated localities. These collections differ so greatly in character from one another that it seems necessary to infer that more than one flora is represented by them. Many years ago Dr. Tyson found some fossil plants in Maryland which he regarded as of Jurassic age, and which closely resemble certain forms that are found in the European Jura. Professor Ward, in reviewing the large flora which Professor Fontaine has published from the Potomac formation in Virginia, and having in mind also the Maryland plants just referred to, recognizes the Jurassic character of several of the species, according to the European standard, but he takes the rational ground that all obtainable evidence ought to be considered before reaching a final decision as to the true age of the deposits containing them.

Professor Newberry, who has made extensive studies of the plant remains of the Raritan and Amboy clays, finds among them none that give any indication of their Jurassic age. On the contrary, he finds that the flora of those clays as a whole indicates that they ought to be referred to an epoch not later than the middle cretaceous of Europe, nor probably earlier than the upper neocomian.

Professor Marsh has published some dinosaurian remains from apparently the same horizon in the Potomac formation that furnished the plants to Dr. Tyson and Professor Fontaine, which he has referred to the Jurassic.

Paleontological testimony being thus conflicting in its character, one naturally infers that more than one epoch is represented by the deposits that now bear the common name of Potomac formation; but I shall presently call your attention to some cases of commingling of earlier and later molluscan types in one and the same formation which are quite as remarkable as this apparent commingling of diverse plant and vertebrate types in the Potomac formation.

¹ Address before the Section of Geology and Geography of the American Association for the Advancement of Science, at Toronto, Ont., Aug. 29, 1889, by Charles A. White, vice-president of the section.

The marine upper cretaceous deposits of the Atlantic coast region which immediately overlie the Potomac formation are best developed in New Jersey; but there is good reason to believe that they were originally continuous with contemporaneous deposits through the whole length of the region from Long Island to the Gulf States and thence westward to, and far northward within, the interior region. This opinion is based upon specific identity of marine fossils discovered in the different regions.

The upper cretaceous of this region is overlain by eocene deposits, also marine, with little if any observable unconformity where they have been found in contact. I shall, however, presently mention facts which indicate that there is in the Atlantic and Gulf coast region a considerable hiatus between the cretaceous and eocene.

Briefly, then, the mesozoic of the Atlantic coast region consists of a probable representation of the upper trias of Europe, a possible one of the upper Jura, a probable slight one of the middle cretaceous, and a practically certain representation of a large part of the upper cretaceous, but with an hiatus between the latter and the eocene.

Although the cretaceous rocks are, or were originally, continuous between the Atlantic coast and interior regions by way of the Gulf States, the earlier mesozoic rocks of those regions respectively are so widely separated from each other that, as we go westward, we do not find any that can be confidently referred to either the trias or the Jura until we have passed the 100th or perhaps the 103d meridian.

As the latter meridian coincides with the western boundary of Texas, the foregoing statement implies that no triassic rocks exist within at least the greater part of the fully thirty thousand square miles in that State and in the Indian Territory, which some geologists have represented as being occupied only by rocks of that age. A personal examination of a large part of that region and of the fossils collected there has satisfied me that the sum of all the known evidence is in favor of the Permian age of the strata in question and against their triassic age. But these strata have an important paleontological relation with the mesozoic, to which I wish to call your attention for a few moments.

Upwards of fifty species of vertebrates, embracing reptiles, batrachians, and fishes, have been described from these rocks by Professor Cope, upon the evidence of which he referred them to the Permian of Europe, although, as he states, not one of the genera is common to both continents.

I have collected upward of thirty species of invertebrates from the same beds which furnished the vertebrates, representative examples of all the more important of which were obtained from one and the same stratum. Of these, fully one-half are common, characteristic coal-measure species. A part of the cephalopod species, however, possess such decided mesozoic characteristics that probably no special student of that class of fossil mollusca would hesitate to refer them to a formation not older than the trias, if they had been submitted to him without any information as to their true stratigraphical position.

It is a significant fact that if three special selections were made from the fossils of all kinds that have been obtained from this formation in Texas, one could be made, by the usual method of chronological classification practised by paleontologists, to prove its coal-measure age, another its Permian age, and still another its triassic age. It is admitted that the sagacity of an experienced paleontologist will often enable him upon limited evidence to become satisfied in his own mind as to the approximate age of a given formation; but it is only after all the obtainable paleontological and stratigraphical facts are carefully considered together that one is justified in expressing a definite opinion upon a subject of this kind. Such a summing up of all the evidence at present available seems to fully justify the reference of this Texan formation to the Permian of Europe.

My special object in presenting the foregoing facts is to call your attention to the important paleontological relation of the Texan Permian with the mesozoic, which is shown by the presence of ammonitic and ceratitic cephalopods among paleozoic types of mollusks. The discovery of such forms in such association in the Texan Permian, as well as in the Productus limestone of India,

shows conclusively that certain mesozoic types began their existence long before the close of paleozoic time. Such forms in such association may be properly regarded as harbingers of an approaching, but not yet established, mesozoic era, because, in this case at least, the balance of paleontological evidence favors their reference to the paleozoic. Such facts as those which have been mentioned, as well as others presently to be referred to, indicate that upon the confines of epochs, periods, and ages of geological time there was always a commingling of types of then living forms which in their culmination were characteristic of each of those chronological divisions respectively. Furthermore, I shall call your attention to evidence that some of the types which especially characterized certain geological periods survived in full vigor through later periods. But let us return to a consideration of the mesozoic rocks.

Those rocks of the great interior region which have by common consent, but upon comparatively slight evidence, been referred to the trias, are found upturned against the flanks of the Rocky Mountain, and other ranges, and exposed to view in the valleys and cañons of the plateau province. They reach several thousand feet in thickness, and are so nearly uniform in color and lithological character over the whole of the great area within which they occur that they are often designated as the "red beds." They are found resting upon rocks of different age in different places, but in some districts they rest with apparent conformity upon a series of sandstone strata which are probably of Permian age.

This formation is apparently of non-marine origin, and, as a rule, it is quite barren of fossils. The few molluscan remains that have been obtained from it give no indication as to its age, and, in the light of present knowledge, the few plant and vertebrate remains obtained from it are far from satisfactory in this respect. Still, it is not my object to deny the triassic age of this formation, but only to call your attention to the fact that paleontological evidence upon this point is very meagre.

Because of the paucity of fossils both in this formation and in the reputed Permian upon which it rests in different districts, little is known of any paleontological relationship between them. There are, however, some indications of such relationship that deserve mention. The case of the commingling of mesozoic and paleozoic types in the Permian of Texas has already been stated. Another case in South Park, Colorado, may be mentioned, and the possible occurrence of still another in south-eastern Idaho may be suggested.

Important collections of plants and insect remains have been obtained from certain strata in South Park which are reported as immediately overlying rocks of unquestionable carboniferous age. The plants are regarded by Professor Ward as constituting the most characteristic Permian flora that has been found on this continent. The stratigraphical relation of these rocks is also suggestive of their Permian age; and yet Mr. Scudder referred the insects to the trias without qualification.

Some years ago Dr. Peale discovered in south-eastern Idaho an unique assemblage of fossils in strata which rest conformably upon the carboniferous, and evidently occupy a position beneath the triassic red beds, which occur in the same neighborhood. A part of the species belong to the *Ammonitida* and a part to the *Ceratitida*; and upon the evidence of these cephalopods Professor Hyatt referred the strata bearing them to the middle trias of Europe. When one remembers that cephalopod forms similar to those just referred to occur in India associated with a characteristic carboniferous fauna, he naturally inquires whether it is not possible that the Idaho strata ought to be referred to a period not later than the Permian.

Those Idaho strata and the South Park and Texan Permian all possess great interest as indicating an intimate relationship between the mesozoic and the carboniferous of the interior region; and if the record between the paleozoic and the mesozoic had not been so generally and so badly broken on this continent, we should doubtless now find many similar and more complete cases of the commingling of earlier and later types.

Some American field geologists have privately, if not publicly, expressed the opinion that the Permian ought to be assigned to the mesozoic, rather than to the paleozoic; but notwithstanding the paleontological relationship that has just been mentioned, such

a view is untenable when all the known facts are considered. It is at present sufficient to say that the great break between the mesozoic and paleozoic of North America occurred while yet paleozoic forms of life were far in excess of mesozoic forms; and that almost all the North American strata that have been recognized as of Permian age appear to have been the result of continuous sedimentation from the carboniferous. In short, all the hitherto recognized or reputed Permian of North America is far more intimately related, both paleontologically and stratigraphically, with the paleozoic than with the mesozoic. Therefore the lower delimitation of the North American mesozoic must coincide with the base of the lowermost discovered triassic strata.

A few hundred feet in thickness of strata, which have by common consent long been referred to the Jurassic, are found within a large part of the middle portion of the interior region, resting conformably upon the triassic strata which have already been noticed. Where these Jurassic strata have been fully studied, especially in Colorado and Wyoming, they are separable into an upper and a lower portion, the lower portion being of marine, and the upper of fresh-water origin. The invertebrate fossils of the upper portion are mostly of types that are now living, and are, therefore, of no value as indicating their geological age. Those of the lower portion are few, and the cephalopods only, or mainly, present such characters as to suggest their Jurassic age; and it was upon this slight evidence, together with the relative position of the strata, that their reference to the Jurassic was first made.

Professor Marsh's well-known publications of the remarkable dinosaurian faunas from both the upper and lower portions of the strata in question have left no reasonable doubt that they are really of Jurassic age. Professor Marsh refers all these strata to the upper Jurassic of Europe; and in connection with this statement I wish to call your attention to the fact that wherever they have been found in contact with the triassic strata already discussed, they are not only strictly conformable, but they seem to have been the result of continuous sedimentation. In fact, it is paleontology alone that suggests an hiatus between them. The field geologist finds no evidence of it.

The Jurassic rocks of the interior region disappear both to the northward and southward, their geographical range being apparently a little less than that of the underlying triassic beds. No equivalent of the former has been found in Canada, although the cretaceous Dakota group, which immediately overlies the Jurassic further southward, has been recognized there. It may be remarked also that where the Jurassic is not present beneath the cretaceous, the latter, especially in the eastern part of the region, is often found resting directly upon the older rocks, sometimes even upon the archæan. In Texas the Jurassic is also absent from beneath the marine formation, which is regarded as the representative of the Dakota group there, the latter resting directly but unconformably upon the Comanche beds, to be presently noticed.

Omitting present consideration of the isolated masses of reputed Jurassic rocks in western Nevada and eastern California, this subdivision of the mesozoic seems to be represented in North America mainly by the slight accumulation of strata in the interior region which has just been noticed. We know little or nothing of the flora which existed when these strata were deposited; their invertebrate fossils are of little value in determining their geological age, and if it were not for their dinosaurian faunas their Jurassic age might well be questioned.

The section of the cretaceous formations which prevail in the central portion of the interior region, and to which I shall more particularly refer in following remarks, differs materially from a similar section in the southern portion, usually known as the Texas section. Meek and Hayden divided the cretaceous of the central portion of the region into the Dakota, Benton, Niobrara, Pierre, and Fox Hills groups, the first mentioned being the earliest, and the last one mentioned the latest. In Texas the cretaceous section is continued much beneath the equivalent of the Dakota group there. These lower Texan strata constitute the important marine formation now known as the Comanche beds, the molluscan fauna of which gives peculiar paleontological character to the Texas section. Above the Comanche beds there is a series of formations

that are understood to respectively represent all the more northern formations which have just been mentioned.

After due consideration of all the known facts, some of which are of recent acquisition, there seems to be no room for reasonable doubt that the marine cretaceous deposits of the interior region which are later than the Dakota group are, as a whole, not only equivalent with the marine cretaceous deposits of the Atlantic and Gulf coast region, but that they were all originally continuous through the whole of that great geographical extent. These formations are too well known to need present characterization; and they are now known to constitute the most extensive and definite taxonomic horizon that has been recognized among the mesozoic formations of this continent. Furthermore, the marine molluscan fauna of these strata is of such a character as to leave little room for doubt that they represent homotaxially the Senonian, and perhaps a part of the Danian, of Europe. The difficulty, however, of accurately correlating the cretaceous formations of this continent with those of Europe is very great, as has, for example, lately been indicated by Professor Rømer's reference of certain fossils of the Comanche beds to the upper Turonian. These beds lie wholly and unconformably beneath the horizon of the Dakota group, which is itself not probably newer than the Cenomanian.

Before proceeding to a consideration of the Laramie group, it is proper to say that the presence in British America of the Kootanie formation beneath the Dakota group, and that of the Comanche beds beneath the equivalent of the latter in Texas, shows that there is really an hiatus between the Dakota and the Jurassic in the interior region, although their conformity is so complete that it has never been detected by field observation. If a similar hiatus exists between the Jurassic and triassic in the same region, we have also no stratigraphical evidence of it.

The Laramie is in many respects one of the most remarkable of the North American formations. It is found occupying large portions of the interior region from the State of Nuevo Leon in Mexico to beyond 52° north latitude. It reaches a maximum thickness of nearly four thousand feet in Colorado, and more than that in British America. It is not only everywhere conformable upon the Fox Hills group, but wherever the junction between them has been seen, sedimentation from the older to the later formation appears to have been continuous.

In all its great geographical extent the Laramie group has never been found to contain any animal remains similar to those which inhabit the open sea only. A considerable proportion of its invertebrates are like those which are now denizens of brackish waters, and a still greater proportion are fresh-water forms. It is mainly upon this abrupt change from a marine to a brackish and fresh water character of the molluscan fossils, and not upon stratigraphical difference, that we rely to determine the lower limit of the Laramie formation.

The labors of Dr. G. M. Dawson and Mr. Whiteaves, and their associates in the Canadian Survey, have shown that conditions similar to those which gave character to the Laramie formation existed in a large part of the northern interior region long before the close of the Fox Hills epoch, and that they were probably continued into the Laramie epoch. But time will not permit me now to discuss this interesting question.

Besides the invertebrate fauna which has just been referred to, a few insect remains, a rich flora and a somewhat extensive and varied vertebrate fauna have been obtained from the Laramie formation. None of the molluscan remains, so far as I can judge, possess characters which any similar forms might not have possessed at any time from the middle cretaceous to the eocene inclusive; and a large part of them differ from living forms only as species.

Similar remarks may be properly made concerning the plant remains of the Laramie formation. Professor Ward has shown that of the one hundred and twelve genera of plants which have been discovered in the Laramie, thirty-eight of the genera and five of the species are common to the Dakota Group; eighty-five of the genera are living and twenty-seven are extinct. These extinct genera are all so nearly allied to living genera respectively that it is difficult to separate them. Furthermore, not less than three species from the upper strata of the Laramie have been identified with living species.

Mr. Scudder has referred the insect remains to the tertiary, but the vertebrate remains, especially those of mammals and land reptiles, are of more ancient types than those of the plants and invertebrates. Among the few Laramie mammals that have been discovered there is no indication as to the ancestry of that great mammalian fauna which characterized the immediately following Wasatch period. The reptiles are mainly dinosaurs of cretaceous types, but some of them seem to possess characters that suggest their Jurassic age.

Some paleontologists have long hesitated to give an opinion as to the true taxonomic position of the Laramie formation; but those who have studied the vertebrates only have usually referred it unqualifiedly to the cretaceous, apparently assuming that, containing dinosaurian remains, it could not be of later age. Field geologists, especially those who practically ignore paleontological evidence, also refer the Laramie to the cretaceous, because of its intimate stratigraphical relation to the marine cretaceous beneath it, and because in all the principal displacements, which the latter has suffered in the interior region, the Laramie was equally involved.

The formations which overlie the Laramie were, by common consent, long regarded as of tertiary age; but concerning the age of some of them, difference of opinion have since arisen. Between the Laramie and any overlying formation there is often, but not always, unconformity. In Utah, and apparently in the valley of the lower Yellowstone also, I have found the Laramie passing gradually up into purely fresh-water deposits without any stratigraphical break. In the former case I am sure, and in the latter case I believe with Professor Newberry, that the upper strata represent the lower part of the Wasatch group.

In Utah several of the fresh-water molluscan species, which are widely distributed in the Laramie, are found to have passed up into the Wasatch, thus confirming the stratigraphical evidence of the immediate succession of the Wasatch upon the Laramie. In southern Wyoming dinosaurian remains are found in some of the uppermost strata of the Laramie; and the lowermost Wasatch strata in the same region bear coryphodont and other placental mammalian remains; but remains of these two orders have never been found commingled. Still, in view of the facts just stated, it is not possible to doubt that those placental mammals lived contemporaneously with at least the last of the Laramie dinosaurs.

In north-western New Mexico and south-western Colorado, Professor Cope has found certain strata at the base of the Wasatch, and overlying the Laramie, to contain the remains of a peculiar vertebrate fauna whose distinguishing members are placental mammals which are quite different from those of the Wasatch. These strata he designates as the Puerco group, and he now refers them, together with the Laramie, to the cretaceous, because of certain characteristics which the Puerco mammalian and reptilian remains present; but he formerly regarded that group of strata as of Cenozoic age. These Puerco strata have the appearance of having been deposited simultaneously with those which elsewhere constitute the lower portion of the Wasatch group; and before their vertebrates were studied by Professor Cope their identity with the Wasatch was not questioned.

But we are not yet done with dinosaurs. Mr. George H. Eldridge has lately shown that in the vicinity of Denver, Col., there is a distinct formation, from 600 to 1200 feet in thickness resting unconformably upon the Laramie, which he has called the Arapahoe formation. Mr. Whitman Cross has also lately shown that still another formation in the same district, having a maximum thickness of fourteen hundred feet, rests unconformably upon both the Arapahoe and Laramie formations. To these strata he has given the name of Denver formation. The great aggregate thickness of these formations, together with their respective displacement with relation to the Laramie and, to each other, shows that much time must have elapsed between the deposition of the uppermost Laramie strata in that district and the uppermost Denver strata.

Mr. Cross shows that a large part of the plant remains, which have been reported as coming from the Laramie in this district, really came from the Denver formation. Some of the fresh-water mollusca of the Denver strata I am not able to distinguish from Laramie species. But the most unexpected fact of all which these gentlemen have brought out is that both these formations above

the Laramie contain dinosaurian remains in comparative abundance. The skull in some species is found to bear a pair of horns similar in posture and shape to those of the hollow-horned ruminants. Some of the bones also present characters which are suggestive of earlier mesozoic age; but in a general way, at least, these dinosaurs are similar to those of the Laramie.

The Laramie group does not reach its maximum thickness in the Denver district, and it is not known whether the latest Laramie strata are represented there. Both the Denver and Arapahoe formations are of limited extent, and it is quite probable that the latter, and perhaps the former, together represent the later portion of the Laramie period. But it is reasonable to infer that at least the later portion of the Denver formation was contemporaneous with the earlier fresh-water eocene strata of the Green River basin, notwithstanding the fact that the former bears dinosaurian remains.

The present state of our knowledge seems to justify us in regarding the marine cretaceous formations immediately beneath the Laramie as representing the Senonian of Europe, perhaps including even a part of the Danian. Now if we add to the American cretaceous the Laramie, Arapahoe, and Denver formations, we evidently extend the cretaceous in America much beyond its recognized latest limit in Europe.

But why, we may ask, should not those dinosaurs have survived from mesozoic, into tertiary time? Why should they not have continued their existence as long as physical conditions were favorable, and as long as they could compete in the struggle for existence with such mammalian faunas as that whose earliest known history is recorded in the earlier strata of the Wasatch formation?

Before summarizing the conditions of the mesozoic of the interior region and proceeding to a consideration of the Pacific coast section, I wish to refer to the relation of the Laramie group with the marine tertiary of the Gulf and the Atlantic coasts.

For reasons presently to be mentioned, no direct stratigraphical proof of contemporaneity of our great fresh-water inland deposits with marine coast deposits is possible, and direct paleontological proof is not to be expected. I had long hoped, however, that because the Laramie group was in part of brackish water origin its continuity or contact with some marine coast deposit might be discovered. Such a discovery was first announced by Professor Cope, which I afterward confirmed, and showed that in the vicinity of Laredo, Texas, the Laramie group as a whole underlies with apparent conformity marine strata which contain an abundance of *Cardita planicosta* and other characteristic eocene fossils; but I was not able to detect the continuity of the Laramie with any sea-coast formation.

It was this discovered relation of the Laramie to the Gulf coast eocene that was referred to by the suggestion in a previous paragraph that there is really an important hiatus, although apparent conformity, between the cretaceous and the tertiary deposits of the Atlantic coast. The Gulf coast eocene just mentioned being regarded as equivalent with that of the Atlantic coast, and the uppermost marine cretaceous immediately beneath the Laramie, as equivalent with the uppermost marine cretaceous of the Atlantic coast, it follows that the hiatus referred to equals the whole of the Laramie. It may also be mentioned in passing, that, both upon stratigraphical and paleontological evidence, I regard both the northern lignitic of Higard in Mississippi and its equivalent in eastern Texas as equivalent with the upper, lignite-bearing, portion of the Laramie as it occurs in the valley of the Rio Grande.

Very briefly summarizing the mesozoic of the interior region, we find that its lower delimitation is greatly lacking in uniformity, the lowest member being sometimes the triassic, sometimes, but rarely, the Jurassic, and sometimes the cretaceous. The triassic apparently represents the upper trias of Europe, the Jurassic, the upper Jura, and most of the cretaceous, the upper part of that subdivision of the mesozoic. Above the marine cretaceous strata, inland sea and lacustrine deposits were continued into tertiary time, apparently without a break, either paleontological or stratigraphical.

Having to deal with extensive inland deposits alone when investigating the immediate relation of the mesozoic to the cenozoic in the interior region, we find that the most direct means of determining such relationship is wanting, because the continuity of the

marine paleontological record is broken at the base of the Laramie formation. Still, the opinion that we have a continuous record there from cretaceous into tertiary time is strongly supported by paleontological and stratigraphical evidence. But we come now to consider the mesozoic of the Pacific coast region, where we shall find proof of unbroken continuity of marine deposits from the upper cretaceous to the tertiary. Time will not permit me now to discuss the mesozoic of western British America, which Dr. G. M. Dawson, Mr. Whiteaves, and other Canadian geologists have done such excellent work upon, and I must therefore confine myself mainly to the California section.

The rocks of this portion of the Pacific coast region have been so greatly displaced since their deposition that their study is more difficult than that of the rocks of the interior region. Still, our knowledge of the upper part of the Pacific coast mesozoic is quite satisfactory. The oldest mesozoic strata of the California section which I shall specially refer to on this occasion were, by the California geologists, assigned to the lower cretaceous, under the name of the Shasta group. But these strata do not probably represent the very earliest part of the cretaceous period.

The exact relation of the Shasta group to the cretaceous formations above it has not yet been made clear; but Mr. Diller's investigations in northern California seem to indicate that the hiatus between them is not so marked as has been supposed. The geologists of the California Survey did not recognize any formation as belonging between the Shasta and Chico groups, but Dr. G. F. Becker has reported upon a series of strata in Mendocino county which he believes to be later than the Shasta, and earlier than the Chico. Upon examining the fossils which he collected from those strata, some of the species of which have also been found at Todos Santos Bay in Lower California, I concurred in his opinion, and suggested for those strata and their equivalents the name of Wala-lala group. Still, actual contact of this group with any other cretaceous strata has not yet been discovered, and its actual taxonomic position is not known.

From the base of the Chico group upward, the series of California strata which has been referred to the cretaceous is so well known that little if any difference of opinion exists as to essential facts concerning it, although a wide difference of opinion has arisen as to their significance and importance. This series, aggregating more than ten thousand feet in thickness, was divided into two groups by the California geologists; namely, the Chico below and the Téjon above, although they recognized the fact that there is no distinct break, either paleontological or stratigraphical, between them.

A considerable number of fossil invertebrates, among which are a species of baculites and several ammonitic forms, constitute such a decided mesozoic feature of the fauna of the lower portion of this Chico-Téjon series that the California geologists naturally and properly referred it to the cretaceous. The upper, or Téjon, portion contains a fauna that is so obviously cenozoic in character that several geologists, especially Heilprin and Conrad, have strenuously contended that it is of eocene age. A large proportion of these Téjon species are found to be so common in the Chico portion that if they were not there commingled with the cretaceous forms just referred to, the tertiary age of those lower strata would hardly be questioned. In short, there is in this stratigraphically unbroken Chico-Téjon series of California, a gradual transition of faunal characteristics from the cretaceous to the tertiary.

This transition was recognized by Mr. Gabb, and yet he referred the whole series to the cretaceous. His view was that, a portion of the series being assigned to the cretaceous, the remainder of it must follow, because the series can only be arbitrarily divided; and other geologists still entertain a similar opinion. By whatever name or names this great series of strata may be known, it is plain that it represents a continuous portion of geological time, extending from the later mesozoic to the earlier cenozoic age inclusive. Therefore the mesozoic series of strata in this portion of the Pacific coast region has really no definable upper limit.

It is true that by our present methods it is inconvenient to classify a series of strata like this, but the recognition of its true character is of far more importance than mere convenience of classification. Indeed this case constitutes one of the most instructive

discoveries that has been made in the whole range of historical geology; and it should be understood as demonstrating that abrupt transitions from one epoch, period, or age to another have always been due to local or regional changes in physical conditions; or, in other words, to accidental circumstances.

Concerning the relation of the other members of the California section of the mesozoic to the Chico-Téjon series, or to each other, and the relation of the lowest of those formations to the Jurassic, our knowledge, as before mentioned, is imperfect.

The satisfactory correlation of a part of the cretaceous formations of the interior region with those of the Atlantic coast region has already been mentioned; but we have never been able to satisfactorily correlate any of the cretaceous formations of the Pacific coast region which have been mentioned, with any of those of the interior and Atlantic coast regions, even in cases of presumable contemporaneity. If such correlations are ever made, we must expect them through the labors of the Canadian geologists in the North-west. The whole fauna of each of the Pacific coast formations referred to seems to be different from that of any of the more eastern formations, the few cases in which specific identity has been recognized being of doubtful character. This inability to correlate formations in different and not far distant parts of our own continent, which were presumably contemporaneous in their origin, may well cause us to doubt the correlation of at least a part of the American formations with those of other parts of the world which various authors have confidently assumed.

It has already been shown that the lower limit of the North American mesozoic must coincide with the lowermost triassic strata in any given section, whether those strata are regarded as representing the earlier or the later trias; and that no strata hitherto recognized as Permian can be reasonably referred to the mesozoic. That is, the lower limit is defined by a great break in the geological record of this continent, constituting an hiatus, which began before the full completion of paleozoic time and continued until after the beginning of mesozoic time.

But we are quite unable to designate clearly the upper limit of the mesozoic in at least a large portion of this continent. It is true that in the Atlantic coast region the upper limit of the mesozoic is clearly marked where the marine eocene rests upon the uppermost of the cretaceous strata there, but that delimitation is produced by an hiatus. In portions of both the interior and Pacific coast regions, however, it is quite impossible to clearly designate the delimiting boundary between the mesozoic and cenozoic, because in at least a part of both regions no break in either the stratigraphical or paleontological record occurred until after cenozoic time was fully established.

In connection with the foregoing brief summary of the characteristics of the North American mesozoic, certain views have been expressed which I entertain in common with some, but not all, other geologists concerning the correlation of formations and the inter-relation of presumably contemporaneous fossil faunas and floras. The following propositions are offered as the basis of those views. A part of them, however, will not be questioned by any geologist, but these are given with the others for the sake of relevancy.

(1) In accordance with the principles of modern biology, we must conclude that, although it has not been demonstrated by actual discovery, there has been a continuous genetic succession of living organisms upon the earth ever since life began; that is, while numerous breaks in that succession have occurred, they have never been of universal, but only of local or regional extent, and they have been due to similarly restricted physical changes.

(2) The record of that succession of living organisms has been accomplished and preserved by the natural entombment of their fossilizable remains in aqueous sedimentary deposits. Subsequent physical changes have destroyed or rendered inaccessible a large part of the record, and all we know of that succession is derived from such of those remains as we have been fortunate enough to discover.

(3) The record of the succession of terrestrial life has been far less complete, and has suffered greater interruptions, than that of aqueous life, because the record of the former has been made under conditions which were irrelevant or inimical to that life, and

the entombment of its remains has always occurred under accidental conditions.

(4) The record of marine life is necessarily more complete than that of any other, because the seas have furnished continuous and more uniform conditions than either the land or fresh waters, and because the preservation of its remains was a natural consequence of the conditions under which that life existed. Therefore the record of marine life was less modified by other than evolutionary changes of a cosmical character than that of the land and fresh waters, and it is consequently more trustworthy as an index of the progress of geological time.

(5) Breaks or interruptions in the succession of marine forms of life have been coincident with breaks of continuity, or with changes in the characters of the sediments by which their remains were entombed. These breaks in sedimentation, and in the succession of living organisms, are used by all geologists as indicating the delimiting boundaries of geological epochs, periods, and ages respectively, as well as of formations and systems. Their causes were independent of the existence of life, and their occurrence was accidental with reference to it.

It therefore follows that the recognizable time record in one part of the world is necessarily different in its divisions from that of any other part. For example, a period the close of which was marked by such interruptions as have been mentioned in one part of the world would be continued in other parts as long afterward as the occurrence of similar breaks there should be postponed. While such interruptions were occurring in one or more parts of the world, life and sedimentation were continuous and unaffected by them in others. This is plainly shown in the case of the Chico-Téjon series in California, because no inter-delimiting boundary occurs between its cretaceous and the tertiary portions, as has already been explained; while an evident hiatus exists between the uppermost known cretaceous and the lowermost known tertiary both in Europe and a large part of North America.

(6) While there has been progressive development in the order of succession of living organisms from lower forms in earlier, to higher forms in later geological time, the rate of progress of that development has not been uniform in all parts of the world for the same kinds of life. For example, the plant life of North America is now understood to have reached, in later mesozoic time, a higher stage of development with relation to animal life than it had in Europe; and the difference in grade among the now living indigenous faunas of the different continents respectively, indicates that a similar difference in the rate of development has also prevailed in different divisions of the animal kingdom.

(7) The various stages of progressive development of living organisms have been marked by the successive introduction and extinction of class, ordinal, family, and generic types; and yet certain of those types survived in some parts of the world during long epochs after they had become extinct in other parts. This proposition is supported by such facts as that of the survival into the Laramie, Arapahoe, and Denver epochs, of dinosaurian faunas which apparently show little if any indication of decadence or of approaching extinction; and also by the survival of highly organized representatives of mesozoic families and genera to the present time. Therefore it is not to be expected that we should find exactly the same association of faunal and floral types, or evidence of more than approximately the same grade of development of life in contemporaneous but widely separated formations. Therefore, also, the custom which has been adopted by some paleontologists of making the assumed absence of certain of those types a distinguishing element in the chronological diagnosis of formations is by no means to be commended, even if it were possible for us to discover remains of all the forms of life which then and there existed.

(8) Correlation of lake and inland sea deposits with those of open-sea origin, even within the same continental area, is necessarily a matter of uncertainty. This uncertainty is due to the great difference in the character of the faunas of those waters respectively, to the fact that constituent members of faunas of inland waters were not so diversely differentiated in the course of geological time as were those of marine waters; and also the inevitable want of geographical continuity of the two classes of deposits with each other, even in cases of actual contemporaneity. The only really

trustworthy paleontological means of determining the equivalency or contemporaneity of deposits in such cases as these is the specific identification of such remains of land animals and plants as may have found entombment in then existing contiguous inland waters, on the one hand, and marine waters on the other. For reasons mentioned in proposition 6, the mere similarity of types, even of the more highly organized animals and plants, which may be discovered in different districts cannot be relied upon as indicating contemporaneity. Geographical continuity of strata being always wanting in such cases, the only aid to be expected from stratigraphy in determining equivalency of the formations must come through the discovery of the overlying or underlying position of the inland deposits with reference to marine deposits of known geological age.

It will be seen that these propositions involve serious questionings of the validity of certain methods and practices common among many of those geologists who devote themselves mainly or exclusively to paleontology. Such questionings afford scope for elaborate and varied discussions, but I shall close my present remarks with only a brief reference to the general subject of a proper recognition of a universal scheme of geological classification, which must of course have a biological basis.

The greater part of my own geological studies having been prosecuted from a biological standpoint, I am naturally not disposed to underestimate the value of paleontology as a branch of geological investigation, nor to encourage, even by incidental utterance, those who do. But I am sure no greater harm can be done to paleontological science than either to encourage, or to fail to oppose, the erroneous views which some of its votaries are shown by their own publications to entertain. For example, it is apparent to every one who is at all familiar with paleontological literature that many authors assume to designate with precision the geological age of any and all fossils submitted to them, as well as the taxonomic position of the strata from which they were obtained, without reference to stratigraphy, or to any related geological fact.

Those paleontologists who make this unwarranted application of their science to systematic geology, all use the scheme of classification that has been established for Europe, and use it as if it were of infallible application to all other parts of the world, and also as if it were already absolutely perfected for that continent. While I have no inclination to question the general accuracy of the European scheme of classification for that continent, I do not hesitate to express the opinion that it is not of infallible application to other parts of the world, except as to its larger divisions, and that even in this respect it will need modification. That is, I hold that investigations of the formations which are found upon any given continent or great division of the earth's surface ought to be prosecuted, first, with relation to one another, and second, with reference to their ultimate, not immediate, correlation with those of other continents or divisions.

It is true that the general consensus of geological thought and opinion has long been in favor of adopting the European scheme of classification in all, or nearly all, its details as applicable to all other parts of the world, and every considerate naturalist will treat such opinion with deference. But prevalence of opinion is by no means proof of its accuracy. None of the older naturalists present need be reminded of the great revolution in opinion that took place a little more than twenty years ago; and the older geologists will remember that the degree of displacement, the amount of consolidation, the crystallization and the lithological composition, of strata, were once accepted by all geologists as indices of the geological age of the formations which they composed. Remembering these incidents in the history of natural science, it does not seem unreasonable that present opinions should be frequently questioned, even those which are generally accepted.

I do not wish to be understood as condemning the scheme of classification now in use, nor even as recommending the present substitution of it by any other; but I insist that for universal application, it is plainly imperfect. A scheme of classification, as a working rule, is not only a convenience but a constant necessity; so constant, indeed, that I have not been able to present these remarks without its aid. But while the one which has been established for Europe ought by no means to be discarded, it ought to

be used tentatively in each of the great divisions of the earth, and with reference to the ultimate establishment of a universal scheme after all those divisions have been thoroughly investigated.

The time has come when North American geologists can, and ought to, hold a commanding position in this respect; and when we have elaborated a scheme of classification for the formations of our own continent, it will have equal claim to the favorable consideration of the geological world with any other.

NOTES AND NEWS.

AFTER a stoppage of two years, caused by a lack of funds, work was recently resumed on the double tunnel under the Hudson River between this city and the New Jersey side. Operations are restricted as yet to the Jersey City end of the north or up-river tunnel, which has been excavated to a distance of nearly two thousand feet from the shaft. The total length of the tunnel from shaft to shaft, when completed, will be 5,600 feet, to which must be added the length of the inclines or approaches leading to the surface, work upon which has not been begun. Work is carried on under an air-pressure of about thirty-four pounds to the square inch, and the heading progresses at the rate of twenty-five feet a week.

— Professor Elihu Thompson has perfected an invention by which the rails of street or steam railways may be welded together by electricity after being placed in position. A dynamo propels over the tracks an electric welding machine, which welds the rails into one continuous line after it passes over them. It is proposed to have at every one hundred feet a break, to allow for expansion. Any kind of rails can thus be welded.

— There has been patented in Germany a process by means of which sulphuric acid for manufacturing purposes can be safely transported. The inventor takes advantage of a property of certain salts—of which alkaline sulphates are representatives—by which they give up their water of crystallization when heated and take it up again when cool; and he does so by mixing the salts in an anhydrous condition with a calculated quantity of sulphuric acid. The whole mass becomes granular, or may be formed into cakes, and when heated the whole liquefies, and may be used as if it were sulphuric acid, for the presence of bisulphate of soda does no harm.

— Several reports received at the Hydrographic Office in Washington during the past month serve to illustrate the source of many doubtful or imaginary dangers to navigation that encumber the charts so long before their existence can be disproved. On July 14, in 43° 17' north latitude, 57° 32' west longitude, the captain of a Norwegian vessel sighted an immense dead whale which at a distance had the appearance of a rock. A number of sea-birds were about it. On July 22 the German steamship "National," while on a scientific exploring expedition, passed a dead whale under similar circumstances. On Aug. 2 the captain of a British steamship sighted a dead whale, about a hundred feet long, showing six feet out of water. It will readily be seen how easily such an obstruction might be mistaken for a shoal, and, if reported in a region where the depths are not too well known to admit of the possibility of such a thing, it might add one more doubtful danger to the many that have been reported.

— A nailless horseshoe which has been undergoing severe tests in England during the past two years, with satisfactory results, is described as follows: The shoe is attached by a steel band which passes below the coronet from one extremity of the heel to the other. This band is kept in position by a steel pillar which runs from the centre of the shoe up to the centre of the hoof. In addition there are three short studs, one in the centre of the shoe, and the others near the heel and on each side of it. It can be put on by any one who has once seen the process, which takes about half the time required with the cold-shoe system, which latter is an improvement as regards time on the ordinary process with nails. The nailless shoe diminishes or puts an end to cutting, and is particularly suited to brittle hoofs or hoofs with sand cracks. It costs as little, weighs as little, and lasts as long as the ordinary shoe; and, moreover, is not sucked off on heavy ground.

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ONE OF THE FEATURES of the meeting of The American Association at Toronto just closed was the growth of the societies devoted to special branches of science which meet each year at the same time and place as the association. The Botanical Club has been in successful operation for some years, as has also the Agricultural Society. This year there was held a meeting of the Geologic Society, and the formation of a chemical society was vigorously discussed. The Entomological Club is another of the groups into which congenial spirits unite, possibly to free themselves of the more cumbersome meetings of the sections of the association. Of the vice-presidents' addresses, we print this week those of vice-presidents R. S. Woodward and C. A. White. That by Professor H. S. Carhart, in the Physics Section, was a review of theories of electrical action. In the Chemical Section, Professor W. L. Dudley spoke of "The Nature of Amalgams." He gave a *résumé* of the most important work done in this interesting field, and a few results of his own. Appended to the address is a complete index to the literature, embracing over three hundred titles. In the Section of Mechanics and Engineering no address was delivered, and the work of the section was quickly over, few papers being presented. Vice-president G. L. Goodale's address before the Biologic Section was on protoplasm. The address of Vice-president Garrick Mallory, before the Anthropologists, treated of the "Israelite and Indian, a Parallel in Planes of Culture." This we hope to print in an early number. The remarks of Vice-president C. S. Hill before the Eco-

nomic Section on the "Economic and Sociologic Relations of the Canadian States and the United States, prospectively considered," roused considerable criticism. The meeting adjourned to meet next year on the third Wednesday in August at Indianapolis. The officers of the meeting will be as follows: president, Professor George L. Goodale, Harvard University; vice-presidents, A. Mathematics and Astronomy, S. C. Chandler, Cambridge, Mass.; B. Physics, Cleveland Abbe, Washington; C. Chemistry, R. B. Warder, Washington; D. Mechanical Science and Engineering, James E. Denton, Hoboken, N. J.; E. Geology and Geography, John C. Branner, Little Rock, Ark.; F. Biology, C. S. Minot, Boston, Mass.; H. Anthropology, Frank Baker, Washington; I. Economic Science and Statistics, J. Richards Dodge, Washington; permanent secretary, F. W. Putnam, Cambridge, Mass.; office, Salem, Mass.; general secretary, H. Carrington Bolton, of New York; secretary of the council, James Loudon, Toronto; secretaries of the sections, A. Wooster A. Beman, Ann Arbor, Mich.; B. W. Le Conte Stevens, Brooklyn, N. Y.; C. W. A. Noyes, Terre Haute, Ind.; D. M. E. Cooley, Ann Arbor, Mich.; E. Samuel Calvin, Iowa City, Iowa; F. John M. Coulter, Crawfordsville, Ind.; G. H. Joseph Jastrow, Madison, Wis.; H. I. S. Dana Horton, Pomeroy, Ohio; treasurer, William Lilly, of Mauch Chunk, Penn.; auditors, Henry Wheatland, Salem, Mass.; Thomas Meehan, Philadelphia.

THE MATHEMATICAL THEORIES OF THE EARTH.¹

THE name of this section, which, by your courtesy, it is my duty to address to-day, implies a community of interest among astronomers and mathematicians. This community of interest is not difficult to explain. We can of course imagine a considerable body of astronomical facts quite independent of mathematics. We can also imagine a much larger body of mathematical facts quite independent of and isolated from astronomy. But we never think of astronomy in the large sense without recognizing its dependence on mathematics, and we never think of mathematics as a whole without considering its capital applications in astronomy.

Of all the subjects and objects of common interest to us the earth will easily rank first. The earth furnishes us with a stable foundation for instrumental work and a fixed line of reference, whereby it is possible to make out the orderly arrangement and procession of our solar system and to gain some inkling of other systems which lie within telescopic range. The earth furnishes us with a most attractive store of real problems: its shape, its size, its mass, its precession and nutation, its internal heat, its earthquakes and volcanoes, and its origin and destiny, are to be classed with the leading questions for astronomical and mathematical research. We must of course recognize the claims of our friends the geologists to that indefinable something called the earth's crust, but, considered in its entirety and in its relations to similar bodies of the universe, the earth has long been the special province of astronomers and mathematicians. Since the times of Galileo and Kepler and Copernicus it has supplied a perennial stimulus to observation and investigation, and it promises to tax the resources of the ablest observers and analysts for some centuries to come. The mere mention of the names of Newton, Bradley, d'Alembert, Laplace, Fourier, Gauss, and Bessel calls to mind not only a long list of inventions and discoveries, but the most important parts of mathematical literature. In its dynamical and physical aspects the earth was to them the principal object of research, and the thoroughness and completeness of their contributions toward an explanation of the "system of the world" are still a source of wonder and admiration to all who take the trouble to examine their works.

A detailed discussion of the known properties of the earth and of the hypotheses concerning the unknown properties, is no fit task for a summer afternoon: the intricacies and delicacies of the subject are suitable only for another season and a special audience. But it has seemed that a somewhat popular review of the state of our mathematical knowledge of the earth might not be without in-

terest to those already familiar with the complex details, and might also help to increase that general interest in science, the promotion of which is one of the most important functions of this association.

As we look back through the light of modern analysis, it seems strange that the successors of Newton, who took up the problem of the shape of the earth, should have divided into hostile camps over the question whether our planet is elongated or flattened at the poles. They agreed in the opinion that the earth is a spheroid, but they debated, investigated, and observed for nearly half a century before deciding that the spheroid is oblate rather than oblong. This was a critical question, and its decision marks perhaps the most important epoch in the history of the figure of the earth. The Newtonian view of the oblate form found its ablest supporters in Huyghens, Maupertuis, and Clairaut, while the erroneous view was maintained with great vigor by the justly distinguished Cassinian school of astronomers. Unfortunately for the Cassinians, defective measures of a meridional arc in France gave color to the false theory and furnished one of the most conspicuous instances of the deterring effect of an incorrect observation. As you well know, the point was definitely settled by Maupertuis's measurement of the Lapland arc. For this achievement his name has become famous in literature as well as in science, for his friend Voltaire congratulated him on having "flattened the poles and the Cassinians," and Carlyle has honored him with the title of "Earth-flattener."

Since the settlement of the question of the form, progress towards a knowledge of the size of the earth has been consistent and steady, until now it may be said that there are few objects with which we have to deal whose dimensions are so well known as the dimensions of the earth. But this is a popular statement, and like most such, needs to be explained in order not to be misunderstood. Both the size and shape of the earth are defined by the lengths of its equatorial and polar axes; and, knowing the fact of the oblate spheroidal form, the lengths of the axes may be found within narrow limits from simple measurements conducted on the surface, quite independently of any knowledge of the interior constitution of the earth. It is evident in fact, without recourse to mathematical details, that the length of any arc, as a degree of latitude or longitude, on the earth's surface, must depend on the lengths of those axes. Conversely, it is plain that the measurement of such an arc on the surface and the determination of its geographical position, constitute an indirect measurement of the axes. Hence it has happened that scientific as distinguished from practical geodesy has been concerned chiefly with such linear and astronomical measurements, and the zeal with which this work has been pursued is attested by triangulations on every continent.

Passing over the earlier determinations as of historical interest only, all of the really trustworthy approximations to the lengths of the axes have been made within the half century just passed. The first to appear of these approximations were the well-founded values of Airy, published in 1830. These, however, were almost wholly overshadowed and supplanted eleven years later by the values of Bessel, whose spheroid came to occupy a most conspicuous place in geodesy for more than a quarter of a century. Knowing as we now do that Bessel's values were considerably in error, it seems not a little remarkable that they should have been so long accepted without serious question. One obvious reason is found in the fact that a considerable lapse of time was essential for the accumulation of new data, but two other possible reasons of a different character are worthy of notice, because they are interesting and instructive whether specially applied to this particular case or not. It seems not improbable that the close agreement of the values of Airy and Bessel, computed independently and by different methods, — the greatest discrepancy being about one hundred and fifty feet, — may have been incautiously interpreted as a confirmation of Bessel's dimensions, and hence led to their too ready adoption. It seems also not improbable that the weight of Bessel's great name may have been too closely associated in the minds of his followers with the weight of his observations and results. The sanction of eminent authority, especially if there is added to it the stamp of an official seal, is sometimes a serious obstacle to real progress. We cannot do less than accord to Bessel the first place among the

¹ Address before the Section of Mathematics and Astronomy of the American Association for the Advancement of Science, at Toronto, Ont., Aug. 28-Sept. 3, by R. S. Woodward, vice-president of the section.

astronomers and geodesists of his day, but this is no adequate justification for the exaggerated estimate long entertained of the precision of the elements of his spheroid.

The next step in the approximation was the important one of Clarke in 1866. His new values showed an increase over Bessel's of about half a mile in the equatorial semi-axis and about three-tenths of a mile in the polar semi-axis. Since 1886, General Clarke has kept pace with the accumulating data, and given us so many different elements for our spheroid that it is necessary to affix a date to any of his values we may use. The later values, however, differ but slightly from the earlier ones, so that the spheroid of 1866, which has come to be pretty generally adopted, seems likely to enjoy a justly greater celebrity than that of its immediate predecessor. The probable error of the axes of this spheroid is not much greater than the hundred thousandth part, and it is not likely that new data will change their lengths, by more than a few hundred feet.

In the present state of science, therefore, it may be said that the first order of approximation to the form and dimensions of the earth has been successfully attained. The question which follows naturally and immediately is, how much further can the approximation be carried? The answer to this question is not yet written, and the indications are not favorable for its speedy announcement. The first approximation, as we have seen, requires no knowledge of the interior density and arrangement of the earth's mass; it proceeds on the simple assumption that the sea surface is closely spheroidal. The second approximation, if it be more than a mere interpolation formula, requires a knowledge of both the density and arrangement of the constituents of the earth's mass, and especially of that part called the crust. "All astronomy," says Laplace, "rests on the stability of the earth's axis of rotation." In a similar sense we may say all geodesy rests on the direction of the plumb-line. The simple hypothesis of a spheroidal form assumes that the plumb-line is everywhere coincident with the normal to the spheroid, or that the surface of the spheroid coincides with the level of the sea. But this is not quite correct. The plumb-line is not in general coincident with the normal, and the actual sea level or geoid must be imagined to be an irregular surface lying partly above and partly below the ideal spheroidal surface. The deviations, it is true, are relatively small, but they are in general much greater than the unavoidable errors of observation, and they are the exact numerical expression of our ignorance in this branch of geodesy. It is well known, of course, that deflections of the plumb-line can sometimes be accounted for by visible masses, but on the whole it must be admitted that we possess only the vaguest notions of their cause and a most inadequate knowledge of distribution and extent.

What is true of plumb-line deflections is about equally true of the deviations of the intensity of gravity from what may be called the spheroidal type. Given a closely spheroidal form of the sea level and it follows from the law of gravitation, as a first approximation, without any knowledge of the distribution of the earth's mass, that the increase of gravity varies as the square of the sine of the latitude in passing from the equator to the poles. This is the remarkable theorem of Stokes, and it enables us to determine the form or ellipticity of the earth, by means of pendulum observations alone. It must be admitted, however, that the values for the ellipticity recently obtained in this way by the highest authorities, Clarke and Helmert, are far from satisfactory, whether we regard them in the light of their discrepancy or in the light of the different methods of computing them. In general terms we may say that the difficulty in the way of the use of pendulum observations still hinges on the treatment of local anomalies and on the question of reduction to sea level. At present, the case is one concerning which the doctors agree neither in their diagnosis nor in their remedies.

Turning attention now from the surface, towards the interior, what can be said of the earth's mass as a whole, of its laws of distribution, and of the pressures that exist at great depth? Two facts, namely, the mean density and the surface density, are roughly known; and a third fact, namely, the precession constant, or the ratio of the difference of the two principal moments of inertia to the greater of them, is known with something like pre-

cision. These facts lie within the domain of observation, and require only the law of gravitation for their verification. Certain inferences also from these facts and others have long been and still are held to be hardly less cogent and trustworthy, but before stating them, it will be well to recall briefly the progress of opinion concerning this general subject during the past century and a half.

The conception of the earth as having been primitively fluid was the prevailing one among mathematicians before Clairaut published his "Théorie de la Figure de la Terre" in 1743. By the aid of this conception Clairaut proved the celebrated theorem which bears his name, and probably no idea in the mechanics of the earth has been more suggestive and fruitful. It was the central idea in the elaborate investigations of Laplace, and received at his hands a development which his successors have found it about equally difficult to displace or to improve. From the idea of fluidity spring naturally the hydrostatical notions of pressure and level surfaces, or the arrangement of fluid masses in strata of uniform density. Hence follows, also, the notion of continuity of increase in density from the surface towards the centre of the earth. All of the principal mechanical properties and effects of the earth's mass, viz., the ellipticity, the surface density, the mean density, the precession constant, and the lunar inequalities, were correlated by Laplace in a single hypothesis, involving only one assumption in addition to that of original fluidity and the law of gravitation. This assumption relates to the compressibility of matter, and asserts that the ratio of the increment of pressure to the increment of density is proportional to the density. Many interesting and striking conclusions follow readily from this hypothesis, but the most interesting and important are those relative to density and pressure, especially the latter, whose dominance as a factor in the mechanics of celestial masses seems destined to survive whether the hypothesis stands or falls. The hypothesis requires that while the density increases slowly from something less than 3 at the surface to about 11 at the centre of the earth, the pressure within the mass increases rapidly below the surface, reaching a value surpassing the crushing strength of steel at the depth of a few miles, and amounting at the centre to no less than three million atmospheres. The inferences, then, as distinguished from the facts, are that the mass of the earth is very nearly symmetrically disposed about its centre of gravity, that pressure and density except near the surface are mutually dependent, and that the earth in reaching this stage has passed through the fluid or quasi-fluid state.

Later writers have suggested other hypotheses for a continuous distribution of the earth's mass, but none of them can be said to rival the hypothesis of Laplace. Their defects lie either in not postulating a direct connection between density and pressure or in postulating a connection which implies extreme or impossible values for these and other mechanical properties of the mass.

It is clear from the positiveness of his language in frequent allusions to this conception of the earth, that Laplace was deeply impressed with its essential correctness. "Observations," he says, "prove incontestably that the densities of the strata [*couches*] of the terrestrial spheroid increase from the surface to the centre;" and "the regularity with which the observed variation in length of a seconds pendulum follows the law of the squares of the sines of the latitudes, proves that the strata are arranged symmetrically about the centre of gravity of the earth." The more recent investigations of Stokes, to which allusion has already been made, forbid our entertaining anything like so confident an opinion of the earth's primitive fluidity or of a symmetrical and continuous arrangement of its strata. But, though it must be said that the sufficiency of Laplace's arguments has been seriously impugned, we can hardly think the probability of the correctness of his conclusions has been proportionately diminished.

Suppose, however, that we reject the idea of original fluidity. Would not a rotating mass of the size of the earth assume finally the same aspects and properties presented by our planet? Would not pressure and centrifugal force suffice to bring about a central condensation and a symmetrical arrangement of strata similar at least to that required by the Laplacian hypothesis? Categorical answers to these questions cannot be given. But whatever may have been the antecedent condition of the earth's mass, the conclusion seems unavoidable that at no great depth the pressure is suffi-

cient to break down the structural characteristics of all known substances, and hence to produce viscous flow whenever and wherever the stress difference exceeds a certain limit, which cannot be large in comparison with the pressure. Purely observational evidence also of a highly affirmative kind in support of this conclusion, is afforded by the remarkable results of Tresca's experiments on the flow of solids and by the abundant proofs in geology of the plastic movements and viscous flow of rocks. With such views and facts in mind, the fluid stage, considered indispensable by Laplace, does not appear necessary to the evolution of a planet, even if it reach the extreme refinement of a close fulfilment of some such mathematical law as that of his hypotheses. If, as is here assumed, pressure be the dominant factor in such large masses, the attainment of a stable distribution would be simply a question of time. The fluid mass might take on its normal form in a few days or a few months, whereas the viscous mass might require a few thousand or a few million years.

Some physicists and mathematicians, on the other hand, reject both the idea of the existence of great pressures within the earth's mass, and the notion of an approach to continuity in the distribution of density. As representing this side of the question, the views of the late M. Roche, who wrote much on the constitution of the earth, are worthy of consideration. He tells us that the very magnitude of the central pressure computed on the hypothesis of fluidity is itself a peremptory objection to that hypothesis. According to his conception, the strata of the earth from the centre outwards are substantially self-supporting and unyielding. It does not appear, however, that he had submitted this conception to the test of numbers, for a simple calculation will show that no materials of which we have any knowledge would sustain the stress in such shells or domes. If the crust of the earth were self-supporting, its crushing strength would have to be about thirty times that of the best cast steel or five to one thousand times that of granite. The views of Roche on the distribution of terrestrial densities appear equally extreme. He prefers to consider the mass as made up of two distinct parts, an outer shell or crust whose thickness is about one-sixth of the earth's radius, and a solid nucleus having little or no central condensation. The nucleus is conceived to be purely metallic, and to have about the same density as iron. To account for geological phenomena, he postulates a zone of fusion separating the crust from the nucleus. The whole hypothesis is consistently worked out in conformity with the requirements of ellipticity, the superficial density, the mean density, and precession; so that to one who can divest his mind of the notion that pressure and continuity are important factors in the mechanics of such masses, the picture which Roche draws of the constitution of our planet will present nothing incongruous.

In a field so little explored and so inaccessible, though hedged about as we have seen by certain sharply limiting conditions, there is room for a wide range of opinion and for great freedom in the play of hypothesis; and although the preponderance of evidence appears to be in favor of a terrestrial mass in which the reign of pressure is well-nigh absolute, we should not be surprised a few decades or centuries hence to find many of our notions on this subject radically defective.

If the problem of the constitution and distribution of the earth's mass is yet an obscure and difficult one after two centuries of observation and investigation, can we report any greater degree of success in the treatment of that still older problem of the earth's internal heat, of its origin and effects? Concerning phenomena always so impressive and often so terribly destructive as those intimately connected with the terrestrial store of heat, it is natural that there should be a considerable variety of opinion. The consensus of such opinion, however, has long been in favor of the hypothesis that heat is the active cause of many and a potent factor in most of the grander phenomena which geologists assign to the earth's crust; and the prevailing interpretation of these phenomena is based on the assumption that our planet is a cooling sphere whose outer shell or crust is constantly cracked and crumpled in adjusting itself to the shrinking nucleus.

The conception that the earth was originally an intensely heated and molten mass appears to have first taken something like definite form in the minds of Leibnitz and Descartes. But neither of

these philosophers was armed with the necessary mathematical equipment to subject this conception to the test of numerical calculation. Indeed it was not fashionable in their day, any more than it is with some philosophers in ours, to undertake the drudgery of applying the machinery of analysis to the details of an hypothesis. Nearly a century elapsed before an order of intellects capable of dealing with this class of questions appeared. It was reserved for Joseph Fourier to lay the foundation and build a great part of the superstructure of our modern theory of heat diffusion, his avowed desire 'being to solve the great problem of terrestrial heat. "The question of terrestrial temperatures," he says, "has always appeared to us one of the grandest objects of cosmological studies, and we have had it constantly in view in establishing the mathematical theory of heat." This ambition, however, was only partly realized. Probably Fourier underestimated the difficulties of his problem, for his most ingenious and industrious successors in the same field have made little progress beyond the limits he attained. But the work he left is a perennial index to his genius. Though quite inadequately appreciated by his contemporaries, the "Analytical Theory of Heat," which appeared in 1820, is now conceded to be one of the epoch-making books. Indeed, to one who has caught the spirit of the extraordinary analysis which Fourier developed and illustrated by numerous applications in this treatise, it is evident that he opened a field whose resources are still far from being exhausted. A little later Poisson took up the same class of questions and published another great work on the mathematical theory of heat. Poisson narrowly missed being the foremost mathematician of his day. In originality, in wealth of mathematical resources, and in breadth of grasp of physical principles, he was the peer of the ablest of his contemporaries. In lucidity of exposition it would be enough to say that he was a Frenchman, but he seems to have excelled in this peculiarly national trait. His contributions to the theory of heat have been somewhat overshadowed in recent times by the earlier and perhaps more brilliant researches of Fourier, but no student can afford to take up that enticing though difficult theory without the aid of Poisson as well as Fourier.

It is natural, therefore, that we should inquire what opinions these great masters in the mathematics of heat diffusion held concerning the earth's store of heat. I say "opinions," for, unhappily, this whole subject is still so largely a matter of opinion that in discussing it one may not inappropriately adopt the famous caution of Marcus Aurelius,—"Remember that all is opinion." It does not appear that Fourier reached any definite conclusion on this question, though he seems to have favored the view that the earth in cooling from an earlier state of incandescence reached finally, through convection, a condition in which there was a uniform distribution of heat throughout its mass. This is the *consistentior status* of Leibnitz, and it begins with the formation of the earth's crust if not with the consolidation of the entire mass. It thus affords an initial distribution of heat and an epoch from which analysis may start, and the problem for the mathematician is to assign the subsequent distribution of heat and the resulting mechanical effects. But no great amount of reflection is necessary to convince one that the analysis cannot proceed without making a few more assumptions. The assumptions which involve the least difficulty, and which for this reason partly have met with most favor, are that the conductivity and thermal capacity of the entire mass remain constant, and that the heat conducted to the surface of the earth passes off by the combined process of radiation, convection, and conduction, without producing any sensible effect on surrounding space. These or similar assumptions must be made before the application of theory can begin. In addition, two data are essential to numerical calculations, namely, the diffusivity, or the ratio of the conductivity of the mass to its thermal capacity, and the initial uniform temperature. The first of these can be observed, approximately at least; the second can only be estimated at present. With respect to these important points which must be considered after the adoption of the *consistentior status*, the writings of Fourier afford little light. He was content, perhaps, to invent and develop the exquisite analysis requisite to the treatment of such problems.

Poisson wrote much on the whole subject of terrestrial temper-

atures, and carefully considered most of the troublesome details which lay between his theory and its application. While he admitted the nebular hypothesis and an initial fluid state of the earth, he rejected the notion that the observed increase of underground temperature is due to a primitive store of heat. If the earth was originally fluid by reason of its heat, a supposition which Poisson regarded quite gratuitous, he conceived that it must cool and consolidate from the centre outwards; so that according to this view the crust of our planet arrived at a condition of stability only after the supply of heat had been exhausted. But Poisson was not at a loss to account for the observed temperature gradient in the earth's crust. Always fertile in hypotheses, he advanced the idea that there exist, by reason of interstellar radiations, great variations in the temperature of space, some vast regions being comparatively cool and others intensely hot, and that the present store of terrestrial heat was acquired by a journey of the solar system through one of the hotter regions. "Such is," he says, "in my opinion, the true cause of the augmentation of temperature which occurs as we descend below the surface of the globe." This hypothesis was the result of Poisson's mature reflection, and as such is well worthy of attention. The notion that there exist hot foci in space was advanced also in another form in 1852 by Rankine, in his interesting speculation on the re-concentration of energy. But whatever we may think of the hypothesis as a whole, it does not appear to be adequate to the case of the earth unless we suppose the epoch of transit through the hot region exceedingly remote and the temperature of that region exceedingly high. The continuity of geological and paleontological phenomena is much better satisfied by the Leibnitzian view of an earth long subject to comparatively constant surface conditions but still active with the energy of its primitive heat.

Notwithstanding the indefatigable and admirable labors of Fourier and Poisson in this field, it must be admitted that they accomplished little more than the preparation of the machinery with which their successors have sought and are still seeking to reap the harvest. The difficulties which lay in their way were not mathematical but physical. Had they been able to make out the true conditions of the earth's store of heat, they would undoubtedly have reached a high grade of perfection in the treatment of the problem. The theory as they left it was much in advance of observation, and the labors of their successors have therefore necessarily been directed largely towards the determination of the thermal properties of the earth's crust and mass.

Of those who in the present generation have contributed to our knowledge and stimulated the investigation of this subject, it is hardly necessary to say that we owe most to Sir William Thomson. He has made the question of terrestrial temperatures highly attractive and instructive to astronomers and mathematicians, and not less warmly interesting to geologists and paleontologists. Whether we are prepared to accept his conclusions or not, we must all acknowledge our indebtedness to the contributions of his master hand in this field as well as in most other fields of terrestrial physics. The contribution of special interest to us in this connection is his remarkable memoir on the secular cooling of the earth. In this memoir he adopts the simple hypothesis of a solid sphere whose thermal properties remain invariable while it cools by conduction from an initial state of uniform temperature, and draws therefrom certain striking limitations on geologic time. Many geologists were startled by these limitations, and geologic thought and opinion have since been widely influenced by them. It will be of interest, therefore, to state a little more fully and clearly the grounds from which his arguments proceed. Conceive a sphere having a uniform temperature initially, to cool in a medium which instantly dissipates all heat brought by conduction to its surface, thus keeping the surface at a constant temperature. Suppose we have given the initial excess of the sphere's temperature over that of the medium. Suppose also that the capacity of the mass of the sphere for diffusion of heat is known, and known to remain invariable during the process of cooling. This capacity is called diffusivity, and is a constant which can be observed. Then from these data the distribution of temperature at any future time can be assigned, and hence also the rate of temperature increase, or the temperature gradient, from the surface towards the centre of the sphere can be computed. It is tolerably certain that the

heat conducted from the interior to the surface of the earth does not set up any reaction which in any sensible degree retards the process of cooling. It escapes so freely that, for practical purposes, we may say it is instantly dissipated. Hence if we can assume that the earth had a specified uniform temperature at the initial epoch, and can assume its diffusivity to remain constant, the whole history of cooling is known as soon as we determine the diffusivity and the temperature gradient at any point. Now Sir William Thomson determined a value for the diffusivity from measurements of the seasonal variations of underground temperatures, and numerous observations of the increase of temperature with depth below the earth's surface gave an average value for the temperature gradient. From these elements and from an assumed initial temperature of $7,000^{\circ}$, he infers that geologic time is limited to something between twenty million and four hundred million years. He says: "We must allow very wide limits in such an estimate as I have attempted to make; but I think we may with much probability say that the consolidation cannot have taken place less than twenty million years ago, or we should have more underground heat than we actually have, nor more than four hundred million years ago, or we should not have so much as the least observed underground increment of temperature. That is to say, I conclude that Leibnitz's epoch of emergence of the *consistenter status* was probably between those dates." These conclusions were announced twenty-seven years ago, and were republished without modification in 1883.

Recently, also, Professor Tait, reasoning from the same basis, has insisted with equal confidence on cutting down the upper limit of geologic time to some such figures as ten million or fifteen million years. As mathematicians and astronomers, we must all confess to a deep interest in these conclusions and the hypothesis from which they flow. They are very important if true. But what are the probabilities? Having been at some pains to look into this matter, I feel bound to state that, although the hypothesis appears to be the best which can be formulated at present, the odds are against its correctness. Its weak links are the unverified assumptions of an initial uniform temperature and a constant diffusivity. Very likely these are approximations, but of what order we cannot decide. Furthermore, if we accept the hypothesis the odds appear to be against the present attainment of trustworthy numerical results, since the data for calculation obtained mostly from observations on continental areas are far too meagre to give satisfactory average values for the entire mass of the earth. In short, this phase of the case seems to stand about where it did twenty years ago, when Huxley warned us that the perfection of our mathematical mill is no guaranty of the quality of the grist, adding that, "as the grandest mill will not extract wheat-flour from peas-cods, so pages of formulæ will not get a definite result out of loose data."

When we pass from the restricted domain of quantitative results concerning geologic time to the freer domain of qualitative results of a general character, the contractional theory of the earth may be said to still lead all others, though it seems destined to require more or less modification, if not to be relegated to a place of secondary importance. Old as is the notion that the great surface irregularities of the earth are but the outward evidence of a crumpling crust, it is only recently that this notion has been subjected to mathematical analysis on any thing like a rational basis. About three years ago Mr. T. Mellard Reade announced the doctrine that the earth's crust, from the joint effect of its heat and gravitation, should behave in a way somewhat analogous to a bent beam, and should possess at a certain depth a "level of no strain," corresponding to the neutral surface in a beam. Above the level of no strain, according to this doctrine, the strata will be subjected to compression, and will undergo crumpling, while below that level the tendency of the strata to crack and part is overcome by pressure which produces what Reade calls "compressive extension," thus keeping the nucleus compact and continuous. A little later the same idea was worked out independently by Mr. Charles Davison, and it has since received elaborate mathematical treatment at the hands of Darwin, Fisher, and others. The doctrine requires for its application a competent theory of cooling, and hence cannot be depended on at present to give anything better than a general idea of the mechanics of crumpling and a rough estimate of the

magnitudes of the resulting effects. Using Thomson's hypothesis, it appears that the stratum of no strain moves downward from the surface of the earth at a nearly constant rate during the earlier stages of cooling, but more slowly during later stages. Its depth is independent of the initial temperature of the earth; and if we adopt Thomson's value of the diffusivity, it will be about two and a third miles below the surface in a hundred million years from the beginning of cooling, and a little more than fourteen miles below the surface in seven hundred million years. The most important inference from this theory is that the geological effects of secular cooling will be confined for a very long time to a comparatively thin crust. Thus, if the earth is a hundred million years old, crumpling should not extend much deeper than two miles. A test to which the theory has been subjected, and one which some consider crucial against it, is the volumetric amount of crumpling shown by the earth at the present time. This is a difficult quantity to estimate, but it appears to be much greater than the theory alone can account for.

The opponents of the contractional theory of the earth, believing it quantitatively insufficient, have recently revived and elaborated an idea first suggested by Babbage and Herschel in explanation of the greater folds and movements of the crust. This idea figures the crust as being in a state bordering on hydrostatic equilibrium, which cannot be greatly disturbed without a readjustment and consequent movement of the masses involved. According to this view, the transfer of any considerable load from one area to another is followed sooner or later by a depression over the loaded area and a corresponding elevation over the unloaded one; and in a general way it is inferred that the elevation of continental areas tends to keep pace with erosion. The process by which this balance is maintained has been called "isostasy," and the crust is said to be in an isostatic state. The dynamics of the superficial strata with the attendant phenomena of folding and faulting, are thus referred to gravitation alone, or to gravitation and whatever opposing force the rigidity of the strata may offer. In a mathematical sense, however, the theory of isostasy is in a less satisfactory state than the theory of contraction. As yet we can see only that isostasy is an efficient cause if once set in action; but how it is started and to what extent it is adequate remains to be determined. Moreover, isostasy alone does not seem to meet the requirements of geological continuity, for it tends rapidly towards stable equilibrium, and the crust ought therefore to reach a state of repose early in geologic time. But there is no evidence that such a state has been attained, and but little if any evidence of diminished activity in crustal movements during recent geologic time. Hence we infer that isostasy is competent only on the supposition that it is kept in action by some other cause tending constantly to disturb the equilibrium which would otherwise result. Such a cause is found in secular contraction, and it is not improbable that these two seemingly divergent theories are really supplementary.

Closely related to the questions of secular contraction and the mechanics of crust movements are those vexed questions of earthquakes, volcanism, the liquidity or solidity of the interior, and the rigidity of the earth's mass as a whole,—all questions of the greatest interest but still lingering on the battle-fields of scientific opinion. Many of the "thrice slain" combatants in these contests would fain risk being slain again; and whether our foundation be liquid or solid, or to speak more precisely, whether the earth may not be at once highly plastic under the action of long continued forces and highly rigid under the action of periodic forces of short period, it is pretty certain that some years must elapse before the arguments will be convincing to all concerned. The difficulties appear to be due principally to our profound ignorance of the properties of matter subject to the joint action of great pressure and great heat. The conditions which exist a few miles beneath the surface of the earth are quite beyond the reach of laboratory tests as hitherto developed, but it is not clear how our knowledge is to be improved without resort to experiments of a scale in some degree comparable with the facts to be explained. In the mean time, therefore, we may expect to go on theorizing, adding to the long list of dead theories which mark the progress of scientific thought, with the hope of attaining the truth not so much by direct discovery as by the laborious process of eliminating error.

When we take a more comprehensive view of the problems presented by the earth, and look for light on their solution in theories of cosmogony, the difficulties which beset us are no less numerous and formidable than those encountered along special lines of attack. Much progress has recently been made, however, in the elaboration of such theories. Roche, Darwin, and others have done much to remove the nebulosity of Laplace's nebular hypothesis. Poincaré and Darwin have gone far towards bridging the gaps which have long rendered the theory of rotating fluid masses incomplete. Poincaré has in fact shown us how a homogeneous rotating mass might, through loss of heat and consequent contraction, pass from the spheroidal form to the Jacobian ellipsoidal form, and thence, by reason of its increasing speed of rotation, separate into two unequal masses. Darwin, starting with a swarm of meteorites and gravitation as a basis, has reached many interesting and instructive results in the endeavor to trace out the laws of evolution of a planetary system. But notwithstanding the splendid researches of these and other investigators in this field, it must be said that the real case of the solar system, of the earth and moon, still defies analysis; and that the mechanics of the segregation of a planet from the sun or of a satellite from a planet, if such an event has ever happened, or of the mechanics of the evolution of a solar system from a swarm of meteorites, are still far from being clearly made out.

Time does not permit me to make anything but the briefest allusion to the comparatively new science of mathematical meteorology, with its already considerable list of well-defined theories pressing for acceptance or rejection. Nor need I say more with reference to those older mathematical questions of the tides and terrestrial magnetism than that they are still unsettled. These and many other questions, old and new, might serve equally well to illustrate the principal fact this address has been designed to emphasize, namely, that the mathematical theories of the earth already advanced and elaborated are by no means complete, and that no mathematical Alexander need yet pine for other worlds to conquer.

Speculations concerning the course and progress of science are usually untrustworthy if not altogether fallacious. But, being delegated for the hour to speak to and for mathematicians and astronomers, it may be permissible to offer, in closing, a single suggestion, which will perhaps help us to orient ourselves aright in our various fields of research. If the curve of scientific progress in any domain of thought could be drawn, there is every reason to believe that it would exhibit considerable irregularities. There would be marked maxima and minima in its general tendency towards the limit of perfect knowledge; and it seems not improbable that the curve would show throughout some portions of its length a more or less definitely periodic succession of maxima and minima. Races and communities as well as individuals, the armies in pursuit of truth as well as those in pursuit of plunder, have their periods of culminating activity and their periods of placid repose. It is a curious fact that the history of the mathematical theories of the earth presents some such periodicity. We have the marked maximum of the epoch of Newton near the end of the seventeenth century, with the equally marked maximum of the epoch of Laplace near the end of the eighteenth century; and, judging from the recent revival of geodesy and astronomy in Europe, and from the well-nigh general activity in mathematical and geological research, we may hope if not expect that the end of the present century will signalize a similar epoch of productive activity. The minima periods which followed the epochs of Newton and Laplace are less definitely marked but not less noteworthy and instructive. They were not periods of placid repose; to find such one must go back into the night of the middle ages; but they were periods of greatly diminished energy, periods during which those who kept alive the spirit of investigation were almost as conspicuous for their isolation as for their distinguished abilities. Many causes, of course, contributed to produce these minima periods, and it would be an interesting study in philosophic history to trace out the tendency and effect of each cause. It is desired here, however, to call attention to only one cause which contributed to the somewhat general apathy of the periods mentioned, and which always threatens to dampen the ardor of research immediately after the attainment of any marked success or advance. I refer to the im-

pression of contentment with and acquiescence in the results of science, which seems to find easy access to trained as well as untrained minds before an investigation is half completed or even fairly begun. That some such tacit persuasion of the completeness of the knowledge of the earth has at times pervaded scientific thought, there can be no doubt. This was notably the case during the period which followed the remarkable epoch of Laplace. The profound impression of the sufficiency of the brilliant discoveries and advances of that epoch is aptly described by Carlyle in the half humorous, half sarcastic language of Sartor Resartus. "Our Theory of Gravitation," he says, "is as good as perfect: Lagrange, it is well known, has proved that the Planetary System, on this scheme, will endure forever; Laplace, still more cunningly, even guesses that it could not have been made on any other scheme. Whereby, at least, our nautical Logbooks can be better kept; and water transport of all kinds has grown more commodious. Of Geology and Geognosy we know enough: what with the labors of our Werners and Huttons, what with the ardent genius of their disciples, it has come about that now, to many a Royal Society, the creation of a World is little more mysterious than the cooking of a dumpling; concerning which last, indeed, there have been minds to whom the question *How the apples were got in*, presented difficulties." This was written nearly sixty years ago, about the time that the sage of Ecclefechan abandoned his mathematics and astronomy for literature to become the seer of Chelsea, but the force of its irony is still applicable, for we have yet to learn, essentially, "how the apples were got in," and what kind they are.

As to the future, we can only guess, less or more vaguely, from our experience in the past and from our knowledge of present needs. Though the dawn of that future is certainly not heralded by rosy tints of over-confidence amongst those acquainted with the difficulties to be overcome, the prospect, on the whole, has never been more promising. The converging lights of many lines of investigation are now brought to bear on the problems presented by our planet. There is ample reason to suppose that our day will witness a fair average of those happy accidents in science which lead to the discovery of new principles and new methods. We have much to expect from the elaborate machinery and perfected methods of the older and more exact sciences of measuring and weighing — astronomy, geodesy, physics, and chemistry. We have more to expect, perhaps, from geology and meteorology, with their vast accumulations of facts not yet fully correlated. Much, also,

may be anticipated from that new astronomy which looks for the secrets of the earth's origin and history in nebulous masses or in swarms of meteorites. We have the encouraging stimulus of a very general and rapidly growing popular concern in the objects of our inquiries, and the freest avenues for the dissemination of new information; so that we may easily gain the advantage of a concentration of energy without centralization of personal interests. To those, therefore, who can bring the prerequisites of endless patience and unflagging industry, who can bear alike the remorseless discipline of repeated failure and the prosperity of partial success, the field is as wide and as inviting as it ever was to a Newton, or a Laplace.

AMONG THE PUBLISHERS.

"TERMINAL facilities of New York" is the title of the supplement feature in *Harper's Weekly* for Aug. 31. The article is from the pen of Mr. G. T. Ferris, and the illustrations, of which there are thirteen, were drawn by Messrs. Schell and Hogan.

—Following the article on the late Miss Laura Bridgman, in the August *St. Nicholas*, the number for September contains an account of "Helen Keller," the young girl also deaf, dumb and blind, whose rapid advance in her studies was described in *Science* a year ago. The sketch is by Florence Howe Hall, a daughter of Dr. Howe, and contains portraits of the child, of her teacher, a facsimile letter from the little girl herself to Mrs. Hall, and other illustrations. In the same number Lieutenant Hamilton gives a sketch of the modern method of defending coasts or harbors, and shows how necessary such defences have become as a consequence of the development of the world's navies.

—The September number of the *Political Science Quarterly* contains a critical estimate of the work of Thorold Rogers, by Professor W. J. Ashley of Toronto University; a demonstration of the "radical unfairness" of representation in Connecticut under the town-rule system, by Clarence Deming of New Haven; a discussion of farm mortgages, by an Illinois farmer, W. F. Mappin; a strong attack upon the policy of the general land office as regards the "indemnity lands" granted to the railroads, by Fred. Perry Powers of Washington, D.C.; a statistical paper upon Italian immigration, by Hon. Eugene Schuyler; the first of two papers upon the materials for English legal history, by Professor F. W. Maitland, Downing professor of law at Cambridge University, England; and the usual number of book reviews.

INDUSTRIAL NOTES.

Electrical Apparatus Abroad.

INFORMATION has reached us that the Sprague Electric Railway and Motor Company has recently closed quite a large contract for electric street railway apparatus with the principal street railway company of Florence, Italy, for the equipment of their line. This apparatus includes overhead system of the regular Sprague type, ten complete car equipments using two thirteen horse-power motors on each car, and station equipment complete.

This will be the first installation of American street railway apparatus abroad, where the progress in electric railway science has been very slow. The present method of running street cars in Florence is partly by animal power and partly by small steam dummies; and it is thought that the electric cars which combine the safety of the horse-car with the speed of the steam-car, and are much cheaper to operate than either, will have a large field to fill. It is said that this equipment is only a small portion of a very large equipment which will be ordered by this company, and if the result proves successful, it is thought that very many other Italian cities will adopt electricity for their street cars.

Electricity at Cleveland.

Cleveland can now be called properly the electric city of the West. In a short time there will be over a hundred electric street-cars running over the principal streets of Cleveland, besides a large number of stationary electric motors in use in a great many varied industries throughout the city.

The history of the East Cleveland Street Railway Company, which was the first in Cleveland to adopt electricity on its line, is an instance of the success and satisfaction which electric street

railway cars are giving in every city where they have been installed. The first equipment of this company was installed by the Sprague Company about nine months ago, and included overhead line, station equipment, and sixteen electric motor cars. The proposition to install this line met with a great deal of opposition in Cleveland.

The electric line was to cover some of the most important and principal business and residential streets in Cleveland, but the equipment was finally installed; and after it had been put in operation, the citizens of Cleveland discovered that the neat iron poles and overhead erection were hardly noticeable, while the rapid transit afforded by the street cars was something vastly superior to the former slow service given, when the cars were drawn by animal power.

There have altogether been five separate orders given by the East Cleveland Company for electric car apparatus. The second order was for four additional cars, the third for eight additional cars, the fourth for eighteen additional cars, and a recent order placed with the Sprague Company by its agent, Mr. C. W. Foote, for thirty additional motors, making seventy-six motor cars to be operated on this one line.

Besides this road, there are two others in Cleveland; the Broadway and Newburgh, and the Brooklyn Avenue roads also operated by electricity. There is nothing which speaks more highly for any kind of apparatus than the indorsement by its users, and there is no indorsement more convincing than the continued addition to an original equipment. The results, therefore, at Cleveland prove conclusively the good results and satisfaction given by electric apparatus when applied to street railways, and cannot be too commendatory of the style of motors used.

Exchanges.

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Shells and curiosities for marine shells, curiosities or minerals address W. F. Lerch, No. 308 East Fourth St., Davenport, Iowa.

I want to correspond and exchange with a collector of beetles in Texas or Florida.—Wm. D. Richardson, P.O. Box 223, Fredericksburg, Virginia.

100 botanical specimens and analyses for exchange. Send list of those desired and those which can be furnished, and receive a similar list in return. Also cabinet specimens and curiosities for the same. Scientific correspondence solicited.—E. E. BOGUE, Orwell, Ashta. County, O.

I will sell to chapters or individual members of the Agassiz Association, 25 fine specimens of fossil plants from the Dakota group (cretaceous), correctly named, for \$2.50. Send post-office order to Charles H. Sternberg (author "Young Fossil-Hunters"), 1033 Kentucky Street, Lawrence, Kan.

One mounted single achromatic photographic lens for making 4 X 5 pictures, in excellent condition; also one "new model" double dry-plate holder (4" X 5"), for fine geological or mineralogical specimens, properly classified.—Charles E. Frick, 1019 West Lehigh Avenue, Philadelphia, Penn.

Drawings from nature — animals, birds, insects, and plants — to exchange for insects for cabinet; or I will send them in sets of ten each for ten cents in stamps. My drawings in botany are in detail, showing plant, leaves, flowers, seed, stamens, pistils, etc.—Alda M. Sharp, Gladbrook, Ia.

The undersigned wishes to make arrangements for the exchange of *Lepidoptera* of eastern Pennsylvania for those from other localities. All my specimens are named and in good condition.—Charles S. Westcott, 613 North 17th Street, Philadelphia, Penn.

California onyx, for minerals and coins not in my collection.—W. C. Thompson, 612 East 141st Street, New York, N.Y.

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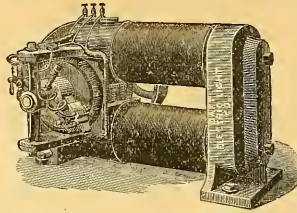
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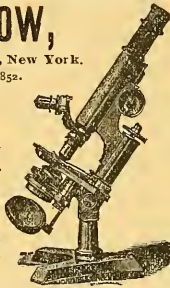
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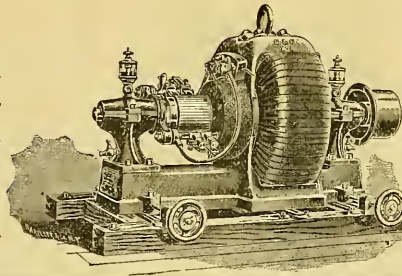


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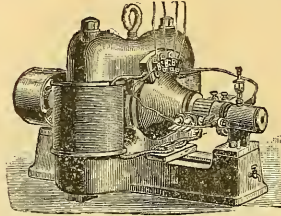
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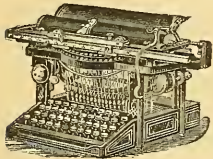
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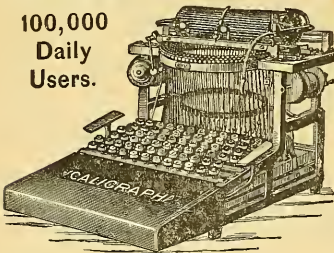
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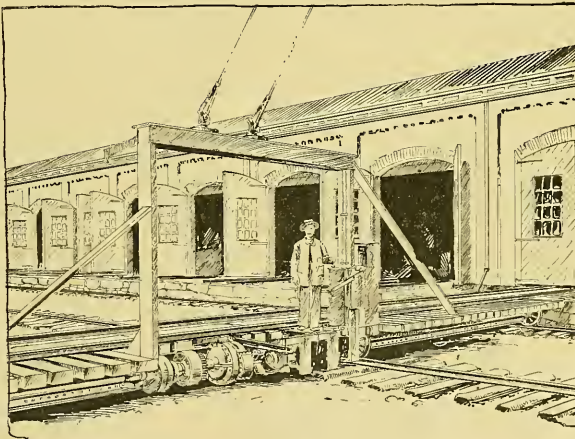
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AN ELECTRIC TRANSFER-TABLE.

THE accompanying cut represents the new transfer-table at the Fitchburg car repair shops at Fitchburg, Mass., just built by the Fitchburg Railroad Company. The table or car is moved by the Union Electric Car Company's system. The motor, gears, clutches, etc., are all on the front axle of the car. The motor is geared to the axle, and the gears run in an enclosed bath of oil. They are brass cut gears, and work with the least possible amount of friction and consequent loss of power. The switch which governs the motor and controls the car is just above the motor, on a platform built out from the front of the car, as are also the reversing

being at the dynamo, now run the table and draw on and off the cars, which work formerly required twelve men and a shifting locomotive and its men, and some four times the amount of work can be done by these three men.

The Union Electric Car Company will use this same system on the Beverly and Danvers Railroad, which is being equipped by the company, and will be running this month. These cars will use storage batteries in place of the overhead wires for the propelling power. The storage batteries are placed under the seats, with two sets to each car. They are charged by a steam and electrical plant in the car-house. Each set runs the car forty miles. It takes eight hours to charge. The batteries are changed by the con-



ELECTRIC TRANSFER-TABLE AT FITCHBURG, MASS.

bar and the handle throwing in and out the clutch by which the motor is used either to propel the car in the desired direction or to draw off and on the cars to be changed from one track to another.

The two shops are each five hundred feet long, and face each other. Each shop is divided into three divisions, separated by brick walls running through the roof. In each division there are eight tracks, making twenty-four in each shop. Between these shops, which are seventy-five feet apart, is the pit in which the table or car moves. The car is ten feet long and seventy feet wide, and runs on four rails laid in the pit. The track on the car, running from side to side, matches the tracks in the shops. The control of the table is so perfect, by the use of the switch, that it can be put and matched to any track desired without the least trouble or hitch; the same power that moved the car forward, stops or slows it. The table is run by the dynamo which lights the shops at night, and is connected by two overhead wires, on which run two trolleys, the trolley-poles being on the top of the house built over the front platform at the front of the table. Three men, one

ductor and driver in from three to ten minutes, and each car makes a run of eighty miles per day.

THE SOFTENING OF HARD WATERS FOR DOMESTIC USE.

SINCE waters possessing an inconvenient degree of hardness are very common in many localities, owing to the almost universal prevalence of calcareous soils and geological deposits, it is of no little interest to have some simple means of doing away with this property, so as to render such waters more convenient for domestic uses. This is the more important, as in some cases the presence of a large proportion of magnesia tends to cause serious, even though usually only temporary, gastric disturbance with persons unused to such waters, whereby quite frequently an unfounded prejudice against the general health-conditions of perfectly healthful localities is created. This subject has been heretofore discussed in many places, especially in California, but its continued importance and the frequent demand for information in the prem-

ises justify the more elaborate consideration recently given it by Professor Hilgard of the University of California.

When, as is most commonly the case, this hardness is due to the presence of large proportions of the carbonates of lime and magnesia, it can be recognized by the extent to which the water becomes turbid, or forms whitish scum or incrustations, when boiled. Boiling, then, is one of the means for softening waters that are hard and "curdle the soap" from this cause; and this fact is well known to housekeepers, but owing to the inconvenience of the application of this remedy, it is rarely resorted to except for drinking-water. For this purpose boiling has the special and additional advantage of insuring the destruction of any minute germs of disease that might contaminate the water.

To soften water for washing, a common and very good remedy is the use of carbonate of soda (sal soda) in sufficient quantity to bring down the lime and magnesia, and thus insure the proper solution of the soap to form suds. Only there is too often a mistake made in not allowing time for the soda to bring down the lime and magnesia in a powdery form, which requires from half an hour to an hour when the water is cold, but occurs very quickly when the water is hot. When, as is commonly done, the soap is put into the water while the lime is still in the gelatinous form and diffused in the water, a certain amount of "curdling" will still happen, and the washed clothes (especially flannels) will have that soggy and unpleasant touch which is caused by the accumulation of the lime and magnesia soaps in them.

That it is undesirable to use soda for softening water to be used for drinking hardly needs more than mention. The natural hard waters usually contain quite as much of saline matters as is desirable in drinking water. Soda, however, does not in any manner correct the sanitary condition of a water; on the contrary, it aids in keeping vegetable and animal matters in solution, and unless added in very large excess does not interfere with the vitality of fungous or other germs.

By far the most convenient and effective mode of purifying larger quantities of hard water for domestic use, is the introduction of a definite amount of quicklime, proportioned to the requirements of each particular water; a point that can be readily ascertained by any one having an ordinary capacity for observation.

The principle upon which this apparently paradoxical process is based is this: The lime and magnesia in most hard waters are contained in the form of carbonates, dissolved in the water by the aid of free carbonic acid. Whatever drives off or takes possession of this free acid will bring down the earthy substances in an insoluble form, and thereon depends the efficacy of boiling as well as of the addition of washing soda; cooking soda or bicarbonate will not produce the effect. Now, lime in the caustic condition, as lime-water, or milk-of-lime, freshly prepared, will most effectually take possession of any free carbonic acid, and will form with it the same insoluble compound that, when hard water is boiled, settles to the bottom or incrusts the boiler. Hence, when an amount of clear lime-water, just sufficient to absorb all the carbonic acid in a water, is added to it, both the lime added and the lime and magnesia originally contained, are brought down in the insoluble form, and the mineral contents of the water are diminished very materially, sometimes to less than one-half of the original amount. With the sediments thus brought down there also usually comes a large proportion of the vegetable or animal matters contained in the water; so that instead of perhaps becoming putrid in a tank serving for domestic supply, water so treated will remain clear and odorless for a long time if protected from recontamination by insects, falling leaves, dust, etc.

The only practical difficulty in carrying out this purification is the ascertainment of the proper proportion of lime or lime-water to be used, so that the water shall neither retain too much of its original hardness nor acquire an unpleasant taste and astringent action from an excess of lime. This can, however, be done quite readily by a few tests with different proportions of lime-water, and the very simple trial as to which will produce the least "curdling" of soap when ready-made soapsuds are added in small proportion. Whatever proportion of lime-water or lime satisfies this easily ascertained condition, is the best for all purposes.

Numerous experiments prove that for the waters of the wells,

springs, and smaller streams, as well as the catchment reservoirs of the middle coast ranges and their valleys, the best effect is usually produced by the addition of from one-tenth to one-twentieth of clear lime-water.

As one part by weight of pure, unslaked lime requires seven hundred parts of water for its solution, a simple calculation shows that the above proportion corresponds to from five to eight grains of lime per gallon, or about three-quarters to one pound per thousand gallons.

In the practical working of this process it is best to have, for small tanks up to one or two hundred gallons, a supply barrel in which clear lime-water of full strength can always be kept on hand ready for use. A few pounds of lime, slaked into a creamy mass, may be put in the barrel, the sediment being stirred up from time to time as the clear water standing over it is replaced. Of course, in order to preserve the proper proportion, once determined, only clear water must be used, otherwise more lime than is called for, will be introduced into the water. The lime-water barrel should be kept closely covered.

For larger tanks it will be more convenient either to take a weighed amount of unslaked lime for each one thousand gallons, slack it into milk-of-lime and stir it in, or else to prepare a large quantity of milk-of-lime which, when thoroughly stirred, will for each measure (bucketful) contain a known amount of lime. This would be the best way to handle cases in which the feeding water of boilers requires to be corrected. It should, in this connection, be understood that the lime treatment is very efficacious against the frothing produced in boilers by waters containing a large amount of vegetable matter, as is commonly the case in that from ponds or other catchment reservoirs.

The sediment that accumulates in tanks used for this treatment is usually of a sandy nature, and not readily stirred up; it therefore causes little inconvenience, and can be removed at leisure, from time to time, as it becomes too large.

It is true that, like some other household measures conducive to sanitation and comfort, the maintenance of this system requires some regular personal interest and attendance on the part of some member of the family. If carelessly handled, there may be unaccountable variations in the gastric conditions of the family, from one extreme to the other, and the soap may curdle from the water's natural hardness one week, and from excess of lime the next. But there is no excuse for such occurrences, except as the result of carelessness or negligence, and the advantage gained, whether as to health or comfort, amply repays the trouble when these hard waters require to be used.

A NOVEL ELECTRIC BATTERY.

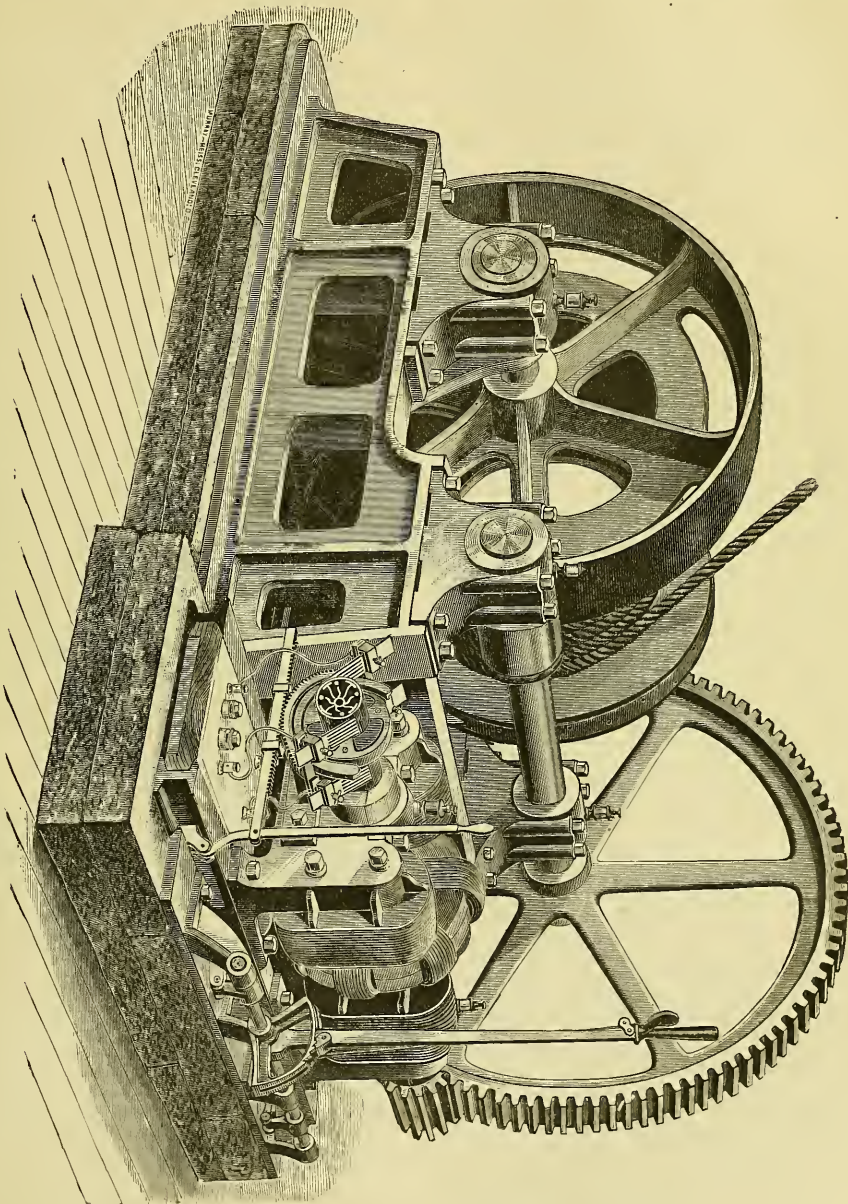
A NOVEL and simple form of electric battery has recently been invented in Italy. As described in the *Rivista Technica*, it consists of conical vessels of cast iron and porous earthenware, with nitric and sulphuric acid. An iron cone is placed point downwards in a stand, and is partly filled with strong nitric acid. Into this there is placed a cone of porous earthenware containing dilute sulphuric acid. Then follows an iron cone surmounted by an earthenware one, and so on in a series, each vessel containing its respective acid. It follows that the inner surface of each iron vessel is bathed in nitric acid, and becomes passive, acting the part of the platinum or carbon in an ordinary cell. The outer surface is attacked by the dilute sulphuric acid, and takes the place of the zinc. There are no connections to make, the simple building of the pile putting all the parts into union. The earthenware cones are eight inches in diameter and four inches in height, and contain five hundred and fifty cubic centimetres of ten per cent sulphuric acid solution. The iron vessel contains one hundred and ten cubic centimetres of nitric and sulphuric acids, the latter being three times the volume of the former. Sixty elements, arranged in two piles, have a resistance of ten and one-half ohms, an electromotive force on open circuit of eighty-one volts, and on closed circuit of forty-five volts, with a current of four and four-tenths ampères. After five hours the difference of potential falls to twenty-eight volts and the current to two and seven-tenths ampères.

THE BRUSH ELECTRIC HOIST.

A COMPACT combination of an electric motor with a winding-drum, for hoisting purposes, is shown in the engraving on this page. The motor, which is of the well-known Brush make, is of

cess of the Brush Company's electric plant in the Chollar mine, which was illustrated and described in *Science* some months ago, has resulted in attracting the attention of the company to the vast field for the use of electric power in mining operations; and this electric hoist is an attempt to supply the demand that is already

BRUSH ELECTRIC HOIST FOR MINING AND OTHER PURPOSES



fifteen horse-power, and is mounted on the same base as the hoisting-drum, which is of the Walker pattern. A gear pinion on the armature shaft meshes with the large gear-wheel, which in turn actuates the winding-drum by means of friction pulleys. The suc-

cess of the Brush Company's electric plant in the Chollar mine, which was illustrated and described in *Science* some months ago, has resulted in attracting the attention of the company to the vast field for the use of electric power in mining operations; and this electric hoist is an attempt to supply the demand that is already

being made in that direction. This company have contracted to equip the copper mines of the Calumet & Hecla Company at Calumet, Mich., with five eighty horse-power electric motors and five one hundred and thirty horse-power dynamos.

OLIVE CULTIVATION.

Of the various food products, or vegetable liquids, perhaps those most extensively shown at the Paris Exhibition are wine and oil. These two seem to follow the progress of civilization and settlement, whenever the climate is suitable. Olive oil is shown in a very large number of the foreign sections, and the wide and extensive progress it has made over the world is exemplified now by one French exhibitor, who exhibits samples from the following widely-separated districts: the Gold Coast of Africa, Melbourne and Adelaide, Chili, Guatemala, Guayaquil, Mexico, Venezuela, La Plata, New Orleans, Philadelphia and New York, Canada, India, Cochín China, Reunion, Mauritius, Japan, Polynesia, Havana, Guadaloupe, Martinique, Trinidad, Hayti, the Black Sea coast, the Levant, Spain, Portugal, and France.

But these are not all the seats of production, and are merely cited to show how widespread is the culture of the olive at the present day.

Taking the French official catalogue, and turning to the alimentary products, "class 69, oils and fatty substances," there will be found over six hundred exhibitors of olive oil specially named, besides numerous collective exhibits, and many others also are included under the general term "comestible" or edible oils. There is much substitution, however, carried on in this respect at the present day by the sale to the public of refined cotton-seed oil, sesame, and other oils, in place of olive oil. The number of exhibitors of olive oil under each country as given by Mr. P. L. Simons in the *Journal of the Society of Arts*, are as follows: Portugal, 448; Algeria, 128; Italy, 8; France, 12; Spain, 5; California, 4; Japan, 1; total, 606. There are two or three exhibitors also from Tunis, and in the French section there is a collective exhibit of edible oils made by sixty-seven producers and dealers from Salon, Bouches du Rhone.

The various uses of the olive for its fruit and its oil are well known. In ancient Greece the tree received all the honors, and had almost a sacred character. This was in consequence of its being the chief production of the country, and its produce the main source of public food.

From olden times the people of the Mediterranean coasts have made the olive their principal culture, and it is there the oil industry chiefly centres, — in Spain, Portugal, Italy, Greece, and France, on the northern coast; and Morocco, Algeria, and Tunis, on the southern shores.

The olive has been cultivated in those regions from time immemorial, as the bounteous gift of heaven and the emblem of peace and plenty. Olive oil takes there the place of butter. Spain has about 3,000,000 acres under olives, Italy 2,250,000, and France about 330,000, of which 15,000 acres are in the district of Nice. Olive oil in the country of Nice forms now four-fifths of the agricultural produce.

The varieties of the olive are very numerous. The naturalist Risso, in 1826, described forty distinct varieties, and these have since been increased to forty-five.

In the countries where it is indigenous, the olive tree attains gigantic proportions. It reaches, occasionally, sixty feet high, with a circumference of trunk of twelve feet, and these trees are supposed to have attained the age of one thousand years. Certain varieties grow more rapidly than others, and some differ from each other in the nature of the wood, the foliage, and the quality of the fruit. There are large olives and small olives, pointed, oval, round, and curved fruit, and of all colors, ranging from white to black, and from green to red. The flavor of the fruit is mild, sharp, or bitter. Hence, according to the variety, there is obtained sweet oil, light colored, and of exquisite flavor, up to dark green, thick, and of a bitter taste, strong and very unpleasant to the palate. Hence it follows that olive oil can be obtained pure, and also quite unfit for food purposes, only suitable for greasing machines and making soap. The green unripe olives, after remaining in a solution of salt for some time, to remove the bitter taste, are preserved in vinegar, with spices, in bottles or small barrels. Those of Tuscany and Lucca are considered the best, on account of their light-green color and strong flesh. In all parts of southern Europe they are in this form a daily food.

The ripe olives are gathered in the fall, when they are as large as common plums; their color is dark green, and the soft kernel has changed into a hard stone, which contains a savory almond. The flesh is spongy, and its little cells are filled with the mild oil, which pours out at the least pressure.

There is a fine collection of preserved olives shown by Hernanos & Company, of Barcelona. The finest oil is the so-called virgin oil, to obtain which the freshly gathered olives are put into little heaps, and by their own weight the oil is pressed out, and is caught in some vessel. It is clear like water, has a delicate nut-like taste, with little or no odor. When the fruits cease to give the oil by themselves, they are pressed with small millstones. The oil gained by this process is also clear, and of a pleasant taste.

After this treatment the olives are still rich in oil, and the fruits are put in sacks; boiling water is poured over them, and they are pressed once more. The oil gained by this process is yellowish green, and has a sharp taste and an unpleasant smell, because it contains some mucilaginous matters.

At Marseilles, the great seat of the vegetable oil trade, the olive oils are classed into manufacturing oils for burning, for greasing machinery in factories, and for soap-making; refined oil; oil from the pulp or husks; and table or edible oil. The latter is divided into superfine, fine, half-fine, and ordinary. The table oil is refined by allowing it to run through layers of thin sheets of wadding into tin perforated boxes; the wadding absorbs all the thick particles, and leaves the oil perfectly clear and tasteless.

In the Spanish section, Signor José Gonzalo Priete, who has steam works at Lora del Rio, Seville, makes a display of an imitation olive tree silvered, from the branches of which are suspended six glass globes, filled with the different qualities of pure olive oil.

The Tuscans were the first who exported olive oil largely, and thus it has obtained the name of Florence oil. It would be a curious fact to ascertain the number of olive trees which exist in the different countries bordering on the Mediterranean, — Tunis has over four millions, Algeria three millions, Nice one million, Syria several millions, while the number in Spain, Portugal, Italy, Greece, Morocco, and Turkey is unknown.

The Union of Proprietors of Nice is a limited society, with a capital of about a hundred thousand dollars, which, by its statistics, binds itself to deal only in pure olive oil. It has about twenty-six plantations and presses in different parts of the district. The company makes a fine display of olive oil.

It may be stated, in conclusion, that the olive crop is a very variable and uncertain one; one that yields a profit does not perhaps occur for six or eight years.

HEALTH MATTERS.

Report of the Paris Commission on Consumption.

THE permanent commission, appointed last year by the Congress for the Study of Tuberculosis, has just presented its report, through M. Villemain, chairman. This report embodies certain instructions to the public, which the commission deems of sufficient importance for general adoption. *The Boston Medical and Surgical Journal* summarizes this report, a comparison of which with that issued in New York, and previously referred to, is of interest.

Tuberculosis is, of all diseases, that which has the most victims, especially in the cities. More than one-fourth of the mortality of Paris during the year 1884 was from tuberculosis in some of its forms. Tuberculosis is a parasitic, virulent, contagious, transmissible disease, caused by Koch's bacillus. The microbe penetrates the organism by food, by air of respiration, and through the skin and mucous membranes by abrasions, excoriations, and divers ulcerations. Certain diseases, as measles, chronic bronchitis, pneumonia; certain constitutional states due to diabetes, alcoholism, syphilis, predispose to tuberculosis.

The cause of tuberculosis being known, there is but little difficulty in preventing its dissemination and propagation, if proper prophylactic means are taken. The parasite of tuberculosis may infect the milk, muscles, and blood of animals which serve for the food of man. Raw meat, underdone meat, blood, may contain the living germ of tuberculosis, and should be interdicted. For the same reasons, milk should be boiled before being ingested. By

reason of the dangers which attend the use of raw milk, the protection of young children, who are so susceptible to tuberculosis, should earnestly engage the attention of mothers and nurses.

By reason of the dangers which attend the use of butchers' meat, which may come from animals that were tuberculous, though having every appearance of health, the public should insist that the inspection of all meats, as required by the law, should be rigorously enforced. The only sure way of avoiding the dangers arising from meat derived from tuberculous animals, is to subject such meat to a thorough cooking, which shall include the entire substance in depth, as well as the surface. Meats completely roasted, boiled, or broiled are alone safe.

As the germ of tuberculosis may be transmitted from the tuberculous to the healthy man, by sputa, pus, dried mucosities, clothing, or other objects impregnated with fine tuberculous particles, it is necessary for the public, in order to be protected against the contagion:—

(1) To know that, the sputa of phthisical patients being the most formidable agents of the transmission of tuberculosis, there is danger in allowing these expectorated matters to be deposited on the ground, on carpets, on drapery, screens, towels, handkerchiefs, clothing, and bed linen.

(2) To be persuaded that the use of spittoons is obligatory on all phthisical patients everywhere. Spittoons should always be emptied into the fire and cleansed with boiling water. They should never be emptied on dung heaps, on garden soil (where they may tubercularize fowl), nor into privies.

(3) To refrain from sleeping in the bed of a tuberculous patient; to remain as little as possible in a room occupied by such person. This caution is especially applicable to young children.

(4) To sequester from all places occupied by phthisical patients, individuals considered as predisposed to tuberculosis, children born of tuberculous parents, or that have lately had measles, small-pox, pneumonia, etc., and all diabetic patients.

(5) To avoid using objects which a phthisical patient may have contaminated—garments, bed-clothing, toilet-implements, playthings, etc.,—till after previous disinfection, in the hot-air stove, by boiling water, sulphur fumigations, etc.

(6) To insist that the rooms of hotels, furnished houses, cottages occupied by phthisical patients at watering-places or winter stations, shall be equipped and tapestried in such a way that disinfection may be easily and completely effected after the departure of each patient. It would be better that these apartments should have no hangings or tapestry, and that they should be whitewashed. The floors should be bare, either oiled or painted. Hotels and furnished cottages in which such hygienic precautions and measures of disinfection are taken should alone be patronized by the public.

At the meeting of the Academy of Medicine, Aug. 6, 1889, this report was discussed. Dujardin-Beaumetz was in favor of suppressing entirely the sections pertaining to raw meat and raw milk. There is nothing that proves the possibility, in man at least, of the transmission of tuberculosis by butchers' meat. As for milk, if it be true that it may on certain occasions contain bacilli, we must not forget that in order that milk may be thus contaminated the cow must not only be tuberculous, but must also have tuberculous mammitis.

Germain Sée did not believe in the communication of tuberculosis by the air of respiration. The bacillus cannot live in the air. It never develops and multiplies outside of the organism of man or the animal. In the open air it dies rapidly, as, in order to live, it needs a temperature of 30° C. The matter of atmospheric contagion is a bugaboo, which has already wrought trouble in families by causing the poor consumptive to be treated like a leper,—shunned and abandoned by his nearest relatives. It has been demonstrated experimentally that air taken three or four yards from the bed of a consumptive patient does not contain a single bacillus; but if the air exhaled by a phthisical person is offensive, the sputa are not so, and too much pains cannot be taken to disinfect and destroy all expectorated matters.

With regard to the prohibition of meat and blood, it is a fact, said Professor Sée, that the blood is never virulent, and animal flesh, according to recent experiments (Nocard, of Alfort), far from containing bacilli, destroys them by the muscular juice which the

flesh contains. Hence, there is no necessity, in order to destroy the bacillus, to boil meat to a pap, to forbid roast meat, or underdone meat, or even raw meat. If we were to hearken to the commission, he thought we should be deprived of some of our best alimentary products, and nothing would be served on our tables that was not spoiled to the taste by over-cooking, as well as rendered more indigestible thereby.

With regard to the care that should be taken of those that were hereditarily predisposed to tuberculosis, he thought that excessive precaution was an evil; the best prophylactic is gymnastic exercises and hydrotherapy.

Professor Sée did not think persons especially liable to tuberculosis, who had been subject to colds, bronchitis, or who had had pneumonia, measles, whooping-cough, or small pox. On the contrary, he had found such persons remarkably exempt from tubercular diseases.

Tuberculous Meat.

Simultaneously with the report of the permanent commission of the French congress on tuberculosis, says the journal before quoted, we have before us a voluminous report from Glasgow, giving the proceedings at trial, under petitions of the Glasgow local authority, against two butchers who exposed for sale, for human food, the carcasses of two tuberculous animals. Among those giving testimony at the trial we find the well-known names of Dr. J. B. Russell, medical officer of health for Glasgow since 1872; Joseph Coats, pathologist to the Royal Infirmary of Glasgow, and Professor J. McCall, Principal of the Glasgow Veterinary College. In addition, there were the medical officers for Edinburgh and Greenock, and for Leeds, Birmingham, and Hull; three other veterinary pathologists besides McCall; and Mr. Mayland, as a bacteriologist and pathologist in addition to Dr. Coats. There were, in all, fifteen witnesses for the prosecution and nineteen for the defence. The conclusions of the French congress, as well as of the Brussels veterinary congress of 1883, and of a departmental committee of the privy council, were frequently referred to in the course of the testimony.

The cases were test cases, brought to enable the medical officers of Glasgow to apply the same stringent standards as were already enforced in Edinburgh and Greenock.

The evidence showed that, in regard to one of the animals, "there were tubercles in the substance of the lungs themselves, in both the costal and pulmonary pleura, in the pleura connected with the diaphragm, and further in the cavity of the body inclosing the respiratory organs;" there was tubercular deposit in the lymphatics, and tubercular bacilli were found in the inguinal gland. In regard to the other, it was shown that there was active tuberculosis in the lungs and pleura, and bacilli were found in the prepectoral gland. The question before the court was, whether the meat of these animals after the carcasses had been "stripped" was "unfit for the food of man."

The prosecution laid down five propositions, and asked for conviction upon their acceptance by the court. (1) The disease called tuberculosis, whatever form it may assume, whether phthisis, or scrofula, or struma, is a widespread disease amongst animals and man, and to it may be attributed a large percentage of the deaths in the community, and a very large proportion of the ill health. (2) That the disease known as tuberculosis now, is identical in man and in the lower animals. (3) The disease is communicable from the lower animals to man, by, amongst other means, inhalation and ingestion. (4) The disease tuberculosis is due to the active presence of a specific organism known as the bacillus tuberculosis. (5) Given the signs of tuberculosis upon certain specific organs of an animal, you may and ought reasonably to infer that the virus of the disease is in other portions of the carcass of the animal, where there may be no outward and visible signs to indicate its presence.

The defence held that no one has ever yet heard of a case of tuberculosis contracted from the ingestion of tuberculous meat; but in the case of milk, the disease has been traced, and if in the latter, why not in the former; that cooking was a sufficient safeguard, and if people preferred to eat partially cooked meat, they should be allowed to take whatever infinitesimal risks might exist; that, even

when the bacillus enters the alimentary canal, there must be a degenerated condition of the tissues before it can find lodgment and fructify; that to a healthy person, therefore, the danger is perfectly visionary; that the alimentary canal is the least favorable channel for entrance into the system; that the disease in these cases was so localized as not to affect the flesh in general; that, in any case, the danger to health and life must be extremely small, too small to justify the exclusion from the market or destruction of large amounts of good, wholesome food.

The prosecution pointed out the inherent difficulty of proving, as a matter of fact, and not merely as a matter of opinion, the actual communication of tuberculosis to human beings by the ingestion of the flesh of tuberculous animals; and adduced evidence that the flesh of animals affected with tuberculosis, more or less, and offered for sale for food in Glasgow, is one half per cent in the year.

In summing up the evidence and the arguments, the court held that whether ingestion be or be not the commonest way in which tuberculosis is communicated, it must certainly be regarded as one mode of its communication; except on the footing that the meat was the medium of the transmission of the disease, it would be unnecessary and wasteful to exclude from the food-supply the carcasses of animals suffering from tuberculosis, however generalized and extensive; but the previously existent practice in Glasgow and elsewhere of condemning extensively diseased animals, clearly showed that the transmissibility of the disease by ingestion had long been recognized, and the evidence leads to the conclusion that it would not be proper to trust to cooking as a sufficient protection; that every animal suffering from tuberculosis, however limited in degree or apparently in locality, probably ought to be condemned, and that such condemnation would not cause a loss of food of more than one-quarter of one per cent; but, in the present instances, the disease, having extended to the lymphatic glands, was undoubtedly generalized.

The number and character of the witnesses, the clearness of statement of the counsel, the respectability of the court, and the Scotch reputation for shrewd, practical common sense, give the report and result of this trial a considerable interest, as bearing upon the present position of science and practice in regard to the questions involved. Should it ultimately appear, as we see by the published abstract of a paper, to be read at the approaching meeting of the Association of American Physicians, Dr. H. C. Ernst thinks he is in a position to prove, that the milk from a cow suffering from tuberculosis is dangerous as an article of food, no matter where the pathological change may be situated, and that Koch's limitation of the danger to tuberculosis of the lacteal tract was too restricted, then the position of those who condemn the meat, even of locally infected animals, would be greatly strengthened.

THE AIR IN EDINBURGH THEATRES.—An interesting account has been given by Mr. Cosmo J. Burton of the amount of carbonic acid and organic matter in Theatre Royal and Royal Lyceum Theatre in Edinburgh. At the time of the experiments the theatres were by no means full; nevertheless, the temperature was from ten to fifteen degrees above that recorded immediately before the houses were opened, while carbonic acid was multiplied from three to five times. Mr. Burton remarks, as quoted by the *Lancet*, that the vitiation of the air proceeds with extraordinary rapidity at first, but the rate of change soon decreases, till towards the end of the performance the air becomes little or no worse, and, indeed, in a few instances it appeared to slightly improve. The atmosphere of all parts of the theatre was not equally vitiated. The air of the gallery was considerably worse than that of any other part of the house; the amphitheatre, dress circle, and pit did not come in the same order as to degree of impurity in the experiments, but the pit was always worse than the dress circle. The late Dr. Parkes stated that headache and vertigo are produced when the amount of carbonic acid in the air of respiration is not more than from fifteen to thirty volumes per ten thousand, and the experience of some theatres leads to the suspicion that Mr. Burton's results are not special to Edinburgh. The facts as to all theatres ought to be known; for the public had much better lose an evening's enjoyment than submit to the enforced inhalation of a polluted atmosphere for a number of hours.

NOTES AND NEWS.

It is stated by the *Scientific American* that carefully repeated experiments made by an English navigator at Santander, on the north coast of Spain, showed the crest of the sea waves in a prolonged and heavy gale of wind to be forty-two feet high; and allowing the same for the depth between the waves, would make the height eighty-four feet from crest to base. The length from crest to crest was found to be three hundred and eighty-six feet. Other estimates of the waves in the South Atlantic during great storms give a height of fifty feet for the crests and four hundred feet for length. In the North Sea the height of crest seldom exceeds ten feet and the length one hundred and fifty feet.

—At a recent meeting of the Paris Academy of Sciences, M. Benger described the curious effects of an electric discharge which struck a silvered mirror during a terrific thunderstorm near Prague, on June 9, 1889. The mirror shows over ten points at which the electric fluid penetrated through its gilded frame, volatilizing and transferring the gold to the anterior face of the glass, while on the opposite side the volatilization of the silver coating produced the most beautiful electric figures. These figures show that there occurred repeated and successive discharges, as also indicated by recent photographs of flashes taken with the oscillating camera obscura.

—In a recent letter from Paris to the *Engineering and Mining Journal*, Mr. George F. Kunz says it may be interesting to know that the following minerals are exhibited in and are for sale in quantity in the Norwegian section of the Paris Exposition at the following rates per pound: Molybdenite, 32 cents; Gadolinite, \$2.54; Zircon, \$1.27; Cerite, 32 cents; Orthite, 13 cents; Rutile, 20 cents; Thorite, \$10.54; Ytrotitanite, 20 cents; Columbite, 94 cents. In reference to the occurrence and the use of vanadic and molybdic acids, both of these acids have until recently been considered rare. Since they, however, replace phosphoric acid in the lead ores of New Mexico and Arizona in the minerals wulfenite, vanadinite, etc., which exist there in quantities, they can be obtained at much less cost than they could before.

—“The great development in electricity will be, I am firmly convinced,” said Mr. Edison to an interviewer in Paris, “in discovering a more economical process of producing it. At present we only get from coal consumed about four or five per cent of its latent electricity. The rest is wasted in heating water, expanding steam, pushing pistons, turning wheels, and finally causing a dynamo-machine to operate. A process will ultimately be found for extracting ninety to ninety-five per cent of the latent electricity directly from the coal. Then steam engines will be abolished, and that day is not far off now. Already we can get electricity direct from coal to the amount of ninety per cent, but only for experimental purposes. When I was on shipboard coming over I used to sit on deck by the hour and watch the waves. It made me positively savage to think of all that power going to waste. But we'll chain it up one of these days, along with Niagara Falls and the winds. That will be the electric millennium.”

—It is stated in the *Metallarbeiter* that iron can be coppered by dipping it into melted copper, the surface of which is protected by a melted layer of cryolite and phosphoric acid, the articles to be thus treated being heated at the same temperature as the melted copper. Another process consists in dipping the articles into a melted mixture of one part of chloride or fluoride of copper, five or six parts of cryolite, and a little chloride of barium. If the article, when immersed, is connected with the negative pole of a battery, the process is hastened. A third method consists in dipping the articles in a solution of oxalate of copper and bicarbonate of soda, dissolved in ten or fifteen parts of water, acidified with organic gas.

—If London is the metropolis of the land of fogs, there is much consolation to be found in the fact that in spite of its smoke and its fogs it is not only one of the healthiest cities in the world, but is growing healthier every year. According to the official statistics for the quarter ending June last, as stated by a leading London newspaper, the annual deaths are only at the rate of sixteen per thousand. If some overcrowded and notoriously unhealthy dis-

tricts could be eliminated from the calculation, the figure would, of course, drop considerably. Still more remarkable would the sanitary condition appear if the area were confined to the high and airy suburbs in which so large a proportion are fortunate enough to dwell. Londoners have only to contrast this condition of things with the statistics of other capitals, to see how great is the advantage they enjoy. In Paris, which shows a comparatively good record, the mean annual death-rate is 32.1; in Berlin it is 27.5; in Vienna, 26.7; in Munich, 32.9, and in St. Petersburg, 43.7. In Brussels, which appears to be the healthiest of continental cities, it is 18.9. To sum up the case, the death-rate during the quarter in twenty-nine colonial and foreign cities, having an aggregate population exceeding 16,000,000 persons, was 26.6 per 1,000, or more than 10½ persons per 1,000 in excess of the London death-rate.

— The Iowa Academy of Science held its third annual meeting at West Des Moines on Sept. 5. Among the papers presented were the following: "Life History of *Lelanaria ignota*," by Mr. F. W. Malley; "The Blue Quail in Iowa," "The Mission of Science," and "Notes on the Geology of North-western Iowa," by Professor J. E. Todd; "Fossils of the Keokuk Beds," by Professor C. H. Gordon; "Pearl Rearing Unios" and "Rearing *Vanessa antiopa*," by Professor F. M. Witter; "Native Forest Trees of Eastern Arkansaw" and "Geology of Eastern Arkansaw," by R. Ellsworth Call; "Geology of North-eastern Iowa," by Dr. P. J. Farnsworth; "Notes on Beggatoa," by Professor L. H. Parmmel; "Distribution of Hemiptera," by Professor Herbert Osborn; "Is the Plum *Curculio* double-brooded?" by Professor C. P. Gillette; "The Food-fishes of Iowa," by Professor Seth E. Meek; and "The Crystalline Rocks of Missouri," by Professor Erasmus Haworth. Professor Todd also exhibited some volcanic dust from a stratum near Omaha.

— Schemes for irrigation in Upper Egypt have been considered by Colonel Ross, inspector-general of irrigation, with the governors of the provinces and the provincial councils. According to *Engineering*, the area affected by these proposals includes 736,000 acres, of which no less than 250,000 acres were not irrigated or were insufficiently irrigated in 1888. The projects are all based on the idea of going up the river to such a distance that a canal starting at that point shall, when the Nile is at fourteen cubits, take enough water and deliver on the surface a free flow. The present system of canals is being utilized by deepening, widening, and prolonging them, and in many cases only by a change of site of the offtake from the river. The masonry works required will, it is estimated, cost about \$900,000, of which \$500,000 is required immediately. The junctions and prolongations of canals are estimated to cost about a million dollars. The length of the valley to be thus protected from the effects of a low Nile is 255 miles.

— Mr. William Crookes, in the course of a presidential address to the Chemical Society, said: "The phosphoscope affords another method of verifying the simple or compound character, of a substance. It is well known that the continuance of phosphorescence after the cessation of the exciting cause varies widely, from some hours, as in the case of the phosphorescent sulphides, to the fraction of a second in the case of uranium glass and quinine sulphate. On examining phosphorescent earths glowing in a vacuum tube under the action of the induction discharge, I found remarkable differences in the duration of this residual glow. Some of the earths, after the cessation of the current, remain luminous for an hour or more, whilst others cease to phosphoresce immediately on the stoppage of the current. Take the case of yttrium. As already stated, I succeeded in resolving this earth into several simpler bodies not equal in basicity. While seeking for further proof of the distinct character of these bodies, I observed that the after-glow differed somewhat in color from that which the earth exhibited whilst the current was still passing. Further, the spectrum of the after-glow seemed to show, so far as I could judge by the faint light, that some of the lines were missing. As this phenomenon indicated another difference among the components of yttrium, I examined them in an instrument similar to Becquerel's phosphoscope, but acting electrically instead of by means of direct light. Under ordinary circumstances it is scarcely possible to perceive any phosphorescence in an earth until the vacuum is so high that

the line spectrum of the residual gas begins to grow faint. Up to this point, the stronger light of the glowing gas overpowers the feeble glow of the phosphorescence. But in the phosphoscope the light of the glowing gas lasts only for an inappreciable time, while that of the phosphorescent earth persists long enough to be distinctly observed. The different bands of the new constituents of yttria do not all appear at the same speed of rotation. At the lowest speed the double greenish blue band of $G\beta$ is first seen, followed next by the dark blue band of $G\alpha$. As the velocity increases, there follows the bright citron-yellow band of $G\delta$, and as the utmost speed approaches the red band of $G\zeta$ is seen, but with difficulty. If lanthanum sulphate along with a little lime is examined in the phosphoscope, the line of $G\epsilon$ is visible at the lowest speed; $G\delta$ follows at an interval of 0.0035 second, and the $G\alpha$ line immediately afterwards."

— Professor Frank D. Adams, having been appointed lecturer on geology in McGill University, Montreal, is about to sever his connection with the Geological Survey of Canada.

— A most interesting exhibit at the Paris Exposition, according to *Engineering*, is a recording flash telegraph for military or other purposes. This apparatus, which is exhibited by MM. Ducretet, is in fact a combination of a flashing telegraph and a Morse printer, consisting of a projector fitted with a powerful lamp in the focus of the usual optical apparatus. In front of the lamp and below it and the lenses is a screen, which may be suddenly removed from the front of the lamp by the depression of a key similar to that in use under the Morse system, and this screen may be as suddenly replaced by the release of the key; the flashes, long or short, are therefore transmitted to the distant station by the action of the key exactly in the same way as in transmitting a Morse message. The movement of the key has, moreover, a second action, for it sets into motion or stops the Morse recorder, doing mechanically exactly what the electric current does in the ordinary form of that instrument. As long as the key is depressed a beam of light is continuously projected to the distant station, and a continuous line is drawn on the paper band, and the moment that the key is released the light is obscured, and at the same time the recorder ceases to draw a line on the paper. Thus every flash, whether short or long, as well as the periods of rest, are accurately recorded on the band of paper, and a permanent record is produced of every message flashed through the instrument.

— The "chemin de fer glissant," or sliding railway, at the Paris Exposition, says the *Engineering and Mining Journal*, is the application in practice of an old theory that, by adopting a sled upon rails with water interposed as the carrying medium, the least possible friction would be encountered and greater speed could be attained than by means of wheels. The promoters of the enterprise give the credit of the invention to a French engineer named Girard, who was killed in the Franco-German war, and named as the date of it 1868; but, if we are not mistaken, the idea was advanced some years before this date in England, where it was looked upon as chimerical and impracticable. However that may be, it has now for the first time been tried on a working scale, and in combination with a system of propulsion which, we believe, is novel. The wheels are replaced by four hollow slides, about eight by four inches, one at each corner of the car, fitting upon a flat and wide rail, grooved on the inner surface. To set the car in motion, water is forced by compressed air into the slide, which it raises slightly from the rail, and the propelling force is supplied by a stream of water at high pressure directed from short iron pillars upon paddles fixed underneath the car. The stream of water is supplied automatically by the movement of the car, being shut off in the same manner by the paddle passing out of range. By the time the last car has passed the jet the foremost one has reached the next pillar. The force developed is represented as very great. The train is stopped by shutting off the stream of water that feeds the slides. The experimental line on the Esplanade des Invalides has four carriages, with seating capacity for about a hundred passengers, and to traverse its length, some two hundred and fifty yards, only a few seconds are required. Great speed is claimed for the invention, not less than about ninety miles an hour, and the ability to stop in thirty yards when running at this speed. Gradi-

ents are represented to be no obstacle, sixteen inches in the yard being practicable, and the descent at such an inclination is said to be safe. No doubt the lowness of the centre of gravity, which is little more than two feet above the rails, will reduce the risk of running off the track, but the enthusiastic recommendation of the system by its promoters as peculiarly adapted for elevated railways in cities would not be echoed, we think, by the dwellers and foot passengers in streets traversed by such a line. We do not see how a continual shower bath is to be avoided, except by such an extensive, expensive, and above all, opaque dripping pan as would both require an immense expenditure and create an intolerable nuisance.

— According to the *Journal of Chemical Industry*, the specific gravity of glycerine when used for tempering steel or cast iron may be varied between 1.08 and 1.26 at 15° C. by adding water, according to the composition of the metal. The quantity of glycerine should be from one to six times greater than the weight of the pieces to be plunged into it, and its temperature may be varied from 15° to 200° C., according to the hardness of the metal. The harder the steel to be tempered, the higher should be the temperature of the glycerine. To increase the quenching power of the bath various salts may be added. Thus, when a harder temper is required, protosulphate of magnesia may be added in quantity from one to thirty-four per cent of the liquid, or from one-fourth to four per cent of sulphate of potassium. For a softer temper one to ten per cent of chloride of manganese and one to four per cent of chloride of potassium may be added. The principal advantages to be derived from these methods are: that the temperature of the aqueous solution of glycerine may be varied within wide limits, the boiling point of pure glycerine being 290° C.; and that, owing to the fact that solutions of glycerine dissolve most salts that are soluble in water, the quenching properties may be varied by readily dissolving in the bath such salts as suit the kind of metal to be tempered and the degree of temper required.

— The *Gardeners' Chronicle* reports that at the Paris Exposition many of the South American republics show specimens of the product known locally as *yerba de mate*, or Paraguay tea, the dried and broken leaves and stalks of different species of ilex. It is exhibited in packets and in original bales of green hide. This is the dietetic beverage of about 20,000,000 of people in South America, and its popularity is shown by the exhibits in the various pavilions of the Argentine Republic, Paraguay, Uruguay, Brazil, Chili, Bolivia, etc. It is difficult to get at any reliable returns as to the entire traffic in this commodity, the production of which is carried on in such a desultory and wide manner, and extends over so vast an area of wild country where the holly-trees flourish. In the Argentine Republic the consumption is over thirty-five million pounds, against five million pounds of coffee. In Paraguay the production of mate is about five million pounds; from Brazil there is an export of sixty-five million pounds to neighboring States, while the local consumption is about half as much. This is singular in the great coffee-producing centre of the world, which sends into commerce annually more than half the entire production of coffee. Strong efforts are being made to open a trade with it in Europe, especially in France, where shops advertise and recommend it. Whether this will succeed remains to be seen, looking at the increased production of tea, and the enormous increase in its sale in Europe. Approaching in its chemical composition to coffee and tea, it is asserted that it does not cause wakefulness or prevent sleep. In the rural districts, as well as in the smaller towns, this beverage is considered a regular form of diet, and not, like tea, a mere accompaniment of the breakfast-table. It is sweetened with sugar until it almost becomes a syrup. It is sold at from four to eight cents per pound, and one pound will produce about twenty quarts of infusion. It is sometimes flavored with cinnamon, orange-peel, or lemon-juice.

— At Cambridge, England, during the month of August, about twenty elementary teachers were in residence for a brief visit at Newnham College, and short courses of lectures were started in history, literature, and physiology, which might serve as a useful kind of university extension on a small scale. Full advantage was taken of the interesting lectures in history, literature, physiology, logic, and other subjects. The lecturers and students vied with

each other in making their visitors' holiday as happy as possible, arranging walking and boating excursions, impromptu concerts, tea-parties, and other forms of entertainment for them. The so-called old hall, the oldest of the three halls which now form the college, was given up to the visitors, who were under the care of two lady lecturers. The pretty rooms and tasteful decorations, the quiet and beauty which form the charms of an academic life, will doubtless be pleasant memories to those whose ordinary work lies in less beautiful places. It has come to be understood that the university extension gathering will in all probability take place annually at Oxford. It appears that the facilities offered by the place, such as the new schools, the general emptiness of the colleges, etc., are much greater than at Cambridge, and that the number of ladies attending these gatherings is likely to increase in future years. As a means of drawing women together, and giving an impetus to education, these meetings have already proved of great value. They supply an enthusiasm and a desire for knowledge and culture which can only be obtained by the gathering together of teachers and students. The actual instruction given can, of course, hardly be of consequence; but for this purpose the second part of the meeting, extending to the end of the month, during which lecturers continued in greater detail the subjects introduced during Part I., was probably found by the fraction of students who remained for it to have considerable educational value. Mr. Moulton, Mr. Mackinder, Professor Green, Mr. Churton Collins, Mr. Shaw, and Mr. Hewins were the lecturers, who worked out in greater fulness the subjects which they had already dealt with in a more summary fashion. This summer meeting at Oxford was marked by an incident which may in time become quite famous. The debating hall at the Union was for the first time invaded by lady speakers. This is, indeed, a sign of the times, which he who runs may read. In an audience of six hundred a resolution in favour of women suffrage was carried by a majority of three to one. The proceedings took place without official sanction, and were tainted with the grossest illegality; but yet the roof did not fall, as doubtless it should have done had it retained a scrap of reverence for the monastic traditions of old Oxford.

— An interesting series of experiments has recently been carried out by the Dutch State railways, says *Engineering*, for the purpose of ascertaining exactly the relative resistance of various pigments to atmospheric changes and to the corrosive action of sea water. The results have proved that the red-lead paints are less affected by atmospheric influence than those which are composed of the brown oxides of iron, on account of their adhering more closely to the metal, and of their possession of greater elasticity. It was also discovered that any sort of paint afforded an increased protection if the plates were pickled in hydrochloric acid before its application. The prevention of corrosion by salt water was found to be possible by the admixture of the oxide of some electro-positive metal, such as caustic lime and soda; but the efficiency of such a covering diminished when its alkaline properties had been neutralized by the absorption of carbonic acid. Magnesia, however, was proved to be the most serviceable, seeing that it does not absorb carbonic acid; and not only does it protect the iron from galvanic action, but it also does not affect the anti-fouling qualities of the paint.

— In the report just issued by the Oxford University Extension delegates some interesting particulars are given, says the *Pall Mall Gazette*, of the devotion to learning under difficulties which some of the students display. Thus, at Camborne one of the students was a miner, who, after the evening lecture, had to go in the night shift underground. At Burnley, a weaver in a cotton-mill, in order to have more time for study, sacrificed her dinner-hour, and remained at the loom reading between her hours of work. To supplement the regular courses of lectures, and to carry on the work therein begun, an increasing number of reading circles and students' associations have, we see, been formed. Of the latter, one of the most successful is at Exeter. It consists of ladies only, and during the year it has held about twenty meetings for the discussion of literary subjects and the readings of essays, besides arranging for the delivery of ten special scientific lectures. The

movement has received an additional impetus from the generosity of the Marquis of Ripon, Mr. J. G. Talbot, M.P., Mr. F. D. Mocatta, the Rector of Exeter, and other donors, who offered scholarships, lately awarded, to enable poorer students to attend the summer meeting at Oxford.

— Some curious facts bearing on the *morale* of the lower animals are given by a correspondent of the *Revue Scientifique*. One source of animal sociability is a permanent sexual friendliness, making individuals mutually agreeable. Thus in stables without stalls, it is desirable to put animals of opposite sex next each other, to avoid injuries. A mare may be safely put into a field containing a horse unknown to it, but if two unacquainted horses be thus put together they will fight. A stallion, indeed, will sometimes get injury from an unknown mare put into a field with it. Again, the authority of the oldest and strongest in a group of males often favors sociability. In the Spanish *ganaderias*, a horseman will lead about a numerous troop of bulls, by means of five or six bulls who obey him and maintain order. In the Madrid circus the writer saw three of these animals bring to its stall a vicious bull which had ripped up five or six horses and mortally wounded an *espada*. They made a slight movement of the horns, and the creature, after a little hesitation, turned and followed them. Once more, when flocks of wild ducks and geese have to go long distances, they form a triangle to cleave the air more easily, and the most courageous bird takes the position at the forward angle. As this is a very fatiguing post, another bird, ere long, takes the place of the exhausted leader. Thus they place their available strength at the service of the society.

— A recent number of the *China Review* contains a paper by Dr. Macgowan on the alleged avenging habits of the cobra in Indian and Chinese folk-lore. The belief in India is that a wounded cobra which escapes will sooner or later revenge itself on the man who has caused the injury, wherever he may go or whatever he may do. Dr. Macgowan says that this belief is prevalent in Indo-China and China as well as in India. But in China there is also a strong prejudice against killing the cobra, lest its spirit should haunt the slayer ever after. Cobras, therefore, are shunned rather than pursued and attacked. Popular stories of the dire consequences of slaying them keep up the superstition. A high official who had killed one died soon afterwards of some mysterious disease, and the death is attributed to the slain snake; again, the spirit of the snake enters into possession of its slayer, and employs the vocal organs of the latter in uttering imprecations on himself until death mercifully removes him. Dr. Macgowan gives a large number of stories of this character. A number of others refer to the retribution on snake-killers after their own deaths. Gratitude, as well as vindictiveness, is ascribed to snakes, of which some characteristic stories are given. In conclusion, Dr. Macgowan observes that the recently established vernacular press in China furnishes inexhaustible stores of folk-lore. "Paragraphs describing popular superstitions, impossible occurrences, monstrosities, and so forth, constitute a great portion of their matter." In regard to snakes, the marvel is that any are killed at all in China, so many dreadful punishments are supposed to overtake their destroyers; and, indeed, it is considered a work meriting favor here and hereafter to purchase captured snakes and liberate them. Nevertheless, poisonous snakes are not numerous in China, probably because their presence is inconvenient to Chinese farmers, and they are therefore destroyed, folk-lore notwithstanding.

— The following practical suggestions, based on results of experiments at the Indiana Agricultural Experiment Station, are offered by Professor W. C. Latta, in the hope that their application would result advantageously on a very large proportion of the wheat farms of Indiana. (1) Sow less wheat; grow more grass, and better live stock. (2) Select a hardy, prolific wheat, adapted to your soil, and stick to it. Give it good treatment and it will not "run out." Sow not less than six pecks of sound seed to the acre. (3) Plough wheat ground early, and harrow immediately after ploughing. You can thus more easily and more thoroughly pulverize the soil. (4) If ground breaks up cloddy, use heavy roll alternating with some form of harrow or cultivator that will bring clods to sur-

face. (5) If manure or fertilizers are used, mix thoroughly with soil in every case. Use only rotted manure, if any, and apply after plowing. Reserve the fresh manure for the corn crop. (6) Before trying a fertilizer, get the experience and advice of farmers whose soils are similar to your own. (7) Test the untried brands carefully, in a small way, before deciding upon their extensive use. This is the best course, for the reason that even the highest grades often act very differently on different soils. (8) Adopt a rotation of crops suited to your soil and needs. It will increase the yield and improve the quality of your crops, enable you to take better care of your live stock, prevent serious insect depredations and fungous diseases, improve your soil and make it more lasting, and put money in your pocket. (9) Bear in mind that soils and climate vary greatly in different localities, and that these potent factors in crop production will very materially affect the results of your work. Therefore, study your local conditions, and intelligently apply the lessons of this bulletin only so far as they may be suited to your needs and surroundings.

— Information has reached us that Mr. Julien of Brussels, the inventor of the Julien electric traction system in operation on the Fourth Avenue street railway in this city, has been awarded a gold medal at the Paris Exposition, for his storage batteries, over competitors from all parts of the world. This is of importance, being confirmatory of the awards obtained by him for his batteries and system of storage battery traction at Antwerp in 1885, by the international congress appointed by the government to report as to the best manner of propulsion of tram cars; and also at Paris in 1886, and at Brussels in 1888, when the Leopold cross was presented him for his invention.

— Russia is organizing a system of technical schools of a very complete form. The schools are of three classes, lower and middle technical schools, and upper, or, as they are so called, trade schools. The first consist of three divisions, for mechanics, chemists, and builders respectively, and the instruction is strictly technical and manual. The second class is intended for assistant engineers and architects, foremen builders, and agricultural bailiffs. The courses of study cover four years, and the students must have completed their primary education before entering the schools. The subjects of study are drawing, mechanics, applied mathematics, and practical exercises bearing on the industry to be followed. These middle schools are divided into five kinds, technical schools of a general character, schools of chemistry, schools of agriculture, schools of architecture, and schools of mines. Some schools combine two or more of these functions, that of Nijni-Novgorod, for instance, two; that of Moscow, three; that of Krasnovodsk also two, agriculture and mining. None of the courses are simply fanciful, all are practical. For instance, in the school of architecture the time will not be spent in sketching Pantheons or designing triumphal arches, but in planning dwellings of a moderate cost, which shall be sound and durable, well warmed and ventilated, well drained, comfortable, and pleasant to live in. The superior trade schools are intended to produce skilled and intelligent workmen in wood and metal. The minister of instruction calculates that the cost of maintenance of a lower school will be about ten thousand dollars per annum, that of a middle school fourteen thousand five hundred dollars, and that of a trade school about six thousand seven hundred dollars.

— An interesting correspondence has been published between the Magdeburgh Fire Insurance Company and Dr. Stephan, head of the German postal and telegraphic service, respecting the relation between the telephone and the electric fluid, from which it appears that, contrary to the general belief, experience in Germany goes to show that a telephone network rather acts as a protection against lightning than otherwise. For instance, in Hamburg, during the period from 1885 to 1888, there was only one case of lightning in the heart of the city, where the net is very dense, but many others in the suburbs where there is no telephone. In Berlin and other German towns, as well as in Copenhagen, similar experiences are reported. Dr. Stephan, however, points out that the imperial telephone network is being laid with every care, and that the number of lightning conductors is very large.

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EDWARD ATKINSON'S PLANS FOR THE WORLD'S FAIR OF 1892.

THE suggestions made by Mr. Edward Atkinson, and printed in *Science*, of Aug. 30, bearing upon the scope of the exhibition to be held in this city in 1892, have attracted much attention from many business men. Voicing the sentiments of those business men and others interested in the success of the exhibition, the president of the Chamber of Commerce of this city requested Mr. Atkinson to present his views more in detail. To this request Mr. Atkinson responded with the following detailed plans for the development of an historic and economic exhibit on certain lines of industry which might be made a part of the proposed exhibition of 1892:—

We may begin with the art of spinning and weaving. The origin of these arts is prehistoric. From the earliest dawn of history woven fabrics have been in use. The linen in which the mummies of Egypt are wrapped is equal in the fineness of the thread and in the texture of the web to many of the examples of the finest work of the modern loom. The distaff is classic, but unless the railway has completed its revolution, some of the natives of northern Italy could be brought to the exhibition who would spin linen thread with the distaff after the manner of Penelope. The loom and the weaver are pictured, as I have been informed, on the walls of Babylon and on the pyramids. The hand-loom worked by the native Egyptians in the same way, and of identical type, could be

brought to the exhibition. Neither the inventor nor the date of the invention of the spinning-wheel is known. The spinning-wheel of the prehistoric type is worked to-day for clothing nine-tenths of the population of China; the wheel and the spinner, the loom and the weaver, could be brought together from there. The wheel and the loom of the same identical type are to-day in operation in the heart of the Southern mountains, working on cotton and wool, and in the western counties of Ireland, working on Irish homespun. The representatives of these prehistoric arts could be brought from there and from many other points in Asia, Africa, South America, Australia, and Polynesia, with examples of all their fabrics, ancient and modern.

Such an exhibition as the one proposed in this paragraph would undoubtedly lead to the establishment of a great and permanent textile museum and weaving school, equal or superior to that at Crefeld in Rhenish Prussia, which was formerly open to Americans, but from which they are now excluded. Such schools have only lately been established even in England, although they have existed for a long time in Germany and France. We have made a small beginning in Philadelphia and in Boston, but nothing in any measure adequate to the necessities of the case. A complete museum of textile fabrics and of looms of various kinds would be among the primary elements required for such a school. The co-operation of the Arkwright Club of Boston, of the Wool and Woollen Association, of the Silk Association, of the Manufacturers' Club of Philadelphia, and of other similar organizations, might be called for in determining the conditions both for the proposed exhibition and for the ultimate destination of the examples of machinery and fabrics which might be brought together at that time.

Within the same rail on the floor of the Atlanta Exposition were two hand carders, two spinners with their wheels, and one weaver,—five persons who could make in a day of ten hours eight yards of narrow coarse cotton osanburg. Within the same rail was the carding and spinning machinery of the Willimantic Thread Company and the looms which were sent there from Massachusetts, on which the cotton which was growing in the field in the morning, after it had been picked, ginned, and prepared, was spun, woven, dyed, and made into a dress suit which I wore at a reception the same evening. The difference in the capacity of the operatives who worked these modern machines as compared to the homespun art on the same fabric was one hundred to one, by actual computation.

The first step in the progress from the spinning-wheel of a single spindle to the spinning-mule of twelve hundred spindles was the spinning-jenny of eight or ten spindles. Some of these spinning-jennies are still made use of, I believe, in Africa, to prepare the yarn for a hand-loom which is carried about in the hands of the natives, on which they weave the narrow strips of which their garments are made when they have been stitched together. The African spinners and weavers, with their machines, can be brought to the exhibition.

In South America, in Mexico, among the Indians of the far North-west, and in every part of the world, are people of various tribes and races who clothe themselves in homespun and hand-woven fabrics, as our grandfathers and grandmothers did in New England only a century since.

It is easy to conceive of a department in the exhibition of 1892 in which shall be built the cabin of the African, the cobble-stone dwelling of the Irish cotter, the model of the cottage of the English peasant, the dwelling of the Chinaman, the wigwam of the Indian, the log cabin of the Southern mountaineers, where each type of each race may conduct the art of spinning and weaving in their own way; while in the next compartment may be exhibited the finest examples of the most modern textile machinery: in this one section would be given the history of clothing from the fig-leaf to the type of the present day. Even the preparation of the different fibres may be brought into view. The seed of the cotton is cleaned from the fibre in China at the present time by the snapping of a bowstring, precisely as it was done in Georgia, giving the name of "bowed cotton" to the Georgia staple before Eli Whitney invented the cotton gin.

Again, while the art of weaving begins with the hand-loom in making the fabrics of the coarsest kind, the art also ends with the

hand-loom on which the finest silks of Lyons and the finest velvets of Rhenish Prussia are to-day woven; and from these points the typical weavers could be assembled with their simple looms on which they make those finest goods, which are in themselves a work of art.

In the matter of printing textile fabrics, the art began by stamping figures of a coarse and rude kind by hand upon the cloth; and that same art is still carried on in the same way in China and in Japan, and could be brought before the eye in the exhibition; while the progress in the art of printing textile fabrics could be witnessed in the next section as it is now carried on by the use of machines of the finest and highest types. But this art would end again in the bringing from France the block printers, who still print by hand the finest examples of the French cretonnes.

This conception of the method of the proposed exhibition is wholly consistent with making the exhibition itself a medium for bringing into notice the finest examples of modern machinery and the finest types of modern fabrics. The only difficulty which might be experienced in carrying out this conception might be that too many makers of machinery and venders of the fabrics of the finest types would apply for place.

The personal factor and the element of individual profit may therefore be brought to bear in connection with this plan, as well as in any other way. The plan only gives a definite point or purpose to the undertaking, and would make the whole exhibition an example of progress and a means of comparing the mechanism by which the people of different countries and races have clothed themselves or otherwise provided for material wants in the past and do now clothe and serve themselves in the present.

If it were too great an undertaking to bring together typical examples of the garments of the past as well as of the present, nevertheless, pictures may be gathered to hang upon the walls of this exhibition, artistic in their conception, typical of the art in the different countries in their execution, and yet object lessons in the history of the textile arts.

I have in my possession six pictures painted in China on silk, giving the whole story of cotton, from the field to the fabric, which were sent to me by Messrs. Russell and Co. to exhibit at Atlanta, accompanied by a complete set of garments worn by the common people of China. They were sent to me without cost, but were evidently expensive. I have already mentioned the little artistic clay figures which can be purchased in India, showing every type of costume, at a mere trifling cost.

If we pass on from the textile out to the treatment of metal, taking iron as an example, we find that iron is still treated in Spain as it was when the Toledo blade became famous. It is treated in Africa in the crudest manner. In the heart of the southern mountains, iron and steel are still made directly from the ore in wayside furnaces heated with charcoal on what I believe are called "Catalan forges." How various or how widespread over the world are the different methods of treating the ore of iron, I am not informed, but all these primary methods could be brought, with those who practise them, into one section of the exhibition; and since the introduction of the most modern type of furnace worked by gas has been adopted, it has also become possible to set up small examples of the most modern form of producing iron and steel and working these metals into manifold shades. The whole history of metallurgy as applied to iron can be brought before the eye; and here again the element of personal interest may be brought to bear on the part of those who desire to exhibit the most modern types of stoves, smelting furnaces, and the like.

Perhaps the most interesting and the most varied of the many arts which can be brought together into view would be the types of the tools and machines used by various races and nations in the conduct of agriculture. Herein again, the plough, as pictured upon the walls of the Pyramids, could be brought from the fields of Egypt, with the fellahin, who still make use of that prehistoric implement; and alongside could be placed the modern polished steel plough, of which I have a record among my insurance papers that when accidentally placed outside a barn it concentrated the rays of the sun, and reflected them in such a way as to set the barn on fire. Herein, again, there would be a rush of competitors to exhibit the best types of the most modern agricultural tools and machines.

Again, the one art which is of all others prehistoric is that of the potter. Would it not be possible to bring the potters from many lands into a single section with their primitive implements, placed alongside the most modern type of apparatus with their artists as well as their ovens?

Lastly, there is nothing like leather. How easy it would be to bring into the same section the worker in leather from different parts of the world; the cobbler from that part of this country which has not yet been penetrated by the railway, alongside the modern machines by which each visitor, having been measured on entering the section, may have a last prepared to fit his or her foot, and a pair of finished boots made to measure ready to put on, within the time that would be necessary to get even a superficial idea of the mechanism by which the work had been accomplished.

When all these and many other arts had thus been brought together, to be conducted under one great roof by representatives of many races and many nations, each according to his kind dwelling in his accustomed way and conducting all the household arts as they are conducted at home, the Arab in his tent, the African in his hut, the Mexican Indian in his adobe house, the mountaineer of the South in his log cabin, the native of Japan in his dwelling of wood and paper, the Chinaman, the Aleut, the Alaskan, and all the rest — what could be more attractive or instructive? And lastly, what would pay better in a mere commercial sense?

I therefore submit that my conception of an exhibition which shall give the history of industrial progress, by means of object lessons drawn from the past, but yet existing in the present, is wholly consistent with the necessary element of personal interest and personal profit on the part of those who contribute the modern examples of existing machinery.

In addition to these object lessons, the art of the painter, and even of the sculptor, may be invoked to decorate the walls; the art of the engineer and of the mill constructor may be called in to build the structures; while the services of the statistician, the economist and the ready writer, and the engraver would be required to prepare the catalogue and to write the descriptions, so as to tell the whole story of what the eye could see in part.

This would be the main conception to be carried out, either in the main building or in the main series of buildings. Auxiliary buildings may be added by States, in the manner previously indicated, in which examples of every crude material, together with maps and descriptions showing the resources of any section of the country, might be brought together. If, in addition to this, it was thought expedient to make preparation for a great fair or bazaar where goods could be exhibited and sold according to the will of the contributor, that purpose might also be provided for in the exact measure of the demand which would ensue for space or place. The conditions precedent to carry out this conception consist, first, in finding the money which will be required to make the preparation, and, second, the men (especially the man) capable of laying out, executing, guiding, and directing the whole work.

AN UNKNOWN ORGAN OF SENSE.

In the frequent dwelling upon questions of development, which one cannot avoid in these days, one sometimes wonders whether the future is destined to endow man with any senses which he is not now in possession of. However that may be, it is probably unknown to a great many of the laity that within a few years past a new organ of sense has been discovered, the existence of which had not before been so much as suspected. It was always known that the internal ear was a curiously complicated structure, and there was little hope of being able to make out the separate functions, in hearing, played by all its different parts. But it was not suspected, even when Flourens had made his celebrated experiments in 1824, that one part of it — the three narrow semicircular tubes which spread out in three planes at right-angles to each other — might be the organ of a totally different sense. It is only now that the question has been definitely set at rest by the admirable experiments of Brener. There can no longer be any doubt that the semicircular canals are the organ for sensations, whether conscious or not, which enable us to determine both the direction and the amount of all rotations performed either by the

head alone or by the head and body together. The argument by which this has been established is interesting, if only as furnishing another instance of the ins and outs of that great scientific method by which truth is being constantly tracked to its lair.

It was first noticed that the semicircular canals could be destroyed without any injury to the sense of hearing, but that their destruction was followed, in various animals, by convulsive motions of the eyes, the head, and the body, and that these motions were in different directions as different ones of the three canals were destroyed. It was next pointed out that certain diseases in human beings which were accompanied by feelings of dizziness and loss of equilibrium were connected with injury to those organs. Finally, distinct sensations were said to be felt upon the performance of certain motions, not to be confounded with either a muscle-sense or a sense of touch, and not to be explained except by the hypothesis of some peripheral organ. But at this stage of the discussion, physiologists went too fast and too far; many of them held that the semicircular canals are spatial sense-organs upon whose activity depends every perception of the position, or of the direction of motion, of the body. The limitation of their functions to the perception of rotations only has been performed by Delage, and in the following way. He pointed out the aid to be got, in such cases, from the study of illusions.

The mind is able to interpret the data of the several senses in accordance with external fact only when the sense-organ in question is working under normal conditions. Unusual conditions are a frequent cause of illusions, and the source of a given illusory sensation can easily be made out, when it is certain that one organ and only one is subjected to circumstances which it is not accustomed to. Even when this simple situation cannot be arrived at, the same thing can sometimes be accomplished more indirectly. Thus when the head is turned far to either side, the eyes being shut, objects which can be correctly pointed at with the head in a normal attitude seem to have shifted their position about fifteen degrees in the opposite direction. This indicates that the organ which gives us the sense of direction when we are at rest is in the head. But it is in the eye and not in the ear, for the illusion persists when we turn the eyes without the head, and it vanishes when, on moving the head, we force the eyes to remain at rest relatively to it. When we have occasion to look far around, we usually accomplish it by moving the head part of the way and the eyes in the head the rest of the way. We have thus acquired the habit, when we move the head to the right, of moving the eyes still farther to the right, and it is this wrong position of the eyes in the sockets which gives rise to the above illusion. It is the muscles of the eye, therefore, which gives us our static sensations of direction. In a similar way it is shown that our knowledge of the position of the body at any instant is derived, when the eyes are shut, from muscular and cutaneous sensations and from a general sensitiveness to the direction of gravitation of the fluids and internal organs of the body.

The feelings which inform us that we are undergoing a progressive motion in any direction, have a similar general origin, but the case is very different with rotations. In the first place, we have a far more delicate sense of rotation than of progressive motion,—a velocity only one third as great can be detected. The illusions that are produced by turning the head to one side while the body is being rotated about any axis are opposite in direction from those produced by the eye, and much greater in amount; they are, in fact, partly counteracted by the eye-illusions. To produce rotation about a vertical axis, the person is seated in a dark rotating box. He feels himself to be rotating about a vertical axis, as he is, but he has only to turn his head over towards his right shoulder to make himself think that the axis of rotation of the box is inclined towards the left, or that the space about him had been shifted to his right. In other words, he cannot help feeling as he would if his whole body were in a continuous line with his head. A sudden change in the position of the head during a swift rotation is enough to cause dizziness, nausea, and a general feeling of extreme unpleasantness,—so much so that Delage says that it requires a very considerable amount of courage to perform the same operation again. There is no other unoccupied organ in the head which might be taken to be the source of

this illusory sensation, except the semicircular canals, and hence we are under the necessity of attributing it to them.

A few years ago Prof. William James made the interesting discovery that deaf people were in very many instances not subject to dizziness nor to sea-sickness, and that they had, for the most part, given up diving, because they found it impossible to tell one direction from another when under water. A disease of the organ of hearing would be very likely to attack the closely adjacent semicircular canals, and hence these curious observations add great weight to the theory that they are the seat of sensation for certain motions of the body and the head. It may be mentioned that Professor James suggests trying blisters behind the ears, or even a gentle rubbing, as a cure for sea-sickness.

The argument at this point is not absolutely conclusive, though it is exceedingly strong, but it is put beyond any shadow of doubt by the recent experiments of Brener upon doves, already referred to. He cuts down to the bony semicircular canals, and, without having injured them in the least, he succeeds in sending an electric current through them. The head moves in absolute obedience to the current in either one of the three planes according to the canal which is stimulated, and in each plane it moves in one direction or the other, according to the direction of the electric current. With the interrupted current, no motion at all is produced. But how is it certain that it is only the canals that are stimulated, and that the motion is not due to direct stimulation of the brain? This objection, which has long been considered a very weighty one, has been absolutely set at rest by Brener. He inserts the needle, which conveys the current, into the matter of the brain, and motions of the head are, indeed, produced. But he next diminishes the intensity of the current until it is no longer strong enough to produce any effect in that place, and then transfers the needle to the semicircular canals. The motions are immediately set up again. It is, of course, perfectly natural that the effect of the current upon either the brain-centres or the fibres communicating with them should be the same as upon the nerve-ends, but the fortunate circumstance that the nerve-ends are stimulated by a current too weak to affect the adjacent parts of the brain proves conclusively—and by a very pretty piece of logic—that the specific function of those nerve-ends is, in fact, the regulation of the convulsive motions of the head. That they regulate the motions through reflex responses to sensations,—in other words, that the motions are by way of compensation for a subjective feeling of falling in the opposite direction,—is proved by the experience of those individuals who execute the same movements under the influence of disease. The chain of evidence is, therefore, now absolutely complete that the nerves which are distributed upon the enlarged ends of the semicircular canals are sensory nerves whose function (or, at least, one of whose functions) is to give us knowledge of the character and extent of all rotations executed by the head.

Mach, in his "*Bewegungsempfindungen*," published in 1875, described many very ingenious experiments which went to show that we are conscious of a specific sensation when the activity of the semicircular canals is excited. These have not been considered conclusive by other writers, and in a later work of his (*Analyse der Empfindungen*, 1886) he lays less stress upon the excitation of specific sensations, and is content to assume that they set free purely reflexory innervations (p. 73). The semicircular canals may still be called a sense-organ, even though we are not immediately conscious of the sensations which they give rise to. The use of the phrase "unconscious sensation" implies that in the opinion of physiologists there is something which may be properly termed a sensation, but which is not *felt* by us in the ordinary meaning of that word. Any message which is sent in to the brain by an afferent nerve, and which gives rise to actions suitable to the circumstances, is called a sensation, even though our conscious self knows nothing about what is going on until after the action is accomplished, if even then. Thus in the eye-illusion first mentioned, the full explanation of what takes place is this:—the angle through which the head has moved is measured by the semicircular canals, and this information is transmitted to the centres of the eye-muscles, whereupon the eyes make the amount of motion appropriate to that position of the head; their unusual position in their sockets is then telegraphed in by other nerves of sensation, and this infor-

mation has its proper effect upon our intelligent judgments of the position of things about us, and these judgments are the only thing, in the whole process, which we know ourselves to be thinking about.

What is the nature of the mechanical stimulation which excites the nerves of the semicircular canals under ordinary circumstances? Brener produces the motions by making a small incision in the canals, and drawing out the liquid contained in them by a piece of blotting paper. If, when the head is moved, the endolymph remained behind for a short time by inertia, and then rubbed against the hairs of the ampullæ as it moved forward, that might be a means for producing a sensation in the nerve. This retarded movement can actually be seen to take place in artificial glass tubes, made of the same shape as the semicircular canals, but of a larger size. But when the tubes are made of the same small size as the actual canals, no effect of inertia can be detected. It is not by any means sure that in the real tubes the retardation would not take place, for they differ in many respects from tubes of glass; an actual retardation, moreover, would very naturally explain the illusion of an after-motion in the opposite direction which is, under some circumstances, very persistent after a rotation has ceased. Mach, however, considers that changes of pressure are quite sufficient to produce the required effect; on calculating their amount he found it to be not so inconsiderable, compared with the energy necessary to affect other organs of sense, as might have been expected. But whether due to changes of pressure, or to rubbing, it is no longer possible to doubt that it is to sensations in the semicircular canals, for the most part unconscious, that we owe that exact knowledge of how far and in what direction we have turned the head at any moment which is necessary to our safe progress every time we attempt to move about in space.

CHRISTINE LADD FRANKLIN.

HARVARD OF TO-DAY.¹

I THANK you with all my heart for this kind reception; but as I look round me and remember how few there are in this large assemblage who have not borne the infliction of my lectures, I am abashed to think how widely my weaknesses and shortcomings must be known. It is fortunate for us old teachers that time so far alters the perspective under which the incidents of college life are seen that our mistakes become less prominent, and our devotion to truth and duty more evident, as we advance in years. Before another generation has passed, I trust that old Father Time will have dealt as graciously with the college work of to-day as he has with our own weak endeavors in the past; but it has seemed to me that many of her friends have of late been criticising Alma Mater very much in the same spirit which her students showed to their teachers in former times, exaggerating her failures and minimizing her successes. In a community of nearly two thousand young men it must be that offences come; and he can have known little of human nature in opening manhood who thinks that by any system of restrictions he can build a wall around the college high enough to keep evil out; and, however much he may dread the conflict, who does not know that no force of character can be attained and no manly virtue won except by meeting the enemy and slaying him?

The discreditable stories which have been so widely circulated about our college have brought upon us the scrutiny of a whole army of reporters; and, whatever of truth or of falsehood there may have been in the sensational paragraphs they have published, of this I am sure, that few societies of men, however sacred their object, could have borne the scrutiny as well. When I have indignantly repelled the scandals, I have been told that I knew nothing about that phase of college life. Thank God I do know nothing about it; and I am in constant association with hundreds on hundreds of young men who know as little about it as I do. We do not expect to solve the problem of evil at Harvard in this generation; but there is this very marked difference between the evil influences of to-day and those of only a few years back. Then the evil was everywhere pervasive. The classes were so small that all the members were brought into more or less intimate association, and

one could not avoid meeting the hateful forms of vice, however greatly he might be repelled by the sight. Now associations are determined to a far greater extent by mutual tastes and affinities; the bad influences are confined to a limited class, and the great majority of our students in passing through college see as little of degrading vice as they would at their homes.

Several years ago an anxious mother consulted me about sending her son to this college. The son was anxious to study in our laboratory, but the mother feared the evil influences of the place. Nevertheless the boy came, as I afterward learned, in consequence of my representations, graduated with highest honors, and is now one of the most promising of the younger members of his profession. The mother followed her son to Cambridge. After she had lived among us for some time, she said to me one day: "I am so much delighted with this place. Things are so different from what I expected. I was told such horrid stories, and not one word of them is true." We have at least one sincere advocate, who has been convinced by experience; and there are numbers of young men who graduate from Harvard every year as guileless as this earnest woman's son.

My friends, I can assure you that the great danger of our dear college at the present time is not over dissipation, but over work. Sixty thousand dollars cannot be distributed in prizes every year without producing an enormous strain; and those of us who are directing the workers know how intense the activity is. We may know little of the evil around us, but we do know a great deal of the good. We know of lofty purposes and of earnest endeavor. We know of perseverance under great discouragements, and of victories won against heavy odds. We know of self-control and of self-devotion. We know of Christian duties habitually practised, and of truth and right manfully upheld; and we maintain that the character of a community of scholars is to be judged by such traits as these, and not by the occasional lapses of its weaker members.

Moreover, I am not one of those who think that a man is necessarily condemned because he is born with a gold spoon in his mouth, or that educated leisure is an unmitigated evil. The college has done a good work in educating rich men, and it owes a great part of its present influence to the noble use which many of its alumni have made of inherited wealth. Such men are educated more by association than by direct instruction; and, as a former president of the college once said, they gain something if they merely rub their backs against the college walls; and if this was true in the past, how much more is it true in the present, when the intellectual life of the college is so much more active, the standard of scholarship so much higher, and the opportunities of cultivating special tastes so greatly enlarged. You cannot expect of such men the asceticism of an anchorite, or the plodding diligence of a scholar; but the university owes them an education, and the duties and obligations are not wholly on one side.

During the last twenty-five years the life at the university has been rendered safer and more healthy, in every respect, by a greatly increased enthusiasm for learning, which extends to almost every department of this large institution. In no one respect has the improvement in the college been more striking than in this; and probably no officer of the college has had better opportunities of observing the change than myself. For forty years I have lectured to the successive freshman classes, beginning with the class which entered in 1849; and many of the older men around me will remember the boyish pranks which in their college days not infrequently amused the class, and greatly tried the temper of the teacher. The lecture was always an up-hill work,—a duty to be enforced on the one side, a task to be endured on the other. The lecturer was always waiting on disturbance, the class always waiting on deliverance. Not only was there no general enthusiasm, but the first suspicion of such a thing in a college lecture-room would have been regarded as a dangerous precedent, alike compromising the dignity of the teacher and violating the traditions of the place. Now, although the classes have so outgrown the accommodations that not only all the seats, but all the approaches to my lecture-room, are crowded almost to suffocation, a more orderly, a more attentive, or a more enthusiastic audience cannot be found. This change is due not simply to our elective system, but far more

¹ Address by Josiah Parsons Cooke, LL.D. at the commencement dinner at Harvard University, on June 26, 1889.

to the putting away of those petty restrictions which were formerly a constant menace, and erected an impassable barrier between the teacher and the taught. We no longer, like the Irishman, stand aloof with a chip on the shoulder, and dare any of the boys to knock it off; but we invite confidence, and receive it, and our relations with the students is not that of taskmaster and toiler, but that of guide and friend. Had our worthy president done no more than break down that old middle wall of partition, he would for this great feature of his administration alone deserve the everlasting gratitude of this community. And let me entreat you, my brethren, not to allow any one to reinstate this wall, or even to lay the first brick in its reconstruction.

Most of our sister institutions are struggling with hobbledehoydom still. Only a few days ago, one of our distinguished graduates, and a highly valued professor in another New England college, said to me: "Cambridge men do not appreciate the advantages they have gained by setting their students free from petty restraints. Treat men as boys and they will act as boys. With us the boyishness first breaks out in the chapel, and then extends to all the classrooms. It belittles all our work, and dampens all our enthusiasm." My friends, in an institution of learning like this, you cannot prize too highly the ennobling virtue of enthusiasm. To awaken it is to make the boy a man. To fail to arouse it, at least in something, is to miss the great end of education. But such virtue cannot be had without cost. Enthusiasm implies of necessity freedom; and who in this New England, after a century's experience, is not willing to incur the risk and pay the cost which freedom entails?

Finally, brethren, while noble character is the crowning grace of education, scholarship is the brightest jewel in this crown; and you may well ask, Has learning kept pace with privilege? But in attempting to answer this question I find myself in the dilemma of the learned commentator who had devoted a chapter to the snakes of Iceland. He could find no snakes, and I can find no comparison. The scholarship of to-day rests on a level so much higher than that of twenty-five years ago, that there is no common measure. I will confine myself to my own department, of which I have accurate knowledge, and of which I may speak unreservedly, because it has so broadened out that only a small part of the instruction now devolves on the director. Besides the very large class, before referred to, which attended the elementary lectures, there were actually working in the chemical laboratory last year more students than were comprised in the whole college of my day, and the contributions to chemical science which will soon be published, as the result of the year's work of students as well as of teachers, will fill more than one half of the annual volume of our American academy. A recent writer in the *Atlantic Monthly*, discussing "Why our Students go to Europe," pays us what he evidently regards as a high compliment in saying, "Now the chemical course at Harvard equals that in most German universities." Our own students who have gone from the laboratory to study abroad will tell you, as they have told me repeatedly, that, whatever advantages may be gained by association with men of special attainments, there is no University in Germany, or elsewhere, at which the instruction is at once so broad, so full, and so thorough as at home. How does this compare with recitations from "Stöckhardt's Chemistry," illustrated by popular lectures?

Fellow alumni, our attention has been so often and so loudly called of late to the shady side of college life, that, whatever opinions you may have formed, I am sure you will not blame me for inviting you on Commencement day to bask for a few minutes in its sunshine. At such a time we can only meet assertion with assertion; but I have spoken solely of what I do know, and if any one is not convinced I invite him, following the example of the anxious mother, to come and dwell among us and partake of our life. Obviously I am no pessimist, but also I am no optimist. The members of this great family are all frail human souls. Evil is ever present with us, as it was with our fathers and will be with our children. We cannot escape the curse. But we have faith in truth and right, and will fight the good fight to the end.

"O yet we trust that somehow good
Will be the final goal of ill,
To pangs of nature, sins of will,
Defects of doubt, and taints of blood."

We all boast the same intellectual parentage. You for the most part have gone out into the world and found a career elsewhere. I am one of the few who have always stayed by the homestead since I was first received into the brotherhood with the Class of 1848. For nearly half a century I have known the dear old Mother as well as a devoted son possibly could; and let me assure my brothers who have come home to keep this feast, that during her long life our Alma Mater was never so worthy of our admiration and veneration, of our love and devotion, as she is this day.

BOOK-REVIEWS.

A Manual of Machine Construction, for Engineers, Draughtsmen, and Mechanics. By JOHN RICHARDS. Philadelphia, Lippincott, \$5.

An experience in constructive engineering extending over a period of thirty-five years, in both Europe and America, has admirably qualified Mr. Richards for the task of preparing this volume. That the task is well done, will not be doubted by those acquainted with his previous work in the same line, which includes a number of treatises on various mechanical subjects.

The book is unique in more than one respect. It is intended to meet the every-day wants of the practical man, in draughting-room or work-shop, and is consequently more a work of direct application than of theoretical instruction. While concise, as such a book must necessarily be, it nevertheless touches with sufficient detail on many minute points concerning which very little has heretofore been accessible in print. The author states that the preparation of the work was suggested many years ago by the inconvenience of common references such as are required in usual machine practice, and by a belief that some more simple form, adapted directly to use, and confined to those things most commonly dealt with, would be of value. Being made up mainly from the personal experience of the author, reproducing and classifying work already constructed, the book presents in a convenient form material gathered in the course of a long and diversified experience, the exact rules formulated in accordance with theoretical considerations being modified to suit the limitations and exigencies of actual practice.

A peculiar feature of the book is its make-up, being bound so that it opens at the end of the page instead of at the side, after the manner of a reporter's note-book, or legal-cap paper; and each alternate page is left blank, for convenience in reference and also to receive notes and original matter. The page titles and numbers are placed at the bottom of the page to facilitate convenience in reference.

The volume is divided into sections on machine design, the transmission of power, steam machinery, hydraulics, and processes and properties, followed by a section devoted to tables and memoranda of weights and measures; standards for screws, bolts, and nuts; sizes of wood and machine screws; circumferences and areas of circles; square and cube roots, etc. To engineers and draughtsmen engaged in machine design or construction, this book will prove of special value.

Monopolies and the People. By CHARLES WHITING BAKER. New York. Putnam. 12°. \$1.25.

THIS work is an attempt to solve the problems presented by the new form and organization of industry. The author is impressed, as most persons are, by the rapid growth of "trusts" and other combinations of a monopolistic character, and by the evils they sometimes produce; and he here undertakes to furnish a remedy for those evils. He writes in a judicial tone and with an evident desire to be fair to all parties. He gives an account of the origin and growth of the combinations known as "trusts," with other chapters on monopolies in minerals and transportation, placing also the labor unions in the general class of monopolies. He regards them all as natural outgrowths of existing industrial conditions, and while he acknowledges that they are in some respects beneficial, he is especially impressed with the abuses that attend them. So far his readers will probably agree with him; but when he comes to state the remedies for the evils he speaks of, we, at least, are obliged to dissent. He holds that the true remedy for monopoly is

not abolition but control, and the control he advocates involves what we should call a violent interference by the state with all the operations of industry. For instance, he proposes that the United States shall buy up all the railroads in the country, paying for them with three per cent bonds, and then lease them to private companies. All fares and freight tariffs are to be fixed by government commissioners, and the government is also to have a share in the directorship of the companies. Mining and gas companies are to be treated in a similar way, but on the subject of manufacturing monopolies Mr. Baker speaks with more hesitation, the principal measure he proposes being a requirement that all such associations as the "trusts" shall sell to all persons at the same price. Such are his remedies for the evils of monopoly; but to our mind they involve altogether too great an interference with the natural course of industry, and we believe the American people will agree with us in this opinion. New laws will doubtless be needed to remedy the abuses that Mr. Baker has here set forth; but such a widespread interference with industry as he advocates would, we feel sure, result disastrously.

AMONG THE PUBLISHERS.

BERGER'S "French Conversations, Idiomatic Expressions, and Proverbs" (New York, F. Berger) has reached a fifth edition.

—Macmillan & Co. will publish early in the fall a revised edition of Mr. Alfred Austin's poem, "The Human Tragedy," which will contain likewise a prefatory essay on "The Present Position and Prospects of Poetry."

—J. Maisonnave, publisher and bookseller, of 25 Quai Voltaire, Paris, has issued a catalogue of rare and valuable works relating to America, in which attention is specially called to the "Letter of Christopher Columbus announcing the discovery of the New World," in the original Spanish text, first edition.

—Cassell & Company have just ready Max O'Rell's new book, "Jacques Bonhomme," a lively description of French manners and customs, to which is added "John Bull on the Continent" and "From my Letter-Box."

—Lee & Shepard have ready "Observation Lessons in the Primary Schools," by Louisa P. Hopkins, a manual for teachers, presenting practical methods for teaching elementary science to the young.

—A. C. McClurg & Co., Chicago, will publish shortly, "Fact, Fancy, and Fable," by H. F. Reddall, a work of comprehensive and cyclopedic character, presenting concise information on a great variety of subjects.

—The publishers of *St. Nicholas* announce that that popular children's magazine is to be enlarged, beginning with the new volume, which opens with November, 1889, and that a new and clearer type will be adopted.

—During the coming volume *The Century* is to have an illustrated series of articles on the French salons of the seventeenth and eighteenth centuries, including pen portraits of many of the leaders and a detailed account of the organization and composition of several historical salons. A great number of interesting portraits will be given with the series.

—Houghton, Mifflin & Co. have published in the series of American Statesmen "Benjamin Franklin," by John T. Morse, Jun., the editor of the series and author of the volumes on John Adams, Thomas Jefferson, and John Quincy Adams; "Recollections of Mississippi," by Hon. Reuben Davis, a graphic description of life in the South for the half century before the civil war; "Literary Landmarks," a guide to good reading for young people, by Mary E. Burt, Teacher of Literature in the Cook County Normal School at Englewood, Ill., with charts; and Part iv. of the Child's "English and Scottish Popular Ballads."

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Physical Realism: being an Analytical Philosophy from the Physical Objects of Science to the Physical Data of Sense. By THOMAS CASE, M.A., Fellow and Senior Tutor C.C. Oxford. 8vo, \$5.00.

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Force and Energy: a Theory of Dynamics. By GRANT ALLEN. 8vo, \$2.25. "Written with extreme lucidity. . . . We can safely assure our readers that, whatever view they may take, they will find Mr. Allen's book pleasant and profitable reading."—*Engineer*.

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A Hand-Book of Cryptogamic Botany. By ALFRED W. BENNETT, M.A., B.Sc., F.L.S., Lecturer on Botany at St. Thomas's Hospital; and GEORGE MURRAY, F.L.S., Senior Assistant Department of Botany, British Museum. With 378 Illustrations. 8vo, \$5.00.

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The Diseases of Children. Medical and Surgical. By HENRY ASHEY, M.D., Lond., M.R.C.P., Physician to the General Hospital for Sick Children, Manchester; and G. A. WRIGHT, B.A., M.B., Oxon., F.R.C.S., Eng., Assistant Surgeon to the Manchester Royal Infirmary, and Surgeon to the Children's Hospital. With 138 Illustrations. 8vo, pp. xx-681. Cloth, \$6.00.

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— Harper & Brothers have just ready "A History of the Kansas Crusade: its Friends and its Foes," by Eli Thayer, who planned and organized the movement by which Kansas was made a free State, with an introduction by Edward Everett Hale, a fellow-worker with Mr. Thayer in the emigration cause; and "Man and His Maladies," a popular handbook of physiology and domestic medicine, by A. E. Bridger.

LETTERS TO THE EDITOR.

* * * Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith. The editor will be glad to publish any queries consonant with the character of the journal. Twenty copies of the number containing his communication will be furnished free to any correspondent on request.

The Law of Population in the United States.

PURSUING the investigation of the law of population, we come to a question of importance in an economical and ethnographic view. What is to be the relative progress in numbers of the Caucasian and the African races here?

The late revolution in Hayti has led to the publication in the daily press of America of so many concise abstracts from the history of that African republic as to make it familiar to all who interest themselves in these matters. It is to be regretted that the progress of regulated liberty in that island has not, in a century, been greater. It is a prevailing belief that with us the African increases faster than the Caucasian. The figures of the census during a hundred years do not confirm this opinion. We find that while the whites since 1790 have increased on the average in each decade by 33.46 per cent, the blacks have gained in the same time only 26.81 per cent.

INDUSTRIAL NOTES.

Comparison of different Street Car Systems.

BEING continually requested by street railroad men to furnish them with a statement of the cost of equipment and operation of a road by means of storage battery traction, and also how the cost of this method of traction will compare with other systems, the Julien Electric Traction Company of this city have made a comparison of the four methods available to-day for street-car propulsion in large cities,—horses, storage batteries, electric conduit, and cable. The estimates and comparisons, it is claimed, have been carefully prepared, and special attention has been given to obtain good authority for statements, mostly from roads having the different systems in actual operation. The estimates are based on a medium-sized road running on the headway generally employed in cities, trying, as far as possible, to cover roads operating under such different circumstances as are found in different localities.

The company mainly aim to treat the subject as applied to cities. They have not included figures on the overhead system as they consider them barred from operating in that field, owing to the necessity of the presence of overhead electric conductors, and the growing sentiment in all communities against the erection of poles. As regards the Julien system, the figures show the results of two years' experience on the Fourth and Madison Avenue line in this city.

The estimates are based on a road six miles long, double track, operating sixty cars, running eight miles an hour by mechanical, and six miles an hour by animal traction, running on one and one-half minutes headway, and eighty-four miles a day in the former, and on two minutes headway, sixty miles a day, in the latter case, allowing nine horses to a car. The item of building and land is not included, as they differ so widely in different cities and localities.

According to the figures given, the cost of constructing and equipping such a road, on the Julien storage battery system, would be \$491,500, or, if the current were taken from a central lighting station, \$419,000; the same road constructed and equipped for a horse railroad, \$229,620; as a cable road, \$1,076,000; as a conduit electric road, \$762,000. The annual running expenses under the different systems would be as follows. Julien system, eighty-four miles a day per car, with electric plant, \$99,206, being \$4.52 per car-day, or .053 of a cent per car-mile; same system, using current from a lighting station, \$113,330, being \$5.17 per car-day, or .061

Applying these rates to the present numbers we may forecast the possible, if not the probable, population, during the next century as follows:—

Year.	Total population.	African descent.	Proportions.
1850.....	67,840,000.....	8,000,000.....	8 to 1
1900.....	89,738,000.....	10,144,000.....	
1910.....	119,650,000.....	12,862,000.....	
1920.....	159,890,000.....	16,309,000.....	20 " 1
1930.....	213,320,000.....	20,681,000.....	
1940.....	284,697,000.....	26,223,000.....	11 " 1
1950.....	379,960,000.....	33,452,000.....	
1960.....	507,090,000.....	42,163,000.....	12 " 1
1970.....	676,760,000.....	53,463,000.....	
1980.....	903,200,000.....	67,790,000.....	
1990.....	1,206,400,000.....	85,957,000.....	14 " 1

The reader can draw his own inferences from these significant figures. We only say that in 1940 and thereafter this country will not be able to offer free space and citizenship and suffrage for the surplus overflowing of China, to a race which does not assimilate with us, and which is pagan; and that it is time to discontinue the complaint that the Chinese exclusion act was mere demagogism. In the light of these figures, it was the highest statesmanship. The importation of native Africans ceased by the Constitution in 1808, though it is alleged that a few fanatics imported cargoes later. But practically the forced importation ceased then. There never has been any voluntary immigration from Africa.

Both Malthus, in 1794, and Alison, in 1840, held that the population of the United States after 1640 doubled every twenty-three and a half years. This rate has continued to 1890, for two hundred and fifty years.

M. C. MEIGS.

Washington, D.C., Sept. 2.

of a cent per car-mile; horse traction, sixty miles a day per car, \$129,562.20, being \$5.91 per car-day, or .098 of a cent per car-mile; cable road, eighty-four miles a day per car, \$163,712.50, being \$7.47 per car-day, or .089 of a cent per car-mile; electric conduit system, eighty-four miles a day per car, \$111,157.50, being \$5.07 per car-day, or .06 of a cent per car-mile.

Carhart-Clark Standard Cells.

In last week's Science appeared an abstract of a paper on an improved form of Clark standard cell read before the American Association for the Advancement of Science by Professor H. S. Carhart of the University of Michigan, vice-president of the Physical Section of the association. We add a few points relating to the special features of this cell and its mounting for commercial and scientific purposes, as sold by James W. Queen & Co., Philadelphia, who have the exclusive handling and sale of it.

This cell embodies several new and important features, chief among which are its low temperature coefficient and safety in transportation. These features are secured by the methods of Professor Carhart, devised after a series of investigations extending over nearly three years. The change of electromotive force produced by a temperature change of a few degrees is practically negligible except in scientific work of the greatest accuracy. The coefficient is only 0.038 per cent per degree C. This is somewhat less than one-half the coefficient of Lord Rayleigh's form, for which he found a value ranging from 0.077 per cent to 0.082 per cent per degree. Almost absolute safety in transportation is secured by confining the mercury to the bottom of the cell, thus precluding the possibility of its reaching the zinc and short-circuiting the cell, no matter how violently it may be shaken. This process presents the additional advantage of increasing the electromotive force about 0.35 per cent above the old form, and of preventing local action, by which very serious changes took place in the old form of the cell on open circuit. Greater uniformity and constancy, it is believed, result from this method of making a cell.

Another well-marked characteristic of these new cells is their remarkable uniformity. This is due to great care in the preparation of the salts and standard solutions, and to the absolute cleanliness observed in every part of the cell. In the Clark cell, as made by Lord Rayleigh, the mercury salt always turned from its normal white to a canary yellow on mixing with the zinc sulphate, a change probably due to the presence of mercuric salt. In this

new form the salts remain white if they are kept out of the light, no change whatever in color appearing on mixing the mercurous sulphate with the zinc sulphate. This result is secured by the greatest care in making the mercury salt. It is found that a mercurous sulphate can be made so free from the mercuric form that it does not turn yellow when all the acid is washed out.

Professor Carhart says, in a letter to Queen & Co. of July 8, 1889, "Sent you six new standard Clark cells, numbers 106, 107, 108, 109, 110, 111. The extreme difference between these cells when only four days old was only 0.0006 of the electromotive force of the cell, and they were still approaching one another. There was a difference of only 0.0003 between five of these, and only 0.0001 between four of them." Again, referring to six cells, not made in the latest secure form for transportation, which were sent by express from Ann Arbor, Mich., to Queen & Co.'s laboratory in Philadelphia, and returned to Ann Arbor, a journey of over fourteen hundred miles, he writes, "After letting the cells rest thirty-six hours I am much gratified to find that their extreme difference from one another is only 0.08 per cent, and the average of the six cells is only 0.08 per cent lower than my standards kept here." These are remarkable results from such a severe test as this, but the latest form will make a still better record.

A new process of sealing the cell is also employed. Marine glue, which was recommended by Lord Rayleigh as a sealing material, always gave trouble to secure a firm hold on glass and to prevent air bubbles from being inclosed to such an extent as to greatly weaken the seal. Its viscosity was also such that any small internal pressure, due to heat or the generation of a little gas, was liable to force the cell open. With the new compound employed the closure remains perfectly firm, and forms an entirely satisfactory hermetic sealing.

These cells are all set up by Professor Carhart in the physical laboratory of the University of Michigan, and are furnished with his personal certificate, giving the electromotive force of the cell, its temperature coefficient, and guaranteeing each cell "provided no current greater than 0.00002 ampère be passed through it, and provided it be subjected to no violent mechanical strain or jar." With even a larger current than the above, these cells show no polarization whatever in five minutes, and with ten thousand ohms external resistance a polarization of only 0.01 per cent is observed in this time. The cell recovers from this small polarization, which is less than the usual accidental differences between different cells, in five minutes or less. The errors arising from ignorance of the exact temperature of the cell are greater than any liable to occur from polarization. To guard against accidental short-circuiting, Queen & Co. are mounting a graphite resistance of about twenty thousand ohms in circuit with the cell and inside the case which incloses it. These cells are mounted in handsomely finished brass cases, 3 3/4 inches high and 2 3/4 inches in diameter, with an engraved hard rubber top, giving the number of the cell corresponding with the certificate, indicating the positive and negative poles, and having a hole for the insertion of a thermometer to ascertain the temperature in the inside of the cell. Batteries of these cells, in any number desired can be mounted if required.

Boissier Dynamos for Plating and Lighting.

THE dynamos shown in the accompanying illustrations possess some features of novelty, invented and patented by Mr. Herman Boissier, electrician of the Arnoux & Hochhausen Electric Company of this city. The aim of the inventor was to produce a dynamo of low first cost, not liable to get out of order, and so simple in construction that it would require no more attention than could be given it by any workman of average intelligence in plating or electrotyping establishments. The favor with which the machines have been received and the flattering testimonials of those who use them would seem to indicate that the dynamos approximate very closely to the inventor's ideal.

The machine shown in Fig. 1 occupies a floor space of only sixteen by twenty-six inches, and weighs about a hundred and thirty-five pounds, of which only about thirty-five pounds are copper. It furnishes current for twenty-five sixteen-candle-power lamps, or a proportionate current of lower voltage when wound for plating purposes. Owing to the peculiar method of winding the armature,

there are only four sections to the commutator. Fig. 2 shows a form of dynamo made specially for use in electrotyping establishments, and furnishing a current of very low voltage. The field

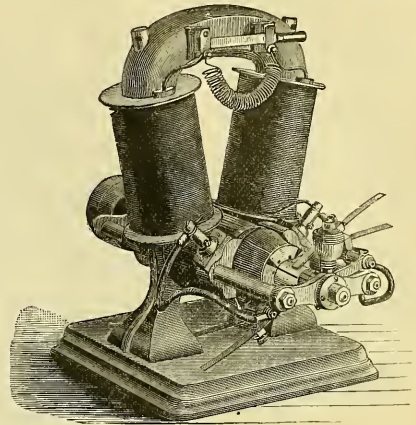


FIG. 1. — BOISSIER DYNAMO.

coils are composed of copper ribbons alternating with ribbons of insulating material. The armature, shown in Fig. 3, is composed of heavy copper bars passing round a cylinder of insulated soft

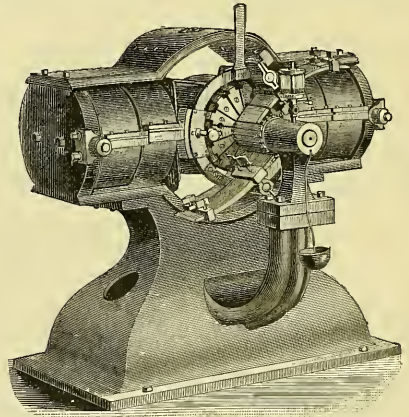


FIG. 2. — BOISSIER DYNAMO.

iron wire. All insulating material on the armature is fire-proof, so that it is impossible that the armature should ever burn out. Two of these dynamos are in use in the government printing office at

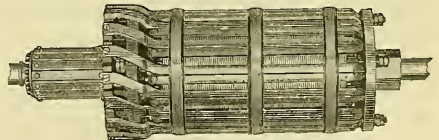


FIG. 3. — ARMATURE OF PLATING DYNAMO.

Washington, in the electrotyping department, where they have a record of three hundred ounces of copper deposited in two hours, using one machine only. They are manufactured by the Arnoux & Hochhausen Electric Company.

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[Exchanges are inserted for subscribers free of charge. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

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100 botanical specimens and analyses for exchange. Send list of those desired and those which can be furnished, and receive a similar list in return. Also cabinet specimens and curiosities for the same. Scientific correspondence solicited.—E. E. Bogue, Orwell, Ashita, County, O.

I will sell to chapters or individual members of the Agassiz Association, 25 fine specimens of fossil plants from the Dakota group (cretaceous), correctly named, for \$2.50. Send post-office order to Charles H. Sternberg

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Drawings from nature—animals, birds, insects, and plants—to exchange for insects for cabinet; or I will send them in sets of ten each for ten cents in stamps. My drawings in botany are in detail, showing plant, leaves, flowers, seed, stamens, pistils, etc.—Alda M. Sharp, Gladbrook, Io.

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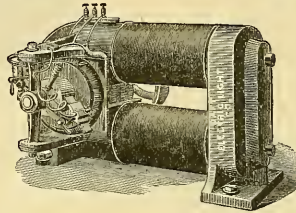
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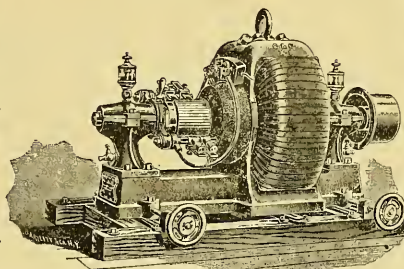
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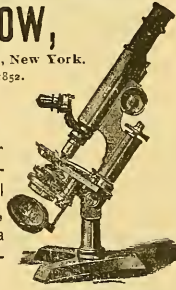
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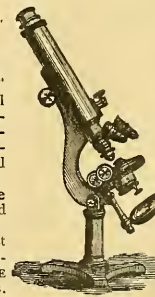
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SEVENTH YEAR.
VOL. XIV. No. 346.

NEW YORK, SEPTEMBER 20, 1889.

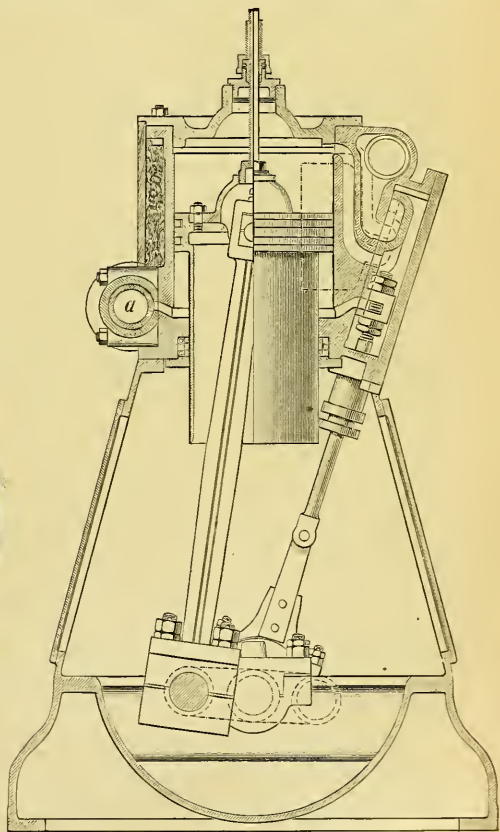
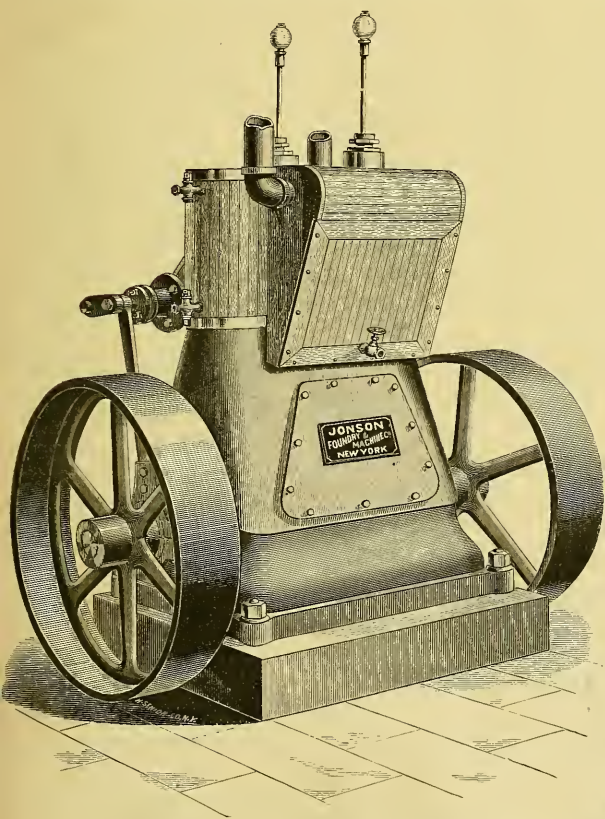
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THE JONSON BALANCED COMPOUND ENGINE.

THE illustrations show a new type of balanced compound high-speed steam-engine now being introduced to the notice of steam-users by the Jonson Foundry and Machine Company of this city. In this engine there are two steam-cylinders, placed side by side,

cylinder having the full area of the piston above the trunk. In the engine here illustrated the diameter of the steam-cylinder is twelve and a half inches, and the diameter of the trunk is eight and five-eighths inches, the stroke being ten inches; so that the engine has two high-pressure cylinders, each about eight inches in diameter.

In the operation of the engine, steam is admitted to the high-



THE JONSON BALANCED COMPOUND ENGINE.

the connecting-rods working in trunks, and the cranks being set at an angle of a hundred and eighty degrees with each other. All the working parts are enclosed as shown.

It will be seen that the arrangement forms a pair of half-trunk engines, the high-pressure cylinder being the annular space between the trunk and the steam-cylinder, and the low-pressure

pressure cylinder for the upward stroke of the piston, and, being exhausted into the low-pressure cylinder, actuates the piston on the return stroke. For small engines, the valves of the high and the low pressure cylinders form one casting, and the steam from the high-pressure cylinder is exhausted through ports in the valve to the low-pressure cylinder. When an automatic cut-off is fitted,

an independent steam-valve for the high-pressure cylinder, shown at *a*, is added, so as to avoid damaging the action of the low-pressure valve and the high-pressure exhaust.

As an example of this practice, in an engine of 275 horse-power of this type, now being constructed for a United States steamer, a piston-valve is used for the steam-valve of the high-pressure cylinder, and a slide-valve for admitting the steam into the low-pressure cylinder and exhausting it therefrom. For small engines an ordinary governor, not shown in the cuts, is usually attached.

The special advantages claimed for this engine are compactness, a low centre of gravity, and particularly the fact that all the moving parts are in pairs, equal, and acting in opposite directions, thus securing a perfect mechanical balance, and adapting the engine to high rates of speed without sensible vibration.

As evidence of the adaptability of this engine for electric-lighting purposes, it may be stated that it has been attached to a thousand-light dynamo, which it ran at the rate of seven hundred and fifty revolutions per minute; and so steady was its performance, and so well was it governed, that, when the entire load was thrown off by means of a switch, it made no perceptible change in its running. The throwing on and off of such a load is a very severe test for an engine.

The following extract is taken from the report of a board of government engineers who had examined this engine with a view to determining its adaptability for the various uses of the government: "The engines are compact, and the working parts are reduced to a minimum; and they have the advantage of long connecting rods, and a reduction of height over the ordinary vertical engine with the same length of connecting rod. They are also well-balanced engines."

THE WITHDRAWAL OF ALCOHOL FROM BOND FOR SCIENTIFIC PURPOSES, FREE OF TAX.¹

It may not be generally known to the members of this association that they can obtain their supplies of alcohol for use in their chemical laboratories free of the internal revenue tax of ninety cents per proof gallon, or \$1.70 per gallon of ninety-five per cent alcohol, by complying with certain regulations prescribed by the secretary of the treasury, in accordance with section 3297 of the Revised Statutes of the United States.

The Law.

This section provides that "the secretary of the treasury is authorized to grant permits to any incorporated or chartered scientific institution or college of learning to withdraw alcohol in specified quantities from bond without payment of the internal revenue tax on the same, or on the spirits from which the alcohol has been distilled, for the sole purpose of preserving specimens of anatomy, physiology, or natural history belonging to such institution, or for use in its chemical laboratory; *provided*, that applications for permits shall be made by the president or curator of such institution, who shall file a bond for double the amount of the tax on the alcohol to be withdrawn, with two good and sufficient sureties, to be approved by the commissioner of internal revenue, and conditioned that the whole quantity of alcohol so withdrawn from bond shall be used for the purposes above specified, and for no other, and that the said president or curator shall comply with such other requirements and regulations as the secretary of the treasury may prescribe. And if any alcohol so obtained is used by any officer, as aforesaid, of such institution, for any purposes other than those above specified, then the said officer or sureties shall pay the tax on the whole amount of alcohol withdrawn from bond, together with a like amount as a penalty in addition thereto."

The above provisions are further extended by the act, approved May 3, 1878 (20 *U. S. Stat.* 48), which provides:—

"That the secretary of the treasury is authorized to grant permits, as provided for in section thirty-two hundred and ninety-seven of the Revised Statutes of the United States passed at the

first session of the Forty-third Congress, to any scientific university, or college of learning created or constituted such by any State or Territory under its laws, though not incorporated or chartered, upon the same terms and subject to the same restrictions and penalties, already provided by said section thirty-two hundred and ninety-seven: *provided further*, that the bond required thereby may be executed by any officer of such university or college, or by any other person for it, and on its behalf, with two good and sufficient sureties, upon like conditions, and to be approved as by said section is provided."

Documentary Evidence required from a Scientific Institution before it can enjoy this Privilege.

To obtain this privilege for its chemical laboratory, an incorporated or chartered, or not incorporated or not chartered, scientific institution, university, or college of learning must, at the time of its original application, clearly show, by a copy of its charter, articles of incorporation, or other documentary evidence, that it is an institution duly entitled to such permit by possessing a suitably equipped chemical laboratory and otherwise.

Form of Application.

Its application is made by the president, curator, or duly authorized agent, "through the collector of internal revenue in whose district the institution for which the withdrawal is to be made is situated," "to the secretary of the treasury for permit" "to withdraw from the distillery bonded warehouse, owned by _____, at _____, in the _____ district of _____, the alcohol which was stored in said warehouse on the _____ day of _____, 18____, described as follows: *viz.*, number of packages; marks and serial numbers of packages; numbers of warehouse-stamps; wine-gallons; degree of proof; proof-gallons; taxable gallons; and amount of tax; for the *sole purpose* of use in the chemical laboratory of the institution, located at _____, in the State of _____, of which institution" the signer is one of the persons above mentioned.

"The application in all cases must be sworn to, or affirmed, before an officer authorized to administer oaths."

Character of the Bond.

The bond, required to be filed with the first application, must be in a penal sum of "not less than \$200, and never less than double the amount of tax on the alcohol withdrawn at any one time," is signed by the applicant "as principal, and with two or more sureties, who shall not be officers of the institution in which the alcohol is to be used, but shall be residents of the United States judicial district in which such institution is located." In the case of "an incorporated institution, its name should be signed to the bond as principal, and its corporate seal affixed by its duly authorized officer, who should also sign his own name as such officer."

The bond is conditioned that "the entire quantity of alcohol" intended to be withdrawn "from distillery warehouse, without payment of tax," by the said principal, will be "for the sole purpose of use in the chemical laboratory of the" said institution, "in the city or town of _____, of the county or parish of _____, and State of _____," "and for no other purpose."

The bond is known as a "continuing bond;" *i. e.*, "withdrawals may be made from time to time," "by the said principal," "until this bond shall have been revoked or cancelled by direction of the secretary of the treasury," of certain alcohol for use "by the said institution, or the proper officer thereof, for the purpose above specified, and for no other purpose." "The principal of said institution shall, as to each lot of alcohol so withdrawn, produce within" the time "fixed by the collector accepting the bond," "from the date of such withdrawal," "proof satisfactory to" the collector of internal revenue of that district, "and to the commissioner of internal revenue, that the said alcohol has been so used for the purpose above specified, and for no other purpose." He shall also "comply with such other requirements and regulations as the secretary of the treasury may prescribe;" and according to the last paragraph of section 3297, Revised Statutes, "the said officer or sureties" are bound by this bond to pay to the collector "the tax on the whole amount of alcohol withdrawn from bond, together with a like amount as a penalty in addition thereto," "in case said

¹ Paper read before the Association of Official Agricultural Chemists at Washington, D. C., Sept. 11, 1889.

alcohol, or any part thereof, shall be used for any purpose other than that specified."

Bond and Application to be filed with the Collector for Approval.

The "bond, together with the first application for permit, will be deposited by the applicant with the collector of internal revenue for the district where the institution in which the alcohol is to be used is located." It is the collector's duty to forward the bond and application to the commissioner of internal revenue, with his certificate of approval, etc. He keeps "a copy of the bond, or a memorandum of its date, penal sum, and the names of the signers; and whenever an application for alcohol is made after the first one, the collector will certify to the commissioner of internal revenue that the bond remains good, or will notify him of any change affecting the responsibility of the signers." "Upon the approval of the bond by the commissioner of internal revenue," applications may be made on the prescribed form "for the withdrawal of alcohol as occasion may require" by the duly authorized officer or agent: "provided, the penal sum of the bond is equal to double the amount of tax on the alcohol to be withdrawn, after deducting all outstanding charges on the bond." The commissioner transmits the applications "to the secretary of the treasury, with a notification of the approval of the bond when the first application is forwarded, and afterwards with a reference to the bond under which the application is made."

Cancellation of Bond.

To cancel the bond "or for the purpose of obtaining a credit on said bond," a sworn certificate is "required of the officer or officers of the institution under whose direction or supervision the alcohol has been used." The certificate is "filed with the collector named in the bond, and if approved, to be forwarded by him to the commissioner of internal revenue with his approval indorsed thereon."

Extension of Time named in Bond.

It sometimes happens that the alcohol is not entirely used up in the time specified in the bond, and that consequently "the principal to the bond is unable, for good cause, to furnish the required proof" of such use. He may obtain an extension of the time named in the bond upon application to the commissioner of internal revenue, "accompanied by the consent of the sureties to the bond to such extension; such application and consent to be approved by the collector with whom the bond was originally filed." "The extension asked for must be for a specified time," "not exceeding one-half the period named in the bond." The application "must be sworn to," and state "the reasons why the conditions of the bond as to the presentation of proof have not been complied with." The consent of the sureties must be "under seal, and witnessed in the case of giving an original bond."

Permits to be issued by the Secretary of the Treasury.

"The secretary of the treasury will issue," "upon receipt of the application" "and notice of the approval of the bond," "and transmit through the commissioner of internal revenue, a permit in duplicate, one copy of which will be forwarded to the applicant and the other copy to the collector of internal revenue for the district in which the distillery warehouse is located," to withdraw from the specified warehouse the number of proof gallons of alcohol described in said application.

The collector notifies "the storekeeper at the bonded warehouse from which the spirits are to be withdrawn" of the receipt of the permit, a copy of which is sent to him, and authorizes him "to deliver the spirits to the person named therein, or his duly-authorized agent, without the payment of tax, upon delivery to such storekeeper and cancellation by him of the duplicate permit issued to such person." This "cancellation shall be made by writing across the face of said duplicate permit the words 'The spirits herein described were delivered to the person herein named this _____ day of _____, 18—;' to be signed by the storekeeper." "There shall also be indorsed on the back of said permit the following receipt: 'Received the spirits within mentioned this _____ day of _____, 18—,' which receipt shall be signed by the person named in said permit."

Such in detail are the steps to be followed as prescribed by the regulations of the secretary of the treasury under date of March 26, 1889.

Blank forms are not furnished by the Treasury Department; and such forms, either printed or written, must be supplied by the parties making the application and bond. The forms to be followed are contained in Circular No. 34, 1889, of March 26, 1889, Treasury Department.

Are Agricultural Experiment Stations entitled to this Privilege?

The laws, quoted above, restrict this privilege of the withdrawal of alcohol free of tax to four specified beneficiaries: viz., (1) "any scientific institution" or (2) "college of learning," "incorporated or chartered;" (3) "any scientific university" or (4) "college of learning" "created and constituted such by any State or Territory under its laws, though not incorporated or chartered;" which are further qualified as using alcohol (a) to preserve specimens of anatomy, (b) physiology, or (c) natural history, or (d) to be employed in its chemical laboratory. With the latter qualification the members of this association are chiefly concerned.

The act, approved March 2, 1887, "to establish agricultural experiment stations in connection with the colleges established in the several States under the provisions of an act approved July 2, 1862, and of the acts supplementary thereto" (24 *U. S. Stat.* 440), commonly called the "Hatch bill," provides in section 8 that these "agricultural experiment stations established by law" may or may not be "in connection with any university, college, or institution not distinctly an agricultural college or school," or may or may not be "separate from" "colleges entitled" "to the benefits of this act;" i. e., land-grant agricultural colleges.

Section 2 provides "that it shall be the object and duty of said experiment stations to conduct original researches or verify experiments on . . . the chemical composition of useful plants at their different stages of growth; . . . the analysis of soils and water; the chemical composition of manures, natural or artificial; with experiments designated to test their comparative effects on crops of different kinds; . . . the value of grasses and forage plants; the composition and digestibility of the different kinds of food for domestic animals; the scientific . . . questions involved in the production of butter and cheese; and such other researches or experiments bearing directly on the agricultural industry of the United States as may in each case be deemed advisable, having due regard to the varying conditions and needs of the respective States or Territories."

These experiments evidently require a well-equipped chemical laboratory, in which alcohol would be often used as a solvent and re-agent in addition to any use of it as a fuel in the laboratory.

Taking the above quoted qualifications and provisions of law into consideration, it would seem that any agricultural experiment station that is established in conformity to the provisions of the act of March 2, 1887, by any State or Territory as such, when such station is connected with a "university or college of learning," is entitled on presentation, by its duly authorized officer or agent, of documentary evidence to that effect submitted to the secretary of the treasury through the commissioner of internal revenue and the collector of internal revenue of the district in which the experiment station is situated, and by filing a bond and otherwise conforming to the regulations, above specified, to the privilege of withdrawing alcohol, free of tax, for use in its chemical laboratory; also that when the experiment is not connected with a college, etc., it may obtain free alcohol under the same regulations, provided it is shown to the satisfaction of the internal revenue officers and the secretary of the treasury that it is of itself a "scientific institution" as construed by those officers, that is, such an institution whose object is educational.

EDGAR RICHARDS.

WHEN an electric current, says a French contemporary, is led through the leaf of a rose, the leaf loses its color, leaving a white line. This peculiarity was recently turned to account at a great dinner in Paris, when, instead of the ordinary card, the seat of each guest was indicated by his name being inscribed in white letters upon a rose-leaf in his *couvert*.

ELECTRICAL NEWS.

THE TELEGRAPHONE. — A problem heretofore only partially and unsatisfactorily solved is the registration of telephonic messages so that they can be received at pleasure. Most of the efforts in the direction of its solution have been towards using the induced currents from the Blake transmitter in producing a record on the phonograph at the other end of the line. An amplifying trumpet has been used, and the vibrations of the diaphragm of the receiving instrument have been recorded on the cylinder of the phonograph. It has thus far been necessary that an operator should be at both ends of the line, and any slight electrical disturbances that would interfere with the delicate induced currents naturally have blurred the phonographic record. An instrument has lately been patented and brought out that will no doubt be of actual use and commercial value. It is called the "telegraphone," and is the invention of Mr. Malone Wheelless of Washington, D.C. Mr. Wheelless does not depend upon the transmitter currents for his impressions: the speaker's voice is registered on the cylinder mechanically, the record being of the nature of dots and dashes on a strip of paper. A stylus connected with a light primary battery moves along these impressions, producing current interruptions of a make-and-break character, almost similar to the Morse code, and reproducing the impressions on the registering cylinder at the other end of the line. In practice, if A desires to send a telephonic message to B, who is not at home, he calls him up in the usual way. Receiving no answer, he turns a switch which throws in the battery power and sets the cylinder at the other end in operation. He then talks into his transmitter. The vibrations are transferred to the cylinder, and the stylus sets up a series of waves, reproducing the impressions at the other end, and registering the message. A then reverses his switch, and the message is repeated back to him. Should any part of the message be inaudible, he simply fills in the blurred words or sentences, and the record at the other end is then satisfactory and complete. Upon B's arrival home, he finds the message waiting for him, corrections and all; and if its importance demands it, he can have it repeated to himself as many times as he chooses. The inventor claims that the apparatus can be manufactured and sold outright at a very low figure, and it is difficult to foretell whether its usefulness or novelty will be the most interesting feature.

ELECTRICAL EXECUTIONS. — This subject will enjoy popular interest as long as the law now supposed to be in force remains upon the statute books of the State of New York. It seems to have been adopted for the reason that those having the matter in hand knew less about death from electricity than from any other cause, and also because the expert advice at hand seems to have been discolored with the tainted aniline of business jealousy. The subject, from a scientific standpoint, is of itself sufficiently interesting and baffling; but when the people realize, as they now must, that the enactment of the law was due largely to the influence of a party whose object was not so much to furnish a quick and painless death as to enrich himself, it causes a cold shiver of horror to pass over the community. Exactly how many volts of electrical pressure will kill is as uncertain as would be the number and force of the strokes from a club that would produce death. A number of persons, among whom may be mentioned Mr. T. Carpenter Smith, the well-known electrical engineer, have been accidentally subjected to the action of the very type of machine intended to be used by the authorities, and have lived. Other persons have died instantly from a much lighter shock. Only a few days ago expert Henry of this city was instantly killed by 1,000 volts. Since that time a Buffalo lineman lived in agony for forty minutes after suffering the enormous pressure of 2,000 volts. Will electricity kill? Certainly it will kill, but exactly how applied, and how many volts?

ENCROACHMENT OF ELECTRICITY UPON GAS IN HOUSE-LIGHTING. — Gas, which is now almost universally employed, has not come into use in a moment. The difficulties attending its distribution at great distances from the source of supply have never called for more than mechanical skill and ingenuity. But with electrical distribution the problem to be solved is not how to cover a certain territory with the mains and feeders of an electric-light system, but how to do it with a fair profit on the investment.

Among the methods making rapid strides is that of the distribution of electricity by means of the alternating current. The very type of machine which the authorities consider so dangerous to life will no doubt be that which will eventually solve the problem of universal electric house-lighting. The current in the outside mains is of a high pressure, — 1,000 volts or more, as the case may be. This current is transformed by means of the converter to a lower potential, and carried into houses at the safe and low pressure of only 50 or 100 volts. More and more private residences are being wired for and lighted by electricity every day, and this is the case more especially in small and growing towns than it is in large cities. Little towns like Marshall, Tex., Vicksburg, Miss., and the small towns of the Far West, are falling into line, and availing themselves of every fresh improvement that will increase the returns from investment and enhance the worth and reliability of the light itself. In the New England States this condition of things to-day obtains to such an extent that nearly every week finds some gas company absorbing the local electric-light company out of pure self-defence, and continuing the work.

AMERICAN ELECTRICAL ENTERPRISE IN LONDON. — The increased and increasing investment of English capital in American institutions has caused much comment. American capital is not doing precisely the same thing in England, but the establishment of a Westinghouse Electric Manufacturing Company in London is a fact that must excite comment and admiration as well. The Westinghouse Electric Company of London has been organized with a capital of \$3,000,000. The factory is to be located on York Road, adjoining the Westinghouse Air Brake Works. Other electric companies are extending themselves abroad, but this is one of the most striking and recent examples of such extension.

ELECTRIC TANNING. — It is now claimed that an electrical process for tanning hides has been devised which reduces the time of the operation from six months or a year to twenty-four hours, turning out leather of equal quality. The cost is said to be reduced more than one-half. It is usually the case with quick processes that the material so turned out is in many respects inferior to that manufactured in the usual way by skilled workmen who have taken advantage of the experience of others, and perfected their process after years of work and study. The new system alluded to does not partake in any way of the nature of an "electric sugar" concern, as each step has been made public and carefully described. When it is proved that the leather thus turned out is equal in all respects to that now manufactured, the process will possess more interest than its shadowy entity now elicits.

ELECTRIC SIGNALLING FROM SHIPS. — If there is any thing in our naval service that is inefficient and undeveloped, it is the system known as "wigwag" signalling. A flag with a short staff is waved to the right and left a given number of times for each letter of the alphabet according to the code, and the speed attained is remarkable for its slowness. Lack of speed can also be attributed to insufficient practice of those using the code, although the exercises enforced on board most vessels have given rise to a number of bright, quick signalmen among the apprentice boys who do the service proud in this respect. But with the most expert signalmen the speed attained is so unsatisfactory that a quicker method will no doubt before long come into use. Where vessels are fitted up with electric lights, a system of signals is sometimes employed, extending the use of the "wigwag" code to two incandescent lamps suspended somewhere in the rigging for night work. In such cases a double key is used, the illumination of one lamp being read "one," and of both lamps at the same instant, "two;" the letters of the alphabet being represented by combinations of "one and two." Although these flashes can be made much faster than the motions of the flag in daylight, still it is so easy to exceed the possible speed of the reader on the other vessel or on shore, that little increase of efficiency is attained. It takes but two or three months to become tolerably proficient in the use of the ordinary key and sounder, reading from fifteen to twenty words per minute at least. The same device that now flashes out the clumsy naval code could be employed in connection with the Morse alphabet with a great saving of time. Practice in taking from a telegraph instrument makes the ear or eye practically drink in the words spelled

out, without a conscious analysis of individual letters. Messages can be flashed from the rigging of ships with almost the rapidity of telegraph messages over ordinary wires. Take, for example, the message "The uniform of the day will be clean blue." This sentence of only nine words, if sent at the rate of nine words per minute according to the regular navy code, could be read by about one officer out of ten. Few officers can read that fast. The average speed of signalling, then, by the "wigwag" system is probably less than nine words per minute. It ought to be more. Mr. Edison has suggested an adaptation of his train telegraph system to the use of ships at sea. If a sufficient area of insulated metallic surface could be exposed somewhere, either on deck or aloft, it might be possible to telegraph from ship to ship by electrical induction without the use of connecting wires, just as Edison in a moving train takes messages from the wires along the track. We know of no experiments in this direction as yet, but the field is certainly an interesting and promising one.

AN ELECTRIC LOCOMOTIVE. — Will trains eventually be run by electricity? The electrician is met by this question almost daily, and his only reply is that they will if the problem of their commercial success be finally solved. Of course, running machinery of any kind from primary batteries is commercially out of the question. Every one with even the most rudimentary knowledge of the science realizes that it takes a certain consumption of zinc or other metal to liberate a certain amount of energy, and that this method is altogether too expensive to be practicable. However, there is now being constructed at the locomotive works, Rome, N.Y., an electric locomotive which is the first engine, we believe, attempted to be run on regular railroad-tracks from storage-batteries. The ordinary rotary type of electric motor will not be employed. Suction-magnets are to be located on either side of the piston, and the current supplied from storage-batteries in the fire-box. The locomotive is smaller than the usual type, and has driving-wheels of less diameter. In a few days the trial trip will be made, and *Science* will give its readers the result. The question will be asked, "How is it possible to utilize the energy of storage-batteries at such a great loss from the original energy of coal, and still be as economical as the steam locomotive?" That is the fact that remains to be proved. It should be remembered, however, that it may be possible to generate electricity by means of large economical compound condensing engines with a final loss at the motor not much greater than that which is found in that great wasteful gormandizer of coal, the steam locomotive.

NOTES AND NEWS.

THE Rev. Mr. Frizelle of Bushmills, England, narrates, in *Science Gossip*, that he witnessed a trial of a rook by his comrades for the act of stealing sticks from other nests. The other rooks assembled round the culprit, and cawed for a considerable time, when the unfortunate bird was condemned to suffer the penalty, and he was then and there set upon and pecked to death. Two magpies were present, who appeared seemingly as witnesses.

— The University of Jena is going to hold autumn courses for teachers in the various sciences. The course, commencing Sept. 23, is to last a fortnight, and comprises the following subjects: psychological principles of education, instruction in chemical experiments, the same in physical science, botanical observations and morpho-physiological experiments, animal biology, school hygiene, physical geography, and colonization.

— Any one who takes a walk abroad in the rural parts of France, when farming operations are going on, says J. W. Slater in *Science Gossip*, will often see small children following the plough armed with small pitchers, into which they put all the white, fat grubs of the cockchafer which are turned up. In England the rooks do this work, without young children being withdrawn from school or from play. But the French sportsman has nearly extirpated these useful birds. A recent iniquity, according to a contemporary, is the systematic destruction of the swallows on their return from Africa. Emissaries of the Paris *modistes* fix up on the shore, about the points where the birds usually land, long wires connected with

powerful electric machines. The wearied swallows perch on the wires, and are struck dead by scores. Their bodies are then sent off to Paris to ornament women who are a disgrace to humanity. The saddest feature is that our contingent of martins and swallows arrive by way of France, and will doubtless be cruelly decimated.

— Professor Beal finds that the peculiar markings in bird's-eye maple do not occur in young trees up to about three inches in diameter, nor very high up in trees which are very much pitted at the base. A specimen taken fifty feet above the ground, *Garden and Forest* states, showed no trace of bird's-eye, while another from near the base of the same tree was very strongly marked. If the cause of these formations could be discovered and used to produce the marks, it would add greatly to the market value of the timber, for the wood of this maple and of other trees somewhat similarly marked is comparatively scarce and in great demand for veneers.

— F. W. Galton, the famous writer on the subject of inherited qualities, proposed to the Congress of Psychological Physiology to issue in the form of a document a series of questions intended to draw from scientific observers the world over the results of their experience touching the inheritance of acquired habits, mental, scientific, or social. He laid before the congress a first-rate conundrum. He told of an aquarium divided into two parts by a plate of glass perfectly transparent, and therefore invisible to the fish. In one division there was a pike, in the other a gudgeon. Every time the pike saw the gudgeon, he rushed to seize him, but every time he was stopped by the plate of glass. He did not learn soon, but for several months made this rush, and bruised his nose against the glass. Finally he came to understand that for some reason inscrutable to his intelligence he could not seize the gudgeon, and then he gave it up. He now swam about, seeing the gudgeon constantly, but paying no attention to it. Then the plate of glass was removed. This made no difference, the pike did not attempt to take the gudgeon. He had acquired the habit of leaving the gudgeon alone. The conundrum was, would his descendants inherit that habit, or possess the original impulse of their kind? Illustrations of this kind, or showing the operation of the principle of acquired inheritance, are what Mr. Galton wants.

— The great chart of France, showing the geological formations of the country on a scale of 1:500,000, has at length been completed, and a copy deposited with the Academy of Sciences at Paris. It is over fifty years since MM. Dufrenoy and Elie de Beaumont published a geological map of France on the same scale, and since that period the rocks of the different provinces have been more intimately studied. In 1882 the new general map was begun under the superintendence of the Commandant Prudent, and published by the depot of fortifications. It has just been finished, and, according to the *Scottish Geographical Magazine*, is an example of the most accurate cartography. Local geologists have contributed to the work as well as the government surveyors, and the scale of 1:500,000 has been adopted in deference to the wish expressed at the geological congress of Bologna in 1881, so that different countries can more easily compare the map with their own. The scale of colors recommended at that congress has also been followed,—that is to say, the sedimentary series is represented by the colors of the spectrum in their regular order. Thus the trias is colored violet, the Jurassic blue, the cretaceous green, and the tertiary yellow. Each of these general colors is subdivided into shades, which are deeper according as the rocks are more ancient. This is the first time the method has been employed on a large work, and it has given every satisfaction, since it allows the systems of rocks and their different gradations to be readily recognized. The eruptive rocks have been colored in different shades of red, and the crystalline schists in carmine. As for the primary rocks, on which the congress came to no decision, the authors of the map have been guided by the same principles in choosing their tints. The Silurian has therefore been colored a flesh pink, and the Devonian a red brown. The carboniferous, according to old habit, has been colored black and deep gray, while the Permian is represented by a yellowish gray. No fewer than fifty shades are employed; but all are easy to distinguish.

— The number of students attending the principal German universities amounts to 29,491, of whom 6,060 study theology, 6,835 law, 8,883 medicine, and 7,713 philosophy and natural sciences. It is of interest to know that 314 of these are Russians.

— A commission representing the various German railway companies has published a report detailing the results of observations made during six years on the durability of steel rails on their lines. According to this report, it appears that the duration of a steel rail may be reckoned on an average at thirty-five years.

— The Prussian minister of education is turning his attention towards the study of the history of medicine, which seems to have been slowly dying out. There used to be a chair for this subject at every German university, but they have all become vacant with the exception of the one at Berlin, occupied by Professor Hirsch, the Nestor of the historians of medicine. To counteract this, it has been ordained that every newly appointed professor of hygiene should give lectures on the history of medicine as part of his work.

— The American Public Health Association will hold its next annual meeting at Brooklyn, N.Y., Oct. 22-25, 1889. This association comprises over eight hundred members, all devoted, officially or otherwise, to its declared purpose, the advancement of sanitary science and the promotion of organizations and measures for the practical application of public hygiene. In the furtherance of this purpose it has met annually, during the last sixteen years, in different cities of the United States and Canada, and has in every instance had the effect of greatly stimulating public effort in the promotion of health and measures for its maintenance. With the hope of still further magnifying this interest and effort, it is the purpose of the association, through its local committee, at the forthcoming meeting, to provide an exhibition of every thing available adapted to the promotion of health. The exhibits will be classified as follows: Division I. The Dwelling, including models and designs for sanitary dwellings; foundations, drainage, drainage tiles, etc.; bricks, tiles, floors, cements, etc.; devices and appliances for furnaces, stoves, water and steam-heating apparatus; ventilation and lighting; domestic water supply, purification, filters, water fittings, etc.; traps, sinks, water-closets, baths, etc.; domestic garbage destructors, garbage receptacles, etc.; and sanitary furniture, refrigerators, wall-paper (non-arsenical), floor coverings, etc. Division II. Schools and Education, including plans and models for improved school buildings; heating, ventilation, lighting; furniture and fittings; improved books, printing, etc.; gymnastic apparatus; and works on sanitary topics. Division III. Factories and Workshops, including designs and models for improvements in factories and workshops, life and health saving devices, and special devices for removing dust and effluvia and preventing injuries from them. Division IV. Clothing and Dress, including improved materials and garments, etc. Division V. Food, including selected displays of unprepared animal and vegetable substances used as food or in the preparation of food; prepared vegetable substances used as food, including canned and prepared, and preserved fruits and vegetables, prepared cereals, meals, flour, biscuits, bread, etc., and sirups, sugars, etc.; canned, smoked, salted, preserved, and prepared animal foods; products of the dairy; alcoholic and non-alcoholic beverages, tea, coffee, cocoa, chocolate, etc.; food for infants and invalids; articles and devices used in the preparation of food; cooking-stoves, ranges, etc.; vessels for preserving food, etc.; adulterants and adulteration. Division VI. Sanitary Engineering, including plans for sewerage and sewage disposal, plans for drainage, plans for water supply, purification, filtration, etc. Division VII. Public Health Administration in Cities and Towns, including treatment of contagious diseases; plans for hospitals; vital statistics, blanks, etc.; disposal of waste, garbage destructors, odorless apparatus; antiseptics, disinfectants, and disinfection; and reports of local and State boards of health. Division VIII. The Laboratory, including instruments of precision in meteorology, thermometers, barometers, hygrometers, etc.; general chemical apparatus for health laboratory; microscopes, etc.; biological apparatus, cultures, etc. Division IX. Red Cross Section. The exhibition will be held in the hall at the north-west corner of Fulton and Pineapple Streets, one block from the Brooklyn Institute, where the sessions of the association will be held, and but

three blocks from the bridge. It will be opened to the public on Oct. 22, at 1 P.M., and will continue open until Dec. 1. Admission free. Applications for space may be made to any member of the committee on exhibits, accompanied with details as to name and character of articles proposed, space required, and the name and address of applicant. To cover the necessary expenses of the exhibition, each exhibitor will be charged ten dollars, allowing him twenty square feet of floor space, and thirty cents per square foot for additional space, to be paid on the second day of the exhibition. All proposals for exhibition and applications for space are subject to the approval of the committee on exhibits, and should therefore be made as promptly as practicable. At the close of the exhibition the association will award diplomas to exhibitors of specially meritorious articles, based upon the judgment of experts. E. H. Bartley, M.D., of 21 Lafayette Avenue, Brooklyn, is the secretary of the association, and J. H. Raymond, M.D., 173 Joralemon Street, is chairman of the executive committee.

— The *Russian Gazette* has received some disturbing intelligence on the subject of the rivers of Russia, which play such an important part in the internal communication of the country. The Dnieper has become so shallow that navigation is difficult at even the deepest parts, such as between Kiew and Catherinaw. Small boats can only pass now where vessels sailed formerly. The Volga itself is not much better, and the river steamers are unable to reach Nijni Novgorod. In consequence of these facts, a strenuous measure of river-dredging and stricter regulation for the control of the navigation of the greater rivers, such as the Don, the Dnieper, and the Volga, is being advocated, and it is believed that the minister of ways of communication has the subject under his serious consideration.

— An instance of the progress made in electro-technical science is furnished by the installation just completed for lighting and transmission of power in the south of France at the neighboring towns of Dieulefit and Valréas, situated twenty-one kilometres apart, and having their common electrical source of supply at Béconnes, situated fifteen kilometres from Valréas, and six kilometres from Dieulefit. The supply of electrical power, according to the *London Electrical Review*, is excellent in both places. The lighting installation has been effected by an electrical firm in Lyons, and the apparatus manufactured by the Edison Company of Paris. The motive power is water, of which some three hundred horse-power are at disposal, but as yet only a part is required. In Switzerland, too, two waterfalls are to be used as motive power for transmission of electricity, namely, at Klus, on the river Aar, and at Lartze, by a company from Zurich. At the Hotel Bernina, at Samarten, in the Engadine, which has for some time been lighted by electricity furnished by a neighboring waterfall, the proprietor has hit upon the ingenious idea of utilizing for cooking the force wasted in the day. Other experimental cooking apparatus has been constructed, containing german-silver resistance coils, which are brought to red heat by the electric current, and all the ordinary cooking is now being done in a range fitted with a number of these coils.

— The commissioner of agriculture of Texas, in his first annual report, presents a statement of the aggregate cotton crop of that State for 1887 by counties. In many parts of the State the season was an unfavorable one for this crop, drought and worms very much reducing the yield per acre. An estimate of the damage done by worms, compiled from the first annual report of the commissioner of agriculture of Texas, by Mr. B. W. Snow, assistant statistician to the department, is presented for each county, ranging from nothing in many counties to a loss of fifty per cent of the crop in others of large production, and an even heavier loss in some counties where the crop is of little importance and insecticides are not made use of. For the whole State the amount of damage done averaged about twenty-one per cent of the crop. According to this return, the total number of bales gathered was 1,125,499, while, had there been total exemption from insect damage, the farmers of Texas would have gathered a crop of 1,422,948 bales. This would make the aggregate loss from worms equal to 297,449 bales. The value per bale of the crop which was made at the place of production averaged slightly over forty dollars. Pre-

suming that an increase of less than half a million bales in the aggregate crop would have made but little difference in price, the actual money loss to the farmers of Texas in one year from the cotton worm alone was \$11,897,960. It is not claimed that these figures are absolutely accurate, but they are undoubtedly approximately correct, and will give some idea of the enormous tribute levied upon American agriculture by injurious insects. In that year Texas produced but twenty-one per cent of the cotton crop of the country, and the cotton caterpillar and boll worm were active in all sections of the cotton belt. The injury elsewhere may not have been so heavy, but it would swell the aggregate loss in one crop to startling proportions.

— The harsh measures adopted by the Russian Government towards the extirpation of German educational landmarks in the Russian Baltic provinces, have been recorded from time to time. There are now two more such ukases to chronicle. The first and vitally important one is the closing of the Deutsche Lehrerseminar in Dorpat, which has existed for over sixty years, and served the purpose of training teachers for the elementary schools in the Baltic towns. The institution had been developing great usefulness during the last twenty-five years especially. The other ukase forbids the working of the Evangelical-Lutheran Society, which had lately been founded for charitable purposes.

— The French Government has made Professor C. V. Riley a chevalier of the Legion of Honor, as a deserved compliment for his effective studies in economical entomology. His researches have not only been of advantage to the farmers and fruit-growers of the United States, says *Garden and Forest*, but he discovered that the phylloxera was an American insect, and identical with the pest which had proved so disastrous to French vineyards. He also introduced into France the spraying-nozzle which bears his name, and which, with certain modifications, is used in that country to counteract the mildew of the vine.

— Dr. Eduard Bodemann of Hanover has just published the correspondence of Leibnitz, which until now had lain buried in the Royal Library of that town. The author gives a minute description of this great literary treasure, the value of which will be easily understood from the fact that more than 153,000 letters had to be perused and edited, and that the number of persons, scholars, statesmen, and royal personages with whom Leibnitz corresponded amounts to 1,028.

— The commission appointed to inquire into the scheme for making Paris a seaport has now issued its report. In this it is stated that the canal is of a nature to increase the commercial activity of France by bringing Paris into more direct communication with the great producing centres, and would in particular enable the city to compete with Antwerp, the commerce of which, it is said, is increasing year by year, to the detriment of French ports. No insuperable engineering difficulties are to be encountered, and even taking the most pessimistic estimate of the cost, viz., 200,000,000 francs, it is believed that the traffic would be sufficient from the very commencement to earn interest on this. French estimates of the expenses of canal construction will, however, be received with some caution after the gigantic fiasco of Panama. Preceding, the report goes on to say that the heavy sacrifices made by France in the past few years have not succeeded in meeting the competition of Antwerp, the trade of which has risen in a few years from 1,000,000 to 7,000,000 tons, and affirms that the only chance of doing so now is by rendering Paris accessible to sea-going vessels. It is further stated that in the event of another war it would be impossible to starve out Paris, as in 1871, were the canal made; though it is not easy to see the grounds of this statement, as one would think that the canal could be blocked without much difficulty. The canal would be 180 kilometres long; and a depth of 6.2 metres is proposed for the channel, the breadth of which at the bottom should be half as wide again as at Suez. The spoil from the excavation could, it is said, be advantageously disposed of in raising the level of some low-lying lands along the banks of the Seine. Whether the work will be undertaken by the government remains to be seen; but it is, on the whole, unlikely, as the engineers of the Seine are said to be opposed to the scheme;

and, if the government do not take it up, no other body in France will, of that we may be certain.

— School-gardens, i.e., gardens for practical instruction in rearing trees, vegetables, and fruit, are being added to nearly all the public and private schools of Austria. There are now already 7,769 such in existence in the Austrian monarchy alone, Hungary not included. They also comprise botanical museums, and appliances for bee-keeping.

— We learn from *Nature* that a report on the appearance of the Hessian-fly in England, by Mr. Charles Whitehead, the agricultural adviser, has been issued by the Agricultural Department of the Privy Council. The fly was first seen in 1886 in Great Britain, and in that year did some harm to wheat and barley plants in England and Scotland. In 1887 it was noticed in twenty counties in England and ten in Scotland, wheat and barley crops being considerably damaged by its action. The weather during the summer of 1887 was hot and dry, like that which normally prevails in America, and was presumably favorable to the development and progress of the fly. During 1888, when the summer was unusually wet and cold, very little was heard or seen of the Hessian-fly either in England or Scotland; but during the early months of the present year the temperature was high and the rainfall small, and, from the reports received by the Agricultural Department, the infested area has largely increased in England. In Scotland it does not appear to have made so much progress, still it is present in many Scotch counties. The actual amount of injury to the crops is slight, and, so far as can be ascertained, is not in any instance so important as that caused in some cases in 1887. It is most probable that the injurious operations of the insect have been checked by the wet, cold weather which has followed the abnormal heat of May, and the warmth and dryness of June. When a cycle of hot summers occurs, it may happen that the ravages of the Hessian-fly may be general and calamitous. Mr. Whitehead therefore urges the desirability of careful watching, and the prompt adoption of simple methods, which he describes, for preventing the increase of the pest.

— In his last report, the British vice-consul at Nisch mentions the terrible havoc which is being made by disafforestation in Serbia since its independence. He says that during the Turkish occupation Serbia was covered with magnificent forests of oak, beech, chestnut, and walnut trees, by means of which the country was assured of a regular and plentiful supply of water, and in the recesses of which the natives found shelter, and refuge from their foreign conquerors. From the date of her independence a destruction of these invaluable treasures commenced which has been carried on with remorseless and unreflecting perseverance, and it appears as though there were at the present day a race against time to complete the havoc. From time to time the consciences of ministers and governments have roused them to interfere; but, beyond passing laws which remain a dead letter, hardly any thing has been done to arrest the evil. Floods in winter, and drought in summer, were declared by Mr. Borchgrave, in 1883, to have already begun to exact the penalty which carelessness or want of foresight must be called upon to pay; but the peasant and his goats continue their work of destruction, while the authorities are apparently more anxious to avoid occasions of discontent which restrictive measures would create than of applying such remedies as legislation has placed in their hands. Whole mountains may be seen completely denuded of timber, with the exception of a low worthless scrub, which were, a few years ago, covered with woods, but which have fallen victims to the innumerable herds of goats which are allowed to browse at will. The peasants among whom the land was divided at the time of the Serbian independence have cleared vast tracts for the purposes of agriculture, and possess the right of cutting timber for firewood in those forests which are under the management of the different communes. Very little coal is used for household purposes, and the amount of wood required for daily consumption adds enormously to the drain on the national resources. The best-wooded parts of Serbia are the districts of the south and south-east, but especially the department of Toplitza, which may be said to contain the only remaining virgin forests of Serbia, and whence are annually drawn large supplies of

walnut trunks and oak staves for casks. The heights of the Nischava valley, Stalatz, and Krushevatz furnish excellent building-timber. Oak forests are abundant on the Turkish frontier of Vrania. Walnut-trees, which attain to an enormous growth, have been mercilessly dealt with, the value of this timber having attracted the attention of Austrian merchants, who send agents to choose and cut the wood for exportation. The fir and juniper are found in the central and western valleys; and on the great Kopanik range on the south-east, the pine on the heights of Zlatibor.

— Mining for ice is a possible future industry, according to the *American Geologist*, which states that an immense deposit of ice, thought to have its date from the glacial period, has been found in Pine Creek Cañon, Idaho. Capitalists, it adds, are considering the feasibility of mining it for commercial purposes.

— The *Industrie Textile* has a long account of the treatment of wild silks (that is, those which are furnished by silkworms other than those of the domesticated *Bombyx mori*) in their native countries. In India there are no less than fifty varieties of silk-bearing insects, the most important of which is called "tussur;" that is, "the weaver's shuttle." The caterpillar, like the moth, is of a great size, and feeds upon more than thirty species of plants. The cocoons of the tussur, which make their appearance twice in the year, are found attached to the branches of trees in the jungle in large oval masses. The caterpillar lives from thirty to forty days, and then weaves its cocoon. In four or six weeks from this time the moth comes out and lays eggs, from which comes a second generation of caterpillars. These wrap themselves in the cocoon, and remain hanging to the trees throughout the rainy season; that is, for seven or eight months. The cocoon, which is about four times the size of that of the mulberry silkworm, is composed of a double and interrupted thread of about 1,400 metres in length. The thread is impregnated with uric acid of sodium, which must be removed by the aid of an alkaline wash before the thread is unwound. The tussur is tended with great care; in fact, for centuries various religious usages have been employed in rearing it. The moth, which is a large insect of a brownish color, having its wings beautified by four transparent eyes, is venerated, and may be only approached by people of a certain caste. Unlike the tussur, which has been domesticated in India for some thousands of years, the cocoons of the other species are collected in the jungle. Among these is the *Attacus Cynthia*, which feeds on the castor-oil plant, and of which the cocoon is white. Other species are the *Antheraea assana*, and the *Cricula trifenestra*, which lives on the mangrove-tree, and spins a cocoon of a bright golden color. The most important Chinese species is the *Antheraea pernyi*, which is cultivated in the province of Sze-chuan. In China also is found the most beautiful of all moths, the *Attacus atlas*, which spins an enormous cocoon, covered at both ends with a very thick silk, known as "Fagara silk." In Japan are the *Ailanthus* caterpillar, and the *Yamanai*, which till lately was reserved for the exclusive use of the Mikado; and the exportation of the eggs was an offence punishable with death. At present attempts are being made to cultivate this species in France, and it is believed they will be successful.

— At a recent meeting of the Kansas Academy of Science, Professor F. H. Snow of the University of Kansas presented a paper upon the species of fossil leaves of the Kansas Dakota rocks. One of these species, of the new genus *Betulites*, according to Lesquereux, but referable to *Viburnum* according to Saporta, is named by Lesquereux *Betulites Vestii*, in honor of the indefatigable collector of these fossils, Mr. E. P. West. A large proportion of the specimens of this very variable species are found to be provided with stipules, which leaf appendages were not previously known to be connected with the Dakota leaves. These stipules, instead of being uniformly in pairs, one upon each side of the base of the petiole, as is the case in living dicotyledons provided with these appendages, are either single (in which case they may be entire, cleft, or parted), or they are in occasional instances entirely divided, constituting a pair of stipules; but, whether single or divided, they are nearly always unilateral, i.e., situated upon one side of the leaf-stem or petiole. In only one instance among at least one hundred stipulate leaves examined are the stipules bilateral, so that their

unilateral character fairly distinguishes them from the stipules of modern dicotyledons. The significance of the discovery of these cretaceous stipules lies in the fact that we have here an additional proof of the descent of our modern forms of vegetation from the ancient forms by a gradual series of changes. To the superficial observer it would seem that our modern forest-leaves are absolutely identical with the cretaceous leaves, which, according to Dana's time-ratios, flourished about five million years ago. The opponents of the modern theory of origin of species by descent have derived a strong argument from the apparent identity of the modern with the ancient forms; but the identity is apparent only, not real. Lesquereux has noted the fact that the Dakota leaves, as a rule, have entire borders, while the modern forms of the same genera have denticulated or serrated borders. Another difference between the modern and the Dakota leaves consists in the greater thickness and toughness, or, in botanical language, the coriaceous character, of the ancient forms. But in the stipules of the Dakota leaves we not only have a prevailing unilateral position of these organs, as distinguished from their modern bilateral arrangement, but we are able to witness the gradual change from the single undivided form through the successive steps of transformation to the completely separated and finally bilateral pair; each stage of differentiation being indelibly stereotyped upon the sandstone matrix by which the leaves are enveloped.

— On Dec. 1, 1888, the resident population of Switzerland was 2,920,731, and the total population 2,934,027. Males numbered 1,427,377, and females, 1,506,650. Those speaking German amounted to 2,092,530; French, 637,972; Italian, 156,606; Romanche, 38,305; and various, 8,574. There were 1,724,957 Protestants; 1,190,008 Roman Catholics; 8,386 Jews; and of various or no religions, 10,766. The returns for the chief towns were, Bâle, 70,386; Geneva, 52,457; Berne, 45,966; Zurich, 27,632.

— Mr. G. W. Roosevelt, American consul at Bordeaux, in a report on the treatment of diseases of vines in France, says that in spite of the numerous inventions meant to destroy *Phylloxera*, it still continues its ravages. One of the most recent plans is that of an American, Mr. L. H. Davis, who inoculates the vine, through a carefully made excision, with a preparation which he claims is destructive to the *Phylloxera*, while it leaves the vine uninjured. It is too soon yet to speak of the results of this plan. Dr. Griffin advocates a distribution, by a machine constructed by him, of a substance which can be used in either a dry or a liquid state. Last spring he operated on a vineyard placed at his disposal by the French Government, and had the satisfaction of seeing the vines treated by him sound and healthy, while other plants in the same vineyard were perishing. The most generally employed remedy has been found to be very serviceable, and free from the danger that was thought to follow it; that is, the submersion, for not less than forty days, in carbon of sulphur dissolved in water. In light permeable soils a strong mixture is used, but on hard soils a weaker solution is better. Within the past few years the actual area of the vines destroyed by this pest is 1,200,000 hectares, or, roughly speaking, one-half of the vineyards of France; and, if we remember that a hectare of vines is worth about 6,000 francs, we can see what a terrible loss France has suffered. In the case of *Oidium*, as in that of *Phylloxera*, no positive remedy has yet been discovered; but the usual mode—that is, the application of sulphur, pure or mixed—checks the disease, and at the same time helps the growth of the vine. In fact, so great have been the good results of the use of sulphur, that it will for the future be used in most vineyards, even where *Oidium* does not exist. Till the year 1885 no remedy was known for mildew. Since that year, however, salts of copper have been successfully employed, though there is some doubt whether that substance is really beneficial to the vineyards. The most general method is to pluck off the diseased leaves and burn them. Besides these, there are other methods, such as the use of *bouillie bordelaise*, *eau céleste*, ammoniate of copper, and verdigris with powdered sulphate of copper. On account of the recent appearance of the disease called "black rot," no satisfactory remedy has yet been tried. With regard to anthracnose, if steps are taken early in the spring, the disease may be brought under control. Perhaps the best remedy is a mixture of lime and sulphur. A first

sulphuring is given when the shoots are four or five inches long; then, if lesions appear, the operation is repeated in about a fortnight with a mixture of lime and sulphur, the proportion being one part of sulphur to three of lime. A mixture of plaster and sulphate of iron has also been very successful. The only really efficacious remedy for pourridie is by removing and burning all roots showing traces of the disease. Erinnose may be treated like mildew; that is, by repeated applications of sulphur.

— The International Prison Congress will be held in St. Petersburg in the summer of 1890. A prize of four hundred dollars is offered by the conductors of the *Prison Discipline Review*, for the best essay on the subject, "What in the most civilized nations has been the historical development of the institutions relating to the correctional education of minors who have been convicted of crimes at common law, or who have been put in custody for idleness and vagabondage, or with a view to paternal discipline?" The essays must be written in Russian or French, and must be sent to the president of the organizing committee of the Fourth International Prison Congress, at St. Petersburg, not later than May 15, 1890. They must be furnished with a motto, and accompanied by a sealed letter containing the writer's name and address.

— The Paris correspondent of the *Medical Press* writes, under date of July 13, 1889, that in the last sixteen years the number of suicides increased in France 55 per cent. Their proportion in regard to the population rose during that period from 15 to 21 per 100,000 inhabitants. In 1872 the total number of suicides was 5,275, while in 1887 8,202 were registered. Women, as in other countries, are less prone to self-destruction than men,—1,768 (22 per cent) against 6,434 (78 per cent). The frequency of suicides increases with age. Up to the fortieth year the propensity is about the same in both sexes, but after that the men take the lead. There were 2,894 unmarried, 3,706 married, while 1,355 were widows or widowers. As to the social condition, 2,614 were in agricultural pursuits, 2,276 belonged to varied industries, while the remainder were in business, or were householders, domestics, clerks, etc. The rural population furnished a higher number of suicides than the urban,—4,279 of the former to 3,807 of the latter. As to the period of the year, summer and spring furnish the largest contingent. The means employed were chosen in the following order of frequency: strangling, immersion, fire-arms, asphyxia by charcoal, sharp instruments, poison, precipitation from heights. The presumed causes were, insanity, 2,023; physical suffering, 1,407; poverty and reverse of fortune, 1,059; domestic affliction, 1,116; drunkenness, 914; disappointed affections, 305; etc. In the above list, alcoholism producing cerebral affections takes the first rank. During the last fifty years the consumption of alcohol has increased threefold, and the number of insane persons fourfold. The liquor which contributes the most to producing mental derangement is absinthe, of which the French are so fond. When a man gets in the habit of taking that drink, he is sure to commit some crime or destroy himself.

— Dr. H. W. Wiley, chemist of the United States Department of Agriculture, in a note accompanying a recent report on the manufacture of sugar by the diffusion process, calls attention to the advancement made in the last few years in the sugar-industry of Louisiana, and to the important part taken by the government in developing that industry. In 1884 the Department of Agriculture established, in connection with the exposition at New Orleans, a complete sugar-laboratory, and at the same time placed an experimental diffusion battery on exhibition. It also established at Magnolia Plantation, Lawrence, La., a complete chemical control of the sugar-factory. In December of the same year, the attention of sugar-growers was called by Dr. Wiley to the importance of chemical control and new methods. In 1885 the department made an unsuccessful attempt to introduce the process of diffusion into Louisiana on a manufacturing scale, and during the next year one hundred and fifty tons of Louisiana cane were shipped to Kansas and worked by the process of diffusion, securing a yield fully thirty per cent greater than the average milling process would have given. In 1887 the diffusion process was successfully introduced by the department on Magnolia Plantation. During the coming season the diffusion process will be used on four large plantations in

Louisiana. Many other planters have also instituted a chemical control of the factory, and a sugar experiment station has been in successful operation at Kenner for four years. The practical result of the work first undertaken in Louisiana by the Department of Agriculture is seen already in a more scientific agriculture, a better knowledge of the problem of sugar-manufacture, a more scientific method in the sugar-house, and the introduction of recent and improved machinery. Before the time first mentioned, the average yield of sugar per ton on the best plantations in the State was scarcely one hundred and forty-five pounds. It is now over two hundred pounds.

— Cholera is reported as raging in Peking with great violence. All foreigners, with the exception of a few officials, have fled to the mountains.

— The total length of submarine cables is 209,322 kilometres (130,066 miles).

— Dr. A. König of Berlin has been promoted to the rank of extraordinary professor of physics.

— Professor Lankester proposes, in *Nature*, that this new word, "Mithridatism," be admitted to the scientific vocabulary, to signify that immunity from the effects of a poison which is induced by the administration of gradually increased doses. The selection of the word has reference to the fable concerning Mithridates, King of Pontus, that he became so charged with the poisons he experimented with, that he obtained an immunity from them all.

— In a paper on the pathogenic properties of the microbes present in malignant tumors, by M. Verneuil, read at a recent meeting of the Paris Academy of Sciences, the author still adheres to the opinion already enunciated in 1883, that these parasites have nothing to do with the initial stage of boils, ulcers, cancer, and the like. At the same time he does not regard their presence as a matter of indifference, but admits that in certain cases they may themselves possess special pathogenic properties, in virtue of which they act on the system like septic poisons.

— At a meeting of the Academy of Sciences at Paris recently, M. Mascart gave a true account of the striking by lightning of the Eiffel Tower, which took place on Aug. 19, and exaggerated reports of which appeared in the daily papers. The conductor was struck, with the normal results, showing perfect communication with earth, and consequently complete safety of the structure from any danger on this score.

— By the will of the late Alonzo Clark, M.D., LL.D., it was placed in the power of the faculty of the New York College of Physicians and Surgeons to bestow a scholarship, with an income of about nine hundred dollars a year, for the purpose of promoting the discovery of new facts in medical science. This has been bestowed, for three years from Oct. 1, 1887, upon T. Mitchell Prudden, M.D., of New York City.

— The *Handels Museum* states, on consular authority, that the fibres of the banana, or paradise fig-plant, are the most important products of the soil in Africa which have hitherto remained unused. This fibre, which is capable of being divided into threads of a silky fineness, extends the entire length of the plant, which has no branches. In Central America this fibre, without any other preparation than the drying, is used for shoe-strings, and for strings and ropes for various purposes. During the twelve months of its vegetation the banana-plant produces only a single bunch of fruit, after which it dies, but from its roots four to ten young plants spring up. In its native place, a bunch of fruit of the banana is worth about twenty-five cents, while the plant, which is thrown away, is worth ten times that amount to a soap-factory, paper-mill, or coffee-bag manufacturer. The leaf of the banana, composed, with its stalk, of the toughest and finest threads, has hitherto only served the native women as an umbrella during the rainy season, as a carpet to sit upon, or a bed to sleep on. "If," says the *Handels Museum*, "this plant, in the innumerable banana plantations of the entire tropical world, is only properly utilized, the whole human race will obtain such a vast mass of textile material that it is certain to influence the value and cultivation of other kindred plants, such as hemp and flax, cotton, jute, etc., and nobody can predict the consequences which the utilization of this hitherto unnoticed material may have."

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ABOUT TEN DAYS AGO there appeared in the *New York Sun* a sensational article to the effect that, on account of the depreciation in the value of Baltimore and Ohio stock, and the loss of income from dividends on the stock, Johns Hopkins University was ruined. What the animus of this article was we do not know. It may have been written with the hope that it might further the interests of some stock jobbers, or it may have been written by some enemy of Johns Hopkins bent on doing the university what harm he could. A glance at the article in question showed that it contained nothing but what was perfectly well known months ago, so far as ill was concerned, and that all reference was omitted to the successful efforts of the university's friends to help it at a time when it was temporarily short of ready cash. We were so impressed at the time with the character of the article, that we made no allusion to it last week, supposing it to be evident enough on the surface that it was all published to produce a sensation, and not to record a plain statement of fact. We should not now have any thing to say were it not for the frequent allusions published in our exchanges, showing that some read the *Sun* and accept its fictions as news. All that need be said now is that for years the trustees of Johns Hopkins University knew, as any body of sensible men would know, that, as a good portion of their income-bearing property was in Baltimore and Ohio stock, it would be wise to save up some of the income to provide against any cessation of dividends.

This was done. Again, when the dividends stopped some months ago, steps were taken to raise additional funds to cover expenses, and these efforts were rewarded with all the success desired. The result is that the university goes on with ample means to continue as a model to all our American universities, as it has been from the start, with a full faculty on full pay.

THE PREPARATION OF JAPANESE LACQUER AND THE MANUFACTURE OF WAKASA WARE.¹

JAPANESE lacquer is the product of a tree (*Rhus vernicifera* D. C.) which grows throughout the main island of Japan. It attains a large size, the trunk sometimes measuring a metre in diameter. It is said the tree will live for forty years, but only comparatively young trees are valued for the production of lacquer. Having yielded for several years, they are cut down, the lacquer extracted from the branches, and young trees take their places.

The principal section of the lacquer industry is between the parallels of 37° and 39°, beginning about one hundred miles north of Tokio. The best lacquer, however, comes from much farther south, from Yoshino, in Yamato.

The lacquer exudes from horizontal cuts in the bark, in the form of a rather viscid emulsion, and may be collected from April to the end of October. In the spring it is more watery than in the later months. However, the sap never flows so freely that it can be collected in vessels, as has been stated by writers. It exudes slowly, and is collected by means of a pointed, spoon-like instrument, and transferred to a wooden receptacle or tube of bamboo. Several cuts are made in each tree, the last as high as a man can reach. Having thus prepared a dozen or more trees in rapid succession, the collector begins to collect the juice from the cuts in regular order, beginning with the one first cut.

Having finished the collecting, he takes other groups of trees, and after about four days returns to the first, where, after removing the accumulated yield, he cuts again into the same trees, and repeats the same rôle fifteen or twenty times. Thus the work may go on for eighty to a hundred days. The utmost yield of a single tree is about forty to fifty cubic centimetres of raw lacquer.

As the sap first exudes, it is a grayish-white thick or viscous fluid, which quickly turns yellow, and afterwards black where it is in contact with the air.

The sap thus collected is *ki-urushi*, *urushi* being the general name for lacquer. An inferior kind is obtained from the branches when the trees are cut down. The branches are soaked in water for several months, then taken up and slightly warmed, when a small quantity of sap exudes. This is *seishime urushi*.

The lacquer is strained through cotton cloth to free it from bits of wood and dirt, first being thoroughly stirred to break up lumps and make a uniform mixture. The product thus purified is known as *seishime urushi*; but this name, which has already been used to designate the lacquer from the branches, has now a different meaning, and is applied to the cheaper kinds of raw lacquer, such as are used for the first coats in lacquering. These lacquers have usually lost some of their water by stirring in shallow receptacles exposed to the sun. They have undergone no further preparation.

Many varieties of lacquer are prepared for special purposes, ranging in price from one or two to six or seven dollars per kilogram. These differ in quality and color. There is a famous black lacquer prepared by the addition of iron, which forms a chemical combination to be mentioned further on; while red, green, yellow, and other colors are imparted by addition of various pigments, as cinnabar for red, orpiment and indigo together for green, orpiment for yellow, etc. Ultramarine is decomposed by lacquer, giving off sulphuretted hydrogen. Certain lacquers have a small proportion of a drying oil (perilla oil) added to them. The lacquer known as *shiu urushi* contains from one to ten per cent of this oil. The name "*shiu urushi*" means "cinnabar lacquer," and is applied to this variety because it is commonly used to mix with cinnabar when a red lacquer is required.

The emulsion as it comes from the tree consists of an aqueous

¹ Abstract of a paper read by Romyn Hitchcock before the Chemical Society of Washington, April 11, 1889.

fluid holding in suspension numerous very minute brown globules and a smaller proportion of lighter-colored larger globules. The former are insoluble in water, but soluble in alcohol. The latter dissolve in water.

The raw lacquer is almost completely soluble in alcohol, ether, carbon bisulphide, benzine, and solvents of gum-resins in general. The most important and abundant constituent is urushic acid, which occurs in the form of the minute spherules already mentioned. The acid is obtained by evaporating the alcoholic solution to a sirupy liquid. The evaporation must be carried on over a water-bath. If too much heat be applied, a tough, black, rubber-like substance is obtained, which I found very troublesome to remove from the dish, and only strong nitric acid would affect it in the slightest degree.

As thus obtained, urushic acid is soluble in alcohol, chloroform, etc., but quite insoluble in water. It possesses marked acid properties, turns litmus-paper red, and forms salts with metals. With iron salts it forms a black compound, to which the color of the fine roiro lacquer is due. With plumbic acetate it yields a gray, flocculent precipitate.

Although the drying, or rather the hardening, properties of lacquer are doubtless due to the oxidation of urushic acid, the product extracted by alcohol possesses no drying qualities. This fact was first observed by Professor Rein, in 1874. More recently Korschelt and Yoshida have found that a peculiar albuminoid of lacquer effects the drying by a diastatic or fermentive action. The fact seems to be that the lacquer hardens only when the albuminous substance is present. If heated above 60° C., or above the temperature at which albumen coagulates, the lacquer will not dry. The strongest evidence of the importance of the albuminoid to the hardening process is found in the fact that while the urushic acid will not dry by itself, it immediately hardens if a portion of the unboiled gum and albumen that does not dissolve in alcohol be added to it, and the rapidity of hardening depends upon the proportion added. It is notable that the albuminoid does not lose its peculiar property of effecting this oxidation by treatment with alcohol. Besides urushic acid and the albuminoid, raw lacquer contains a gum resembling gum arabic, which doubtless imparts some useful properties to the lacquer, and a volatile acid, to which Professor Rein ascribes the poisonous effects of lacquer.

We now come to the further preparation of lacquer for use in the manufacture of the several varieties of lacquered articles, and I would say that whoever is sufficiently interested in the subject to spend an hour at the National Museum will find the process of manufacture very fully illustrated there.

A portion of the raw lacquer, about sixteen pounds, is poured into a large circular wooden vessel, and vigorously stirred with a long-handled tool for five or six hours, while the heat of a small charcoal-furnace is ingeniously thrown upon the surface to evaporate the water. During the stirring, certain ingredients may be added from time to time. The *roiro*, a fine black lacquer, is made by adding iron at this stage. In Tokio a soluble salt of iron is used, but the Osaka manufacturer objects to that, asserting that it injures the quality of the lacquer. The material used in Osaka is the fine iron dust collected from the grinding of knives. This is added in quantities of about a tea-cupful of powder mixed with water at a time, until the desired color is obtained. When the work is finished, the lacquer is poured into a vessel to settle, and is afterwards drawn off from the sediment.

The wood generally used for lacquer-work is the light, easily worked *hinoki*, a coniferous wood. It is prepared to receive the lacquer in various ways. For inferior work it is first covered with paper, but in the finer qualities paper is not used. The operations to be described apply to the manufacture of that variety of lacquer known as Wakasa lacquer, and are from personal observation. The wood is first carefully smoothed, and the corners of the boxes strengthened by gluing pieces of cotton or hemp cloth around them with raw lacquer. All joints and imperfections are then filled with *tsugi urushi* (*tsugi*, "to fasten"), which fills like putty. This is a dark-colored mixture composed of rice-flour made into a paste with water, and mixed with *seshime urushi*. It soon hardens so that it can scarcely be cut with a knife. Sometimes finely cut hemp is mixed with the *tsugi urushi*. The work is then covered

with *jinko*, a mixture of *seshime urushi*, and a coarse powder of a yellowish color. The mixture is soft, of a yellowish-brown color, changing to black by exposure to the air. It is spread with a wooden instrument called *hera*. The article is left for a few days in the open air to allow some of the water to evaporate, after which it is placed in a moist-air closet to harden. In this way a very hard, gritty surface is obtained, affording an excellent ground for the succeeding coat.

This process is not applied in making inferior goods. For these a mixture of the powder with glue is sometimes used, and for this reason cheap ware sometimes blisters when used with hot water, the glue swelling if the water reaches it. Similar blistering may also be occasioned by the natural gum of the lacquer if it should be present in excessive quantity.

The next process consists in covering the entire box with two coats of lacquer, containing a finer powder known as *tonoko*, which is a kind of ochre much used in Japan for cleaning and polishing. This is likewise evenly spread with the *hera*. Three coats of this are applied over the joints. The object of this process is to secure an even, smooth-grained surface for subsequent work. The surface is finally rubbed down with a kind of stone called *toishi*.

The parts that are not to receive any decoration are now ready for the finishing applications of lacquer. The other parts are next covered with a black lacquer, *naka muri urushi*. The lacquer used is *shitaji urushi* mixed with a kind of black lacquer known as *honkuro*, probably the best kind of roiro lacquer. It is applied with a brush, and requires to be rubbed down.

Two coats of black lacquer are now applied. The first is roiro put on with a broad brush. This dries with a brilliant reflecting surface. When quite hard, the second application is made, and in this, while still soft, the designs are impressed. I use the word "impressed" because in the Wakasa lacquer there is no painting or drawing, but the figures are produced in a very curious manner. The white decoration is applied by dropping egg-shell powder in patches here and there. This is done very skillfully by the hand. The other designs are made by pressing various forms of leaves into the soft surface. Thus, the radiating or wheel-like pattern is produced by so arranging the needle-like leaves of the pine, the more complex leaf-pattern with the leaves of an evergreen (*Thuya orientalis*), while many other effects are made by scattering over the surface husks of rice, and these mingled with very short pine needles. The mother-of-pearl from shells is also used. The designs become more or less modified by the subsequent operations.

The lacquer retains the impressions thus produced, when, after the leaves, etc., have been embedded about a day, every thing except the egg-shell powder and mother-of-pearl is removed. The article is then put in the moist closet until it is thoroughly hardened, which may require ten days or a fortnight. The egg-shell is in little heaps, the leaf impressions are beneath the general surface. It is now necessary to fill up all depressions and once more secure an even surface. The first step is to rub down the most conspicuous projections until there is much less irregularity of surface, but even after several successive coats of lacquer there will remain some elevations and depressions.

The next application is a transparent lacquer colored yellow with arsenic sulphide. This is put on with a *hake*, and spread as evenly as possible. The object of this is to afford a yellow ground for the gold which is to follow. A thin coat of *shiu-ai urushi* is spread over this, and the whole completely covered with gold leaf. Then successive coats of the same lacquer, which is a transparent red lacquer, are applied until the surface is quite even. The surface then appears entirely black, beneath which all the gold and decorations are concealed.

Instead of a red ground, green is sometimes desired, as in green lacquer. To make this, the *shiu urushi* is mixed with a green pigment. The next operation is to rub down the surface with stone *toishi* or *sai kido* until the design is again visible. The pattern is now revealed in gold with the pure white of the egg-shell powder to relieve the effect. The work is finally rubbed with a special kind of charcoal, which gives a perfect surface, but to make it more brilliant it is covered with a finishing coat of fine lacquer.

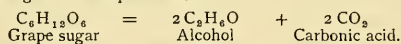
To make practical application of these remarks, I would say that

the peculiar qualities of lacquer make it seem worthy of more consideration than it has received in this country. It gives a surface to wood much harder than our best copal varnish, without brittleness. It takes a polish not to be excelled, which lasts for centuries, as may be seen in the old treasures of Japan. It is proof against boiling water, alcohol, and, indeed, it seems to be insoluble in every agent known. It is the best possible application for laboratory tables. I have a set of photographer's developing trays that have been in use for more than a year, and I find them excellent and cheap. In Japan it is used for many household articles.

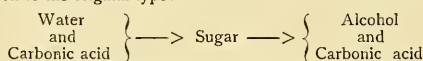
A very serious objection to the use of lacquer in this country is the danger of lacquer-poisoning from the fresh material. I have recently heard of a piano-maker who tried to use it, but it affected his workmen so seriously that he was obliged to give it up. The Japanese are very much in dread of the poison, as I found when I tried to get some of my students to accompany me as interpreters to the places of manufacture. Those who are subject to the poison suffer precisely as patients afflicted by the *Rhus*, or poison-ivy. Of course, those engaged in lacquer-work are not affected by it; but whether one acquires immunity after a time, I am unable to tell. However, if the poison is a volatile acid, it would seem possible to remove it by a heat that would leave the lacquer uninjured, and thus make it available for use in this country.

THE PRODUCTION OF SUGAR.

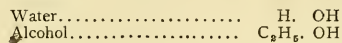
BEFORE proceeding to describe the processes adopted for the extraction and refinement of sugar, says Ward Coldridge, in a sequel to an article on the same subject reprinted from *Knowledge in Science* of Aug. 30, it will be advisable to explain the difference between what a chemist means when he speaks of "a sugar" and what people generally understand by sugar. The chemist uses sugar as a generic term, and includes under it—strange as it may seem—things which have no sweetness, and excludes the sweetest of all substances, the newly discovered saccharine. He subdivides his sugar into two classes,—first, true sugars, which are distinguished by their power of undergoing alcoholic fermentation; and, secondly, bodies which do not suffer fermentation. Recent research has diminished the number of substances of the second class, so that for the purpose in hand this class can be eliminated, and our attention can be fixed on the first group only. These fermentable substances which yield alcohol are typically represented by grape sugar and cane sugar. Now grape sugar is less sweet than cane sugar, and its chemical constitution is different. Grape sugar has the formula $C_6H_{12}O_6$; that is, its molecule contains six atoms of carbon, combined with twelve of hydrogen and six of oxygen. When suitably treated with yeast, it ferments, and forms alcohol, and evolves a part of its carbon and oxygen as carbonic acid, one of the two substances from which the plant originally began to form its sugar. The equation is,



It will be remembered that the plants originally formed their sugar from water and carbonic acid; and now it can be understood that Nature, when she wishes to dispose of an excess of sugar, transforms it into alcohol and carbonic acid. There is thus a reversion to the original type:—



But alcohol takes the place of water. In the face of the wide difference between the actions of water and alcohol on humanity, it may seem absurd to say that the final products bear any resemblance to the original. Yet, in spite of the physiological difference, the chemical relation of alcohol to water may be summed up in the statement that alcohol is water in which one of the two hydrogen atoms are replaced by a group of carbon and hydrogen atoms, " C_2H_5 ." Thus,



Nature does not, however, desire to flood the world with alcohol, for she very quickly transforms it, by aid of a countless army of

minute living organisms, into vinegar; and thence, in turn, she passes back to what she started from,—to water and carbonic acid. So the cycle of changes runs on; in all stages it is always proceeding.

The conversion of common sugar is not so direct. Cane sugar must drink water before it can form alcohol. But the draught of water acts on it chemically, and converts this form of sugar into two others, one of which is uncrystallizable. When the sugar becomes thirsty at the temperature of the West Indies, it absorbs water with greater eagerness, and as a result a quantity of molasses or treacle is formed.

The older method of extracting the sugar—and in future in this paper the word will be used in its commercial sense only—was to take the canes which had been cut off as near the roots as possible and stripped of their leaves, and to crush them. From the crushed canes the juice exuded. This juice held in solution, besides the sugar, various substances of an albuminoid nature containing nitrogen, and of mineral bodies chiefly that phosphate of lime ($Ca_3P_2O_8$), which is obtained from bones. The object of the process is to remove these foreign substances, so as to have command of a comparatively pure solution of sugar in water. The albuminoids must be removed as quickly as possible, for they soon begin to assert their presence by causing fermentation in a manner analogous somewhat to yeast. The plan adopted is to collect the juice in large tanks, and then to add a small quantity of lime. The liquor is next heated to a suitable temperature; a thick scum forms on the surface. When it is considered that this coagulation of the albuminous substances has proceeded far enough, the clear liquor is drawn off from below. From this solution the manufacturer desires to obtain as much sugar as possible by crystallization. He therefore boils off the water quickly in open copper vessels, and incidentally improves the purity of his product by removing such scum as may form. The thick sirup which remains is run into coolers and allowed to stand until no more sugar-crystals separate. Finally he places the magma of crystals, and the mother-liquor from which the sugar has separated, into casks with perforated bottoms. The uncrystallizable thick brown viscid mother-liquor which draws away is the common molasses or treacle which is chiefly used in the manufacture of rum.

The process which has been thus outlined is far from being economically perfect. In fact, it is extravagant and wasteful. To begin with, the mechanical contrivances generally used by the colonial sugar-planter for crushing his canes are not perfect: he might obtain more juice from a given weight of cane. A somewhat recent invention seems to have a future before it in this direction. The principle is very simple and well known. It utilizes the fact that a body, when rapidly whirled around, will fly off tangentially unless restrained. The machinery is here so arranged that the juice may escape, but the solid pulp is restrained, and at the end of the operation is left in a dry condition.

However, the most serious defect of the above process arises in the actual manner of working up the comparatively pure sugar solution. Above it was said that the manufacturer rapidly boiled off the water; of course economy of time is an element to be considered. Allowing, then, that the water is removed quickly, it may seem at first sight that the process is excellent. But as a fact it is very wasteful. Why it should be so will be understood by realizing the fact that at the temperature used the water is not merely evaporated, but that some enters into combination with the cane sugar and converts it into grape sugar, as given above, and in the final result a large proportion of molasses is formed. So the question has been considered whether it is possible to remove this water under such conditions as will prevent, or at least diminish, the chemical change. The answer has been an affirmative one. The liquor, instead of being concentrated by boiling down under atmospheric pressure, is now heated in vessels from which the air can be exhausted. Consequently, according to the well-known connection between the temperature at which water boils and the pressure on its surface, the temperature of ebullition in a vacuum will be much lower than in air; the sugar solution will thus be kept while concentrating at temperatures below that at which it readily drinks water, and becomes in part uncrystallizable.

At the present time the colonial sugar manufacturer is proving

himself to be a man of strong conservative habits, and very slow to recognize the great practical improvements which have taken place. But the day must come, and that quickly, when the exigencies of competition will lead him to adopt artificial advantages which have proved of service to the continental producer of sugar from beet-root. Then, perchance, the prediction of the Brazilian commission, quoted in the former article, will be verified.

The methods employed for the extraction of the raw sugar from the beet are practically the same as for raw cane sugar; but the impulses towards change and improvement, and the necessity for the rapid evolution of more economic manipulation of details, have led to the foregoing inventions.

One new process, however, has been invented which so strikes at the root of the old process that it merits a description by itself. Instead of crushing the beet-root to a pulp, and then extracting the sugar juice together with albuminoid and gummy matters, it aims at removing the sugar without these foreign substances, and so avoids the subsequent labor for their removal. The beet is cut into slices, and these are washed with water. It is claimed that the sugar diffuses out through the walls of the unbroken cells, whereas the albuminoids and the gummy matters of far greater molecular complexity cannot so escape. When the washing is carried out systematically, the process works exceedingly well. Again, the principle of this improvement, like those which underlie the others, is quite old. The walls of the unbroken cells are perforated with fine pores. The particles of sugar can pass through, but the bulky albuminoid aggregates cannot pass. It is like a sieve at work on a minute scale: sugar for the fine gravel, albuminoids for the stones, gummy matters for the lumps of clay, and the minute pores for the holes of the sieve. The originality consists in the application. The same plan has been used over and over again to detect arsenic in a viscous mixture of substances; the mixture is merely boiled with dilute hydrochloric acid, and then floated on a parchment membrane on a vessel of water, the arsenic passes through into the water, and the filth with which it was mixed remains behind. This diffusion-process, which thus owes its birth to the experiments of the Englishman Graham, is much used on the continent, and its applicability to the production of sugar from the sorgho grass is a source of confidence to those who are trying to develop this new American industry. The sugar trade at this moment watches with interest the practical experiments which are now being made, with, as far as can be judged at present, satisfactory results on its application to the extraction from the sugar-cane. Even in Japan an effort has been made to utilize it, and the government have aided the industry by a bounty, and have, it is said, a considerable share in a large manufactory which is now being floated; here, too, the Japanese evince their keenness in adopting Western inventions, and even in extending European ideas.

But the manufacture of sugar does not end with the production of raw sugar; in England it commenced with the raw sugar. The refining of sugar chiefly consists in the removal of the coloring matter which adheres to the small crystals of the raw sugar, and the casting of the purified crystals into moulds. The same processes are applied both to the raw material from the cane sugar; which is pleasant to the taste, and to that from the beet, which smells unpleasantly and is uneatable. The method is the same as a chemist would adopt, who, in the course of an investigation, prepared a substance which he wanted in a state of perfect purity. The sugar is dissolved, and the solution filtered to remove mechanical impurities. The solution by its tint shows the presence of coloring matter, which is removed by filtering through animal charcoal, when it will filter from the charcoal in a colorless condition. It is a curious experiment to shake a wine-glass of port wine with some finely divided animal charcoal; after filtering, the wine is obtained as colorless as water, but it completely preserves all its characteristic properties of taste unaltered. The colorless solution of sugar is then concentrated in a vacuum pan until of the right strength for rapid crystallization. To ascertain this point, the workman places a drop between his finger and thumb, and tests into what length of thread it can be drawn. If the right strength has been reached, some cold unboiled solution is added. Crystals at once appear. If the sugar is finally to be cast in loaves, the

conditions are so adjusted as only to produce small crystals. The mixture of crystals and sirup is then heated to within thirty or forty degrees of the boiling point of water, and poured into the iron moulds of the familiar shape. At the apex of the mould there is an aperture which when unplugged allows the sirup to drain away. Finally, the remaining traces of sirup are removed by allowing a quantity of fine colorless sirup to percolate through the loaf. After the loaf has been subsequently dried and turned in a lathe, it is ready for the market.

Thus, then, the production of sugar is completed. The plants utilize the waste products of animal existence, and work their wonderful chemical transformations. Man gathers wealth from these storehouses of nature, and exercises his ingenuity in obtaining as much as possible. So the history of a lump of sugar contains the story of how plants work, and how mankind inherits their store by aid of labor both of mind and body.

HEALTH MATTERS.

Weight of the Body in Typhoid-Fever.

DR. L. H. COHIN has published a thesis in which he sets forth the daily variations in the weight of patients in typhoid-fever. This publication is the result of studies pursued in Cochin Hospital, where, by a skilful contrivance, successive series of patients were carefully weighed every day, and the weight recorded on their charts, from the beginning to the end of the fever.

The observations of Dr. Cohin, as given in the *Boston Medical and Surgical Journal*, show that the loss of weight varies considerably for each individual. With some it was two hundred grams a day; this was the minimum. With others it was five hundred grams; this was the maximum. The mean of nine observations gives four hundred grams of loss per day; but on taking mild cases, free from complication, the mean fell to three hundred and twenty grams, which represents the daily loss in typhoid-fever of average intensity. The mean of the daily gain, when convalescence was established, was two hundred and eighty grams. The maximum of loss of weight corresponded to the end of the second week, or the beginning of the third. In reviewing the researches on the causes of the loss of weight in typhoid patients, the writer establishes the fact that the febriculant lives at the expense of his own substance.

The conclusions of these studies are as follows: (1) Typhoid-fever presents two distinct periods, one of loss and one of gain; certain accidental causes may modify them, but cannot affect their general character. (2) The daily loss is due to febrile combustion chiefly, and but little to abstinence. (3) The daily loss varies with individuals. (4) The losses in nitrogen and in weight are almost parallel with the march of the temperature, without always following it exactly. (5) The study of the weight-chart may aid in prognosis, a continual rise in the weight being a sign of convalescence. (6) The complications of the disease augment the loss of weight. (7) The study of the loss of weight enables the physician to determine with precision the action of nutritive substances in fevers. (8) The loss of weight in a typhoid patient takes place each day in a uniform manner.

HEALTH IN THE FRENCH ARMY.—According to the official report of the French minister of war, the mortality among the French troops has fallen from twelve to eight per thousand during the last year. From 1875 to 1887 there have occurred 141,648 cases of typhoid-fever, and 21,116 deaths. The percentage of this disease has materially decreased of late, owing to the attention that is being paid to pure water-supply in the barracks. The value of vaccination is proved by the fact that the number of small-pox cases has fallen from 1,042 to 242, and these were mostly among recruits.

NEW METHOD OF PRECIPITATING SEWAGE.—The problem of the disposal of the sewage of large towns has long defied the efforts of sanitary engineers to cope with it in a satisfactory manner. A new method of sterilizing and precipitating sewage has just been brought out, which, it is claimed, accomplishes all that can be required of it at as little cost as any such system can be worked. The method has been put in practice experimentally at

the Wimbledon Sewage Works, England. The principle underlying this plan of dealing with sewage is the employment of "amine" salts in combination with milk of lime. At Wimbledon, herring brine is used, and on mixing with the lime a very soluble gaseous re-agent is evolved, to which the inventor has given the name of "amerinol." This re-agent possesses a peculiar briny odor, and when introduced into sewage is said rapidly to extirpate all micro-organisms capable of causing putrefaction or disease. The effect is almost instantaneous. By the action of the lime, violent flocculation is caused, and subsidence takes place in about half an hour, the putrid smell of the sewage being replaced by the peculiar briny odor. According to Dr. Klein, the destruction of micro-organisms is absolute. The total cost per annum of treating London sewage by this method is put at \$625,000. Should the residue prove to possess any value for agricultural purposes, its sale would tend still further to reduce the expense.

VACCINATION IN JAPAN. — Vaccination, according to *Medical News*, has been obligatory for some years in Japan, and every infant is required by the police to be vaccinated. The value of the procedure is, however, well recognized by the people themselves, and the government hospitals in every town are always thronged with applicants on the weekly "vaccination day." In 1886 there were 1,531 vaccinations to each 10,000 inhabitants.

BOOK-REVIEWS.

Benjamin Franklin. By JOHN T. MORSE, Jun. Boston, Houghton, Mifflin, & Co. 12°. \$1.25.

THIS is the latest issue in the American Statesmen Series, and is well worthy of its place. It treats Franklin exclusively as a statesman, his scientific discoveries being only incidentally alluded to, and his business life very slightly sketched. His early years, too, are passed quickly over, the author thinking that Franklin himself has recounted his early life so admirably that no one else can successfully deal with it. Accordingly, with the third chapter we find our hero despatched on his first mission to England, and all the rest of the book is devoted exclusively to his public services. Mr. Morse shows perfect mastery of his subject, and his style is clear, refined, and dignified; and these qualities make the book interesting throughout. His account of Franklin's labors in England is sufficiently full, and shows why in the main they failed. The dispute between the people of Pennsylvania and the proprietaries of the province was one that could not be settled, and in fact was not settled, until the people had the entire government in their hands. But Franklin's efforts on behalf of Pennsylvania first, and afterwards of all the Colonies, form a very interesting chapter of American history, which is well set forth in this book. The most important of Franklin's public services, however, were rendered in the capacity of minister to France, and it is this part of his work that Mr. Morse has most elaborately treated. Franklin's labors were by no means confined to securing the alliance of France, but included also the difficult task of borrowing, or begging, money in France and everywhere else where it could be got, together with a great variety of services besides. He had for a time two colleagues, but neither was of much use, while one was a mischief-maker of the first order, so that the whole burden virtually fell upon Franklin; and Mr. Morse probably does not exaggerate when he affirms that Franklin's services to the national cause were only less arduous and important than those of Washington.

With regard to the character of his hero, our author expresses himself with some enthusiasm. "Intellectually," he maintains, "there are few men who are Franklin's peers in all the ages and nations. . . . He illustrates humanity in an astonishing multiplicity of ways at an infinite number of points. He, more than any other, seems to show us how many-sided our human nature is." This may be somewhat exaggerated, but it is substantially true; for few men in history have been great at once in such widely separated departments as politics, science, and literature. With regard to his moral character, Mr. Morse, while not extenuating his faults, prefers to dwell on his excellences, which were undeniably of a high order. "As a patriot, none surpassed him," and "the chief

motive of his life was to promote the welfare of mankind." "It is not worth while to deify him, or to speak with extravagant reverence, as if he had neither faults nor limitations. Yet it seems ungracious to recall those concerning one who did for his fellow-men so much as Franklin did. Moral, intellectual, and material boons he conferred in such abundance that few such benefactors of the race can be named, though one should survey all the ages." This is high praise, but it is in the main well deserved; and now, when disinterested patriotism is rare among us, Franklin's example ought to be kept before our eyes, and we hope that this book will be widely read.

Darwinism: An Exposition of the Theory of Natural Selection, with Some of its Applications. By ALFRED RUSSEL WALLACE, LL.D. London and New York, Macmillan. 12°. \$1.75.

DARWIN, in the greatness of his unselfish candor, receded somewhat from the claims of his theory of natural selection, yielding to certain adverse criticisms; and now Dr. Wallace, who had independently originated the same theory, shows anew his own magnanimity in coming to the rescue in a volume entitled "Darwinism." The book is opportune, and worthy of its distinguished author, who is a recognized authority. Addressing all intelligent readers, it surveys the whole subject, confining this for the most part, however, to Darwinism pure and simple, which, as given in the title of Darwin's first enunciation, is the "origin of species;" namely, from pre-existing species by natural selection. Dr. Wallace has the advantage of reviewing the subject "after nearly thirty years of discussion, with an abundance of new facts and the advocacy of many new and old theories," especially from the pens of noted investigators and leading evolutionists.

This limitation to evolution of species, in twelve of the fifteen chapters, avoids many perplexing questions, and gives simplicity and unity to the argument. The author regards the main proposition, in its application to existing or comparatively recent species, as all that can be proven, every thing beyond that lying in the region of probable conjecture. The difficulties, popular or scientific, relate chiefly to the origin of the larger divisions of the organic kingdom, the first development of complex organs, and the like. All this is too remote and too imperfectly recorded to be entirely solved; yet he believes that the generic and ordinal differences among plants and animals are of the same nature as those found in many groups of species, only greater in amount. As we rise to classes and sub-kingdoms, the difficulty is much increased, and we may reasonably doubt whether a radically distinct plan of structure is due to the action of the same laws that have developed species.

In the second chapter, on the struggle for existence, old and new facts are presented, ending with an ethical vindication of nature. In the third the variability of species is illustrated by statistical diagrams and otherwise, showing that it superabounds and offers always and everywhere material that is plentiful for natural selection, rather than slight and rare, thus obviating one of the common objections to transmutation of species. After discussing in further chapters the subjects of artificial and natural selection, and after meeting certain objections (the utility of all specific characters being especially asserted, with some qualification, and the swamping effects of intercrossing denied), the author treats of infertility of crosses, and sterility of hybrids, and opposes the "physiological selection" of Romanes. Going a step further than Darwin, he regards infertility as beneficial under certain circumstances, and increased by selection. Four chapters are given to color, exhibiting the author's well-known views as to its origin and its uses, re-enforced by Alfred Tylor's observations on structural decoration. Darwin's theory of sexual selection of the ornamental is rejected, there being, for example, no evidence, except to the contrary, "that slight variations in the color or plumes, in the way of increased intensity or complexity, are what determines the choice."

The concluding chapters consider geographical distribution; the geological evidences of evolution; certain fundamental problems of variation and heredity, with criticism of the recent speculations of Spencer, Cope, Karl Semper, and Geddes, referring particularly to the improved Lamarckian doctrine, lately revived, that acquired characters are inherited; and, finally, Darwinism applied to man.

The descent of man from some ancestor common to him and the anthropoids is advocated, but it is argued that the law of continuity does not require that the human mind has been developed by the same causes that account for man's physical structure. As the glacial age introduced into the earth's history a new cause, with new effects, so a new agency is needed to explain the appearance of the higher faculties, which are not necessities of our earthly existence, and "appear almost suddenly and in perfect development in the higher civilized races." A new cause manifested itself first in organic life, next in sensation and consciousness, and last in a rational and moral being; and these manifestations of life "probably depend on different degrees of spiritual influx." The Darwinian theory, carried to logical conclusion, does not, in the judgment of Dr. Wallace, oppose, but lends decided support to, the spiritual nature of man.

Such are the principal topics of interest. Others, as, for example, an offered solution of complex modes of cross-fertilization of plants, might be mentioned. A regret may be expressed, that, in treating of variability, the author has confined himself too much to variation in mere proportions of form and color; also, that, on the subject of habits and instincts, he has not taken into consideration the quickness and permanence of sense-association and of associated impulses in animals, remarkably illustrated, for instance, in the dog-and-geese incident from the *Revue Scientifique* lately given in our pages. But the work is as comprehensive as might be expected in view of its special purpose.

The Child and Child-Nature. By the BARONESS MARENHOLTZ-BUELOW. Tr. by ALICE M. CHRISTIE. Syracuse, N.Y., C. W. Bardeen. 8°. \$1.50.

The object of this work is to explain and defend the system of education devised by Froebel, and especially the series of exercises and songs that he invented for mothers to use in training their children. The authoress is deeply impressed with the failings of humanity in the present age, and especially with its moral defects, and thinks that the only way to counteract them is by the reform of education. Froebel's system she believes to be the right one, and she has devoted many years to the work of propagating it. A considerable part of this book is taken up with an exposition of Froebel's peculiar philosophy, which we have always found repulsive, but which seems to have a strange attraction for some minds. Froebel's theory is that education must proceed according to the universal law of development, which is "the reconciliation of opposites," or "the law of balance." What this so-called law really is, it is hard to find out, though in one place we are told that "Newton calls the law in question the law of gravitation." Then we are treated to remarks about "the continuity and inter-connection of all things in the universe," and so forth; but what all this flummery has to do with the education of children we are unable to see. Being at last out of this quagmire, the authoress proceeds to explain the practical methods of teaching devised by Froebel, beginning with the kindergarten, but devoting most attention to the exercises designed for the use of mothers at home. In most of these exercises the child makes a kind of figure with his hands which is supposed to represent some natural or artificial object, and the mother then sings a song. The resemblance, however, between the figure made with the hands and the object it is said to represent is not apparent to us, while the songs as they appear in English are little better than nonsense. Besides these exercises, which are to be systematically practised, Froebel wished to place the young child under a mass of other regulations, and even to regulate and systematize the mother's caresses. What merit there may be in his devices, only actual trial can determine; but we should think that such artificial treatment at the very beginning of life must seriously hamper the natural and spontaneous development of the child. We are not surprised, therefore, to find the authoress remarking of the book in which this system is set forth—the "Mutter und Koserlieder"—that she has learned by repeated experience "that in no way is so much opposition to Froebel's system excited as by any endeavor to propagate this book." She, however, is enthusiastic in its favor, and those who wish to understand the system it advocates will find it elaborately set forth in her book.

AMONG THE PUBLISHERS.

AMONG the popular scientific articles to be published in *The Century* during the coming year will be reports of the latest studies and discoveries made at the Lick Observatory in California, furnished by Professor Holden. Professor Putnam of Harvard has written a series of papers for the same magazine on prehistoric America, in which he will give the result of his own explorations of caves, burial-places, village sites, etc. A detailed account of the strange earth-work known as the Serpent Mound of Adams County, O., will be printed, and the illustrations of some of the papers will include a number of terra-cotta figures of men and women in a style of modelling heretofore unknown in American prehistoric art.

—The Appletons have published "A First Book in American History," by Edward Eggleston, intended for beginners in historical study. It is really a series of biographies of men more or less prominent in American annals, beginning with Columbus and ending with Lincoln, the author believing that children cannot follow the political development of a nation understandingly, and that biography is for them the natural door into history. There is much truth in this view, and Mr. Eggleston has been pretty successful in carrying it into practice, the men whose lives he relates being not only leading actors in American history, but also representatives of American character. The style in which the stories are told is likely to interest children, and the numerous illustrations in the book add to its interest and instructiveness. There is, however, no attempt to connect the various lives recounted so as to make a continuous narrative, and the reader gets no idea of the course of American history as an organic whole. In short, the book is not history, but only an introduction to history, and as such it has considerable merit.

—"Pensions for All" is the title under which Gen. M. M. Trumbull will give a severe lashing to the treasury raiders, in the October *Popular Science Monthly*. The writer was a general in the civil war, and is anxious for the honor, as well as the due rewards, of the former soldiers, and he expresses the fervent wish that the "pension temptation" may not "change the character or diminish the fame of the Grand Army." Dr. M. Allen Starr will have an article on "The Old and the New Phrenology," showing, with the aid of illustrations, what has been definitely learned about the location of the various mental faculties in the brain, and how the errors of Gall and Spurzheim have been exposed. A lively picture of "Evolution as taught in a Theological Seminary" will be given by Rollo Ogden. The writer finds his material for criticism in the lectures on dogmatic theology given in the Union Theological Seminary. Professor J. Howard Gore will contribute an article on "Anthropology at Washington," describing the investigations of the customs and history of the Indians and Mound-Builders which are being made by the government scientific bureaus.

—It is not generally known that there was an American governor of Emin Bey's province in Africa, which has recently attracted so much attention, owing to Stanley's relief expedition. Colonel H. G. Prout, who is now editor of the *Railroad Gazette*, was the immediate successor of General Gordon as governor of the Equatorial Province, and was one of his most trusted friends. It is announced that in the November *Scribner* Colonel Prout will fully describe Emin Bey's province, and will give many interesting recollections of General Gordon, with extracts from some unique private correspondence, and with a number of facsimiles of Gordon's letters and maps.

—The Rev. A. K. Glover will shortly publish a small volume entitled "The Jews of the Far East, or the Jews of the Extreme Eastern Diaspora," with the original Chinese texts of the inscriptions discovered at Kaifung-tu.

—D. C. Heath & Co. will publish in September a translation of "Lindner's Empirical Psychology," by Charles DeGarmo, Ph.D., of the Illinois State Normal University. As the name implies, it is based on common experience rather than on metaphysical theories. It is written from the Herbartian standpoint, and is of interest from the light it throws on the science of teaching. The common complaint is that our ordinary abstract and verbal systems of psy-

chology appear to have only a remote bearing upon the business of teaching. The same firm publishes Sept. 20, "Sept Grand Auteurs du XIXe Siècle: Lamartine, Hugo, de Vigny, de Musset, Theophile Gautier, Merimee, Coppee, An Introduction to Nineteenth Century French Literature," by Alcée Fortier, professor of French, Tulane University of Louisiana. This book consists of a series of lectures, written for students, and forms a superior French reader, giving an account of the lives and writings of seven great French authors.

—The *New England Magazine*, an illustrated monthly, will be published at once in Boston, under the control of Dr. E. E. Hale and Edwin D. Mead. While largely devoted to the past of New England, the articles will not be confined to local topics. Short biographies of Parnell and Gladstone, papers on the French settlements in America, remarkable cities in New England, and fiction in prose and verse, are among the attractions promised during the first year.

—Joseph Thomson, who made the remarkable journey across Masai-land, in Africa, says in *Scribner's* for October: "It is my belief that if Stanley had taken this route [across Masai-land] those disastrous losses in men and goods which befell him would have been avoided, work would have been done in half the time, and a practicable route would have been opened,—an all-important work still to be done, and which must yet be done if the great work commenced by Sir Samuel Baker, carried on by Gen. Gordon, and solidified and extended by Emin Pacha, is not to be sacrificed, and the people once more given up to all the horrors of the slave trade." In the same number Professor N. S. Shaler of Harvard, after a careful consideration of the much neglected condition of the common roads in this country, makes the following suggestions: "I would in the first place suggest that in the Federal Department of Agriculture there should be a commissioner of roads, having at his command sufficient means to prepare and print as public documents accounts of the condition of roadways in this country, with essays on the method of their construction. Each State should likewise have a commissioner of public ways, whose duty should be to advance education in this class of questions in every possible manner. To him the town and county road commissioners should be required to report. He should cause to be constructed a map showing the location and condition of all the roadways in the State. These ways he should classify as regards their condition. Our country folk wallow in the mire of their ways, pay excessive tolls, endure, in a word, a grinding taxation, generation after generation, without appreciating the burden which rests upon them." Professor Charles Sprague Smith of Columbia College will give, in the same number of the magazine, the result of his observations on the present condition of the Icelanders. He made an interesting journey to Iceland in the summer of 1888, during which time he resided with the dean of a diocese near Reykjavik, and made with him an interesting journey into the interior of the island.

—The *Political Science Quarterly* for September has an article on "Italian Immigration," which is of some importance at the present time. The author, Eugene Schuyler, has resided in Italy for three years past, and speaks from some personal acquaintance with the Italian people. The emigrants from Italy in 1888 numbered nearly two hundred thousand, of whom a large proportion came to the United States. Mr. Schuyler discusses the causes of the emigration, the chief of which is the difficulty of getting a living, and as to the character of the emigrants themselves expresses himself favorably. He admits that they are very illiterate, but thinks that they will prove a thrifty class and of good morals too. Another paper of some importance is by W. T. Moppin on "Farm Mortgages and the Small Farmer." Some writers, noticing the increase in farm mortgages in this country, have expressed the fear that the land was passing out of the hands of the small proprietors, who would eventually become an extinct class. Mr. Moppin combats this view, maintaining that the debts are incurred in order to make improvements on the farms or to stock new farms, and that they are in the end beneficial to the farmers. Mr. Clarence Deming treats of "Town Rule in Connecticut," showing the inequalities of representation in the legislature, the little town of Union, for instance, with only 118 voters, having as many repre-

sentatives as New Haven with nearly 18,000 voters. Besides these articles the *Quarterly* has the first instalment of an essay on "English Legal History," treating of the methods and materials of such history, and articles on "James E. Thorold Rogers," by W. J. Ashley, and on "Railroad Indemnity Lands," by Fred. Perry Powers.

—Ginn & Co. announce for publication "The Method of Least Squares," by G. C. Comstock, professor of astronomy in the University of Wisconsin, and director of the Washburn Observatory. This work contains a presentation of the methods of treating observed numerical data which are in use among astronomers, physicists, and engineers. It has been written for the student, and presupposes only such mathematical attainments as are usually possessed by those who have completed the first two years of the curriculum of any of our better schools of science or engineering. The principle of least squares is derived from the observed distribution of residuals in certain typical series of observations, and not from an assumed law of the causes of error, thus diminishing the mathematical difficulties usually encountered at the threshold of the subject. Especial care has been taken to apply all of the leading principles of the method to numerical data selected from published observations, and to give the computations in full, so that they may serve the inexperienced computer as models. It has been the author's purpose to so present the subject that a working knowledge of the method based upon an appreciation of its principles may be acquired with a moderate expenditure of time and labor.

—A book that is sure of a sympathetic audience is "Dante Gabriel Rossetti as Designer and Writer," by his brother William M. Rossetti, including a prose paraphrase of "The House of Life," which Cassell & Co. announce. The present is the only volume that William M. Rossetti has issued regarding his famous brother, though he has kept his memory green by several contributions to the magazines, one of them on the "Portraits of Rossetti," published in the *Magazine of Art*. In this volume the author has not attempted to write a biographical or critical account of Dante Rossetti. "Mine is a book of memoranda and of details," he says. A portrait of the poet at the age of thirty-five accompanies the book.

—On Saturday, Aug. 17, President Carnot received at a private audience in the Palais de l'Elysée, Paris, Dr. R. H. Thurston, director of Sibley College, Cornell University. Dr. Thurston has made a translation into English of the celebrated work of Sadi-Carnot, the great-uncle of the president, "Réflexions sur la Puissance Motrice du Feu,"—a work which had never before been translated into English, but which has become famous throughout the world as the basis of the whole structure of the modern science of thermodynamics. Published in 1824, it was comparatively unknown, until Sir William Thomson, the distinguished British *savant*, called attention to its enormous importance; and its author has thus become famous as the greatest genius which has appeared in that department of science during the nineteenth century. The president of the republic kindly consented that Dr. Thurston should dedicate to him his translation of this great work. The following is the very elegant phraseology which Dr. Thurston proposes to give to this dedication: "Dedicated to Sadi-Carnot, president of the French Republic, that distinguished member of the engineering profession whose whole life has been an honor to the profession and to his country, and who, elevated to the highest office within the gift of the French nation, has proven, by the quiet dignity and the efficiency with which he has performed his august duties, that he is a worthy member of his own noble family, already rendered famous by an earlier Sadi-Carnot, now immortal in the annals of science, and has shown himself deserving of enrolment in the list of great men, which includes that other distinguished engineer, our own first President, George Washington."

—Retail grocers, and other retail dealers doing a credit business, are adopting a plan that is at once novel and decidedly useful. They issue to their customers coupon books similar to mileage books for railways, but instead of the coupons being for one mile, they are for one cent each; the value of the books varying from two to twenty dollars. These coupons are good for their face value in groceries or other merchandise at the store of the firm issuing them. When the books are issued, the dealer charges

his customer with the value of the book. When pay-day comes the customer pays this amount, and meantime uses the coupons for the purchase of supplies, the same as paying cash, thus avoiding all disputed accounts and saving valuable time to both the dealer and his customer. They are manufactured by the Historical Publishing Company, of Dayton, Ohio.

— The October issue of *The Chautauquan* is the initial number of Vol. X., and appears in a new form and with a cover of new design. It presents the following in the table of contents: "The Politics Which Made and Unmade Rome," by President C. K. Adams, of Cornell University; "The Life of the Romans," by Principal James Donaldson, of the University of St. Andrews, Scotland; Macaulay's "Lays of Ancient Rome," paraphrased by Arlo Bates; "Map Quiz" on *The Chautauquan* Map Series; "The Study of the Seasons," by Professor N. S. Shaler, of Harvard University; "Child Labor and Some of its Results," by Helen Campbell; "Mental Philosophy," by John Habberton; "The Uses of Mathematics," by Professor A. S. Hardy, Ph.D., of Dartmouth College; "The Burial of Rome," by Rodolfo Lanciani, of the University of Rome. Professor La Roy F. Griffin explains the general principles of "Explosions and Exposives"; "Canada and Ireland; A Political Parallel," is discussed by Professor J. P. Mahaffy of Dublin University; "The Future Indian School System" is an article full of practical suggestions for improving Indian schools, by Elaine Goodale; Hon. S. G. W. Benjamin, ex-minister to Persia, writes entertainingly of "The Women of Persia"; Bishop J. F. Hurst tells much that is interesting about "The Current Literature of India"; "Impressions Made by the Paris Exposition" is a timely article, translated from the *Revue des Deux Mondes*. The list of contributed articles ends with the Rev. J. G. Wood's observations of "Some Odd Fishes."

LETTERS TO THE EDITOR.

* * *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.
The editor will be glad to publish any queries consonant with the character of the journal.
Twenty copies of the number containing his communication will be furnished free to any correspondent on request.

Methods of Burial.

THERE is one method of preserving the body that is well worthy of notice, and that has not received the attention that its importance demands. It is the desiccation of the remains, considered in a report on the disposal of the dead, by John M. Peacocke, M.D., presented to the Medical Society of the county of Kings, Brooklyn. Long before the Spanish conquest, the Peruvians were adepts in this mode of preserving the dead. The bodies of the Incas, and their queens and countless numbers of their subjects, testify to this. The interesting question is often asked whether the ancient Peruvians embalmed their corpses, or whether the bodies owe their good preservation to the influence of the climate, which is so conducive to mummification. Señor Rivero, the director of the National Museum at Lima, having examined hundreds of mummies, was unable to find any preservative substance in them. It is true that in the skulls a brown or blackish mass, in dust or small pieces, has been found; but a chemical and microscopical analysis has proved that the dust and the pieces were composed of cerebral fat and globules of dried blood. All the mummies contain the brain and intestines, and in none of them could Rivero discover any incision which would have been necessary for evisceration had the bodies been subject to embalmment. In the mummy of a child found by Dr. Von Schudi, and which is now in the Imperial Academy of St. Petersburg, the ribs of the left side were detached from the sternum, exposing the thoracic and part of the abdominal cavities, plainly showing the heart, with the pericardium, the shrivelled lungs, the diaphragm, the transverse colon, and portion of the small intestines. These facts prove that the Peruvians did not have recourse in the preservation of the dead to any elaborate process of embalming as customary among the Egyptians. The bodies were simply desiccated by exposure to the air. The heated soil and calcined sand on the coast dried the corpse, and the pure cold air and dry winds of the interior did the same thing.

In Peru the animals that drop by the wayside will be found at the end of months entire, not corrupted, but dried. On the highway from Arequipa to Lima a number of the mummified animals are to be seen, which serve as landmarks to indicate the road when the wind covers it with sand. The climatic conditions of the imperial city of Cuzco are very favorable to the desiccating process. Here, in the great temple of the Sun, the remains of the Incas have been discovered in a marvellous and lifelike condition. Cuzco, the most ancient city of Peru, has an elevation of 11,380 feet above the sea. Surrounded by lofty and snowclad mountains, it might be supposed to possess a cold, not to say frigid, climate; but its temperature, though cool, is seldom freezing. In what is called the winter season, from May to November, the pastures and fields are dry and withered, more from drought than from frost.

La Casas describes the Peruvian burial rites as follows: "The dead are wrapped in the skin of the llama, then clothed and deposited in a sitting posture. The doors of the tombs, which are all toward the east, are then closed with stone or clay. At the end of a year, when the body becomes dry, the doors are again opened. There is no bad odor, because the skins in which the bodies are placed are sewn up very closely, and from the cold they soon become mummies."

Travellers in Africa have found bodies of camels, which had evidently died of fatigue in the desert, to be so dried and preserved by the heat of the sun that no evidences of post-mortem decay were discovered. The atmosphere of our North-west Territories is, in some places, so dry that the snows of winter pass off from the ground without leaving it wet, and mummified buffalo have been found on the plains of Colorado. When freshly killed meat is subjected to a dry summer heat, it is rapidly converted into the well-known *jerked beef* of the plains. Dried apples, peaches, and other fruits are familiar examples to every housekeeper of desiccated vegetable matter. This method of preservation is as widely known as it is primitive, and clearly indicates that absence of moisture prevents decomposition of organic material, or, in other words, desiccation takes the place of putrefaction. X.

New York, Sept. 16.

Monopolies and the People.

In the criticism which you make (*Science*, xiv. p. 186) of the plan which I proposed for settling the railroad question, in my book "Monopolies and the People," I think you slightly misapprehend my views, as you say, "All fares and freight tariffs are to be fixed by the government commissioners." At the present time, in a number of the States of the Union, fares and freight tariffs are fixed by a State commission; and the provisions of the Interstate Commerce Law subject rates on all interstate traffic to the approval of the United States Government Commission.

My contention is that these rates should be fixed, not by a company, which holds a monopoly, or by a government commission, holding autocratic power. The one plan is unjust to the people; the other, to the railway-owners. The principle which seems to me the true one is, fix rates in proportion to the expense of carrying the traffic.

CHARLES WHITNEY BAKER.

New York, Sept. 14.

Queries.

48. ORIGIN OF THE COMMON NAME OF CROTALUS CERASTES. — Recently a naturalist friend residing in Santa Fé, N. Mex., begged to know of me the origin of the name "side-winder" for the horned rattlesnake (*C. cerastes*), and, although I have often heard that term applied to the crotaline species alluded to, I have never been able to ascertain how such a name came into use. The few persons versed in such lore to whom I have referred the matter could give no account of it, or state whether they knew of any particular habit of the horned rattler that would justify its being so called. Yarrow quotes the name in his "Check List of North American Reptilia and Batrachia" for the species in question, but, so far as I know, nowhere explains its origin; and I would be glad of any light upon this point.

R. W. SHUFELDT.

Takoma, D.C., Sept. 11.

Exchanges.

[Exchanges are inserted for subscribers free of charge. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

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Drawings from nature—animals, birds, insects, and plants—to exchange for insects for cabinet; or I will send them in sets of ten each for ten cents in stamps. My drawings in botany are in detail, showing plant, leaves, flowers, seed, stamens, pistils, etc.—Alda M. Sharp, Gladbrook, Io.

The undersigned wishes to make arrangements for the exchange of *Lepidoptera* of eastern Pennsylvania for those from other localities. All my specimens are named and in good condition.—Charles S. Westcott, 613 North 17th Street, Philadelphia, Penn.

California onyx for minerals and coins not in my collection.—W. C. Thompson, 612 East 141st Street, New York, N.Y.

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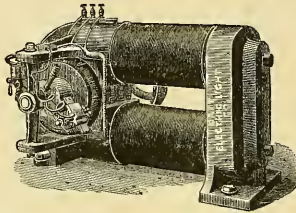
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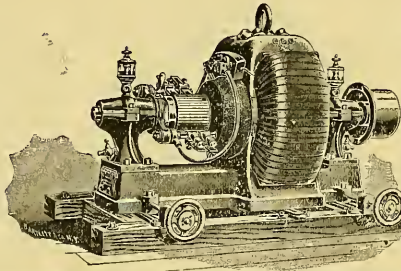
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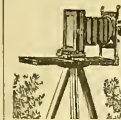
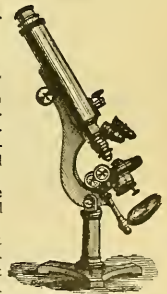
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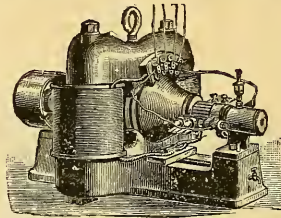
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CINCINNATI INCLINED-PLANE RAILWAY.

IN the accompanying engraving we give a view of one of the Sprague electric cars on the Cincinnati Inclined-Plane Street-Railway. This railway runs from the centre of Cincinnati to the foot of an incline, where the cars are hoisted on elevators to the top of the bluff which surrounds Cincinnati, and there run by means of electricity through the suburbs to the Zoological Gardens. This is the first electric incline installed in Cincinnati, and shows how successfully the street-railway problem in that city has been solved, and how a substitute for cable-roads has been gained. The view

three span wires are used, although the street is two hundred feet wide. This could only be possible with the light silicon-bronze trolley wire of the Sprague system, by means of which only a small portion of current is required to be carried from the centre of the street, while the greater portion is carried on main conducting-wires on the side of the street.

The equipment of this road includes twenty cars, all equipped with the Sprague improved electric-railway motor, and all the latest improvements adopted by the Sprague Company upon their most recent roads. It may be called one of the finest electric rail-



CINCINNATI INCLINED-PLANE RAILWAY.

given shows the car rounding the corner of Fifth and Walnut Streets ; the post-office being on the right, and Fountain Square on the left.

The style of poles used is shown by a single iron pole on the corner, and is a sample of the kind of poles used throughout the line. These iron poles are only four inches at the top, and are very much lighter and neater-looking than the ordinary electric-railway pole. In the residential district the streets are bordered with trees, so that the poles are completely covered, and by the casual observer cannot be seen.

On Fifth Street, just to the right of the poles shown in the engraving, there is a stretch of five hundred and fifty feet where only

ways in the country. The equipment is first-class throughout. The track is laid entirely of steel rails, and iron poles are used throughout the entire electric line. The employees of the road are all dressed in uniform; the men in charge of the motor having a band around their hats with the word "motorneer" inscribed, while the conductors are designated in an appropriate manner.

The president of this road is Mr. H. H. Littel, who is widely known in street-railway circles as one of the most successful street-railway managers in central United States. The general manager of the road is Mr. H. M. Littel, to whom the success of the road is in a great measure due.

TRANSMISSION OF POWER.

THERE is a new device for the transmission of power before the public which is attracting a great deal of attention. It consists in running a loose belt between two pulleys instead of the usual way

belt is loose. It is in this feature that it differs from all other frictions, and bases its claims for superiority.

We illustrate one application of this principle to the driving of dynamos directly from the fly-wheels of an engine. A great sav-

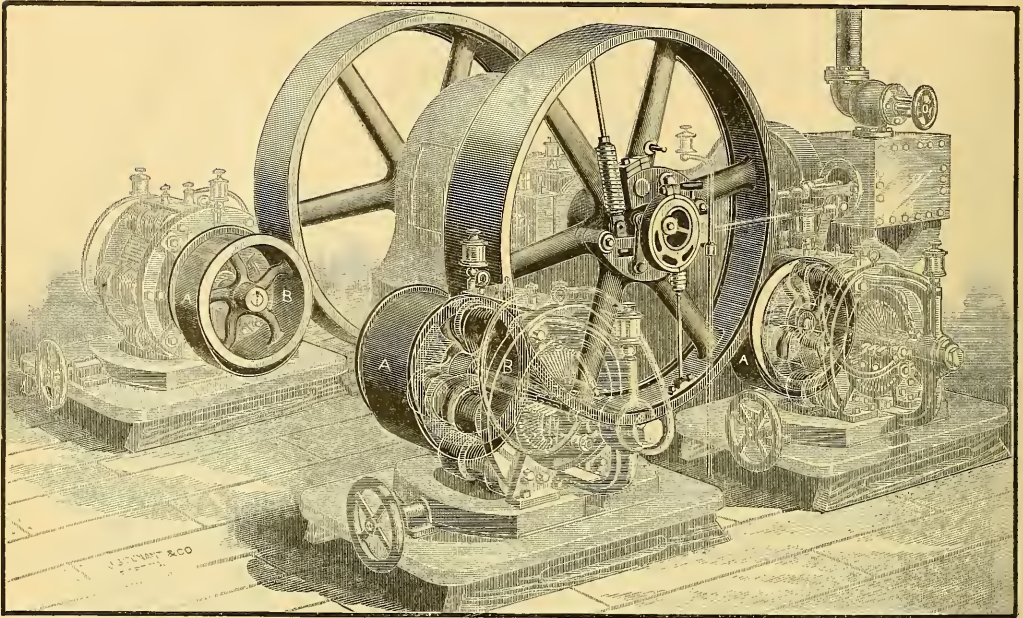


FIG. 1.—DYNAMOS DRIVEN BY MEANS OF EVANS FRICTION BELT.

of encircling the pulleys with a belt. Simple as this arrangement is, it is a very efficient method by which power can be transmitted from one shaft to another. The most remarkable thing about it is

ing in belting, room, and an appreciable saving in power, are among the advantages of this system, and an unusually steady light is produced.

The arrangement of this system is shown in Fig. 2, where C is a driving-pulley, which drives pulley D, through the medium of the belt. The friction of pulley C on the belt produces a tangential force in the direction of rotation. In a similar way, there will be a corresponding force acting in the opposite direction on the under side of the belt, due to the resistance of the driven pulley. These two forces constitute a static couple. The belt is free to act under its influence, and two things take place. The tendency to rotation will cause the pressure to be transmitted in an oblique direction, as shown. These two forces will also produce an upsetting or fulling action, which will thicken the belt, and create pressure enough to drive, after a slight pressure is first put on the belt.

Practical men will appreciate at once the advantage of having a simple and durable way in which they can start and stop one or more dynamos independently of each other, and this without slowing down the engine. This system has been in continual use in stations for some time, and has given universal satisfaction; and large plants which are being built in the vicinity of Boston are preparing to adopt this arrangement.

The same principle is applied by the inventors to the transmission of power from one cone to another, for the purpose of obtaining a variable speed. They have also attached a governor to the driven cone in special cases, where a steady speed is required from a source that is variable, and a very close regulation has been thus obtained. This is especially valuable for driving dynamos where water-power is used.

The patents which control these principles are owned by the Evans Friction Cone Company of Boston. The results of tests which they have made are very interesting. The method seems to be almost universally applicable to all places where power is used.

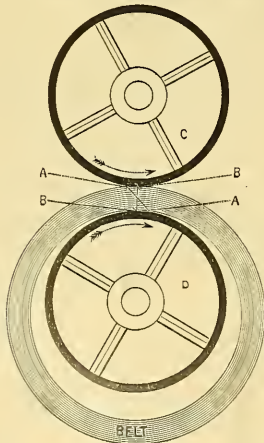


FIG. 2.—PRINCIPLE OF THE EVANS FRICTION BELT.

the fact that more power can be transmitted in this way, with less pressure on the bearings, than in the old way. This may seem at first sight to be unreasonable, but it can be fully demonstrated that this is a fact. It is said that this is owing to the fact that the

THE CAMEROONS DISTRICT OF WEST AFRICA.

At a meeting of the Geographical Society of Berlin, July 6, 1889, Capt. Kund gave a brief *résumé* of the results of the two expeditions led by him into the country lying inland from the Batanga coast, in the Cameroons district of West Africa, which is reported in the "Proceedings of the Royal Geographical Society." The opposition which the coast population offered to the entry of the expedition was only passive, but nevertheless very irritating. All kinds of stratagems, lies, deceptions, and false directions as to routes—of course to no purpose—were tried by them. It was owing to the calumnious reports spread by the inhabitants of the coast, that the expedition, as it penetrated farther into the interior, encountered hostility from the natives, who, made uneasy by the reports conveyed to them by traders from the coast, became fearful, as the white men approached, for their wives and stores of ivory.

The violent attack made upon the expedition by the Bekok, on the first return to the coast in the spring of 1888, rendered it absolutely necessary, in order that the prestige of the white man in these regions should be maintained, for the party to return again as soon as possible to that part of the country; for the news had spread far and wide that the natives had succeeded in killing the white men, and in destroying the expedition. The re-appearance of the supposed dead men was consequently a great moral success, and the second advance presented hardly any difficulties. Among many tribes the expedition was even received with songs and dances, and everywhere the suspicion that the expedition had come for the purpose of taking vengeance quickly disappeared. Capt. Kund, on this occasion, announced most emphatically that nothing was further from his intentions than to take any unfair advantage of the natives, that he had left no stone unturned in order to convince them of his peaceable intentions, and that the first shot had never been fired from his side. It was continually the want of interpreters which caused the complications in which on different occasions he became involved with the natives.

Although the second journey resulted in little that is new from a geographical point of view, inasmuch as the route followed differed in unimportant points from that taken on the first occasion, still the detailed knowledge of the country was considerably increased, and a much more complete insight into the ethnographical conditions of the region was obtained. Thus the expedition became acquainted with a race of people, which, on the first journey, had remained quite unknown. The inhabitants of the primeval-forest region are of remarkably small stature, although not dwarfs, and are yellow-skinned. They roam through the forests without having any fixed abodes, and live by the chase. These people appear to represent the aborigines of the country, who were the first to make paths in the virgin forest. They call themselves the Bojaëli, but are named Baiea by the other tribes. They kill elephants with spears, and possess extraordinary skill in finding their way through the dense forest.

The ethnographical features of the southern Cameroons territory, between the Sannaga and the Campo, are, according to the present state of our knowledge, as follows. Between the Sannaga and the Njong dwell the important group of the Mvèle (Bakoko), who are very unequally distributed through the region of primeval forest as far as the coast range of mountains. The coast itself is here uninhabited. South of the Njong, the Banoko and Bapuko (the so-called Batanga people) live on the coast. They have probably come here from the north. In the rear of them dwell the Kasjua, called by the Batanga people Mabea. They belong to another race, and have probably immigrated from the south. The inhabited part of the coast is, with the exception of the banks of the Njong and Lokundje, where narrow belts of population—on the former the Bakoko, and on the latter the Kasjua and Bakoko intermingled—extend into the interior, nowhere broader than about nine miles. Then follows the uninhabited region of primeval forest, about one hundred and twenty miles broad, in which only the Bojaëli live. In the valleys of the first steep mountain-range the Ngumba live. They call themselves Mavumba, and are closely related to the Kasjua, having probably in the same way immigrated hither from the south. In the north they border at the Lokendje River, on the Batoko; in the south, on the Bulei. The latter belong to the Fang

group, and have pushed their way along the right bank of the Ntembe (Campo River) almost as far as the coast. They embitter the lives of the Ngumba people by constant attacks. East of the Ngumba territory, the country for a stretch of about forty-five miles is again uninhabited, and it is here that the second steep ascent to the great plateau of the interior of Africa commences. The plateau itself is extraordinarily densely populated, and by people closely related in their language to the Fang (Mpangwe, the Fans of Du Chailla) on the Ogowé. Some porters belonging to the latter race accompanied the expedition, and they very quickly learned to make themselves understood by the people of the plateau. The sequence of tribes from the left bank of the Sannaga is as follows: the Jetoni, Botinga, Kollé, Jetudi, Jeundo, Bane, Tinga, Baba, Janguana, and Bulei in the south. The Jeundo and Tinga are distinguished in the most favorable manner from the peoples living farther west. They are of remarkably tall and slim stature, are well nourished, and thoroughly healthy. Their features are, in the case of both sexes, extraordinarily regular. They have a marked tendency to harmless gayety and dancing. The men wear round the loins a piece of bark cloth. It is peculiar that the women for covering their back parts use large bunches of grass threads colored red-brown, while their front parts are barely concealed by a banana-leaf. In the midst of this interesting people, at a point situated about $3^{\circ} 48'$ north latitude and about 12° east longitude, and close on the boundary line between the Bantu and Sudan negroes, the expedition erected their station, at which Lieut. Tappenbeck is at the present time stopping alone.

SPRAYING WITH THE ARSENITES.¹

NINE years ago, at the first meeting of this society, I presented a paper upon the use of Paris-green as a specific against the codling-moth. In that paper I gave the results of careful and elaborate experiments, which settled two facts which were very important in economic entomology,—first, that Paris-green was efficient as a preventive of the ravages of the codling-larva; and second, that such use was entirely safe in respect to poisoning the fruit. To-day, less than a decade from the date of the discovery of this remedy, this method to combat the worst insect-pest of the apple-grower, is generally adopted by the more intelligent orchardists of our country. Its value is now universally conceded. Easy and cheap methods to apply the insecticide are now known and generally adopted.

For several years myself and others have been experimenting, in hopes to find that this same insecticide was equally efficient to destroy the plum curculio. For six or seven years I have sprayed plum-trees once, and even twice, with no apparent good. Test-trees close beside the trees sprayed, and that were not treated, were as free from attack as were the trees that were sprayed, and the trees treated were no more exempt from attack than the others. Thus I was convinced that this insecticide was of no value in this curculio warfare. Several of my horticultural friends, in whose ability to experiment and observe correctly I had great confidence, had tried this remedy with very satisfactory results. In 1888 I studied this matter very closely, and concluded that as the plum is a smooth fruit, with no calyx-cup, like that of the apple, in which the poison may lodge, and as the curculio lays its egg anywhere on the smooth rind, the poison would be very easily washed off, or even blown off by the wind. I thus concluded that my want of success was very likely due to a want of thoroughness. In 1888 I sprayed certain trees three times at intervals of eight days, and omitted to treat other trees close alongside. The benefit from spraying was very marked.

I also found that carbolic plaster (one pint of crude carbolic acid, to fifty pounds of plaster) was quite as efficient to repel the curculio as was the arsenites. This was also applied three times. The season was very dry, and there were few or no rains to wash off the insecticides. This year I repeated the experiments both with the London-purple and with the carbolic plaster, but with no success. All the trees were severely attacked, and all the plums lost. This year we had almost daily rains, which were frequently quite severe.

¹ Abstract of a paper by A. J. Cook, read at Toronto, Aug. 26, before the Society for the Promotion of Agricultural Science.

I believe I am warranted in the following conclusions: the arsenites and carbolized plaster will protect against the plum curculio if they can be kept on the tree or fruit; but, in case of very frequent rains, the jarring method will not only be cheaper, but much more effective. Again: as our wild fruits are more cleared away, we must have plums in our orchards to protect the apples from the curculio. When apples are seriously stung, they become so gnarled and deformed as to be worthless. It will pay, then, to set plum-trees near by or among the apple-trees. Then we will escape mischief among our apples from the curculio, and will only need to spray our apples once to destroy the codling-moth, and can treat the plum-trees three or four times with Paris-green or carbolated lime, in case we have only occasional showers, or can jar the trees when the rains are very frequent. For the apples we can use London-purple (one pound to two hundred gallons of water); for the plums we must use Paris-green (one pound to two or three hundred gallons of water). If the carbolated plaster is preferred, we use one pint of crude carbolic acid to fifty pounds of land-plaster. This is thrown freely over the trees, so as to strike every plum on the tree which is being treated.

Another very important practical point has been suggested by the past season's experience with these insecticides. I refer to the danger of applying them before the blossoms fall. Bees are quite as susceptible to these poisons as are the codling-larvæ and curculio. In their good work of collecting nectar and fertilizing the blossoms, they are very certain to take the poison as well, if the trees have been sprayed. Of course, there is no excuse for spraying at so early a date, as neither the curculio nor codling-larvæ commence their attack till the blossoms fall. Thus for the object in mind, as well as for the safety of the bees, delay should be insisted upon. I think we as scientists, and all educated men, should pronounce vehemently and with one voice against spraying our fruit-trees with the arsenites till the blossoms have all fallen. We should even go further: we should secure the enactment of laws which would visit any such offence with fine and imprisonment. Such laws would prove a ready and active educator.

In the past season many bee-keepers have lost severely from the neglect of their fruit-growing neighbors to observe this caution. I will only mention two cases. Mr. John G. Smith, Barry, Ill., writes, "One of my neighbors, owning an orchard of about one hundred acres of apple-trees, sprayed the trees with Paris-green and water just as they were in full bloom. The result is that ten or twelve bee-keepers are ruined." The imago no less than the larvæ and pupæ were destroyed. Mr. J. A. Pearce, Grand Rapids, Mich., was also a heavy loser from the same cause. His bees likewise died in all stages of development.

It is well to remember and to urge that this loss is not confined to the bee-keeper, for the fruit-grower as well as the apiarist needs the bees and their work to insure his best success. It only requires, then, that our people know the truth, to insure against loss in this direction.

Another practical question of no small moment in this use of the arsenites refers to injury to the foliage of the trees treated. In an elaborate series of experiments the past season, we desired to learn the effect on different trees of the different arsenites, and whether the date of treatment and atmospheric condition had any influence. From these experiments I think we are warranted in the following conclusions:—

First, London-purple is more injurious to the foliage than is Paris-green, and white arsenic (arsenious acid) is more harmful than is either London-purple or Paris-green. This is doubtless owing to the soluble arsenic, which is quite abundant in London-purple, and almost absent in Paris-green. In one experiment it was seen that the colored water after London-purple fully settles is very destructive to foliage, while aniline is not at all harmful. This agrees with the experiments of Professor C. P. Gillette, made in 1888, where white arsenic was found very destructive to foliage.

Second, Peach foliage is especially susceptible to injury, and cherry foliage the least so of any of the kinds treated.

Third, It would seem that London-purple and white arsenic, used just before a rain, are more harmful than when used during a drought. We not only saw greater injury when a rain followed spraying within two or three days, but secured the same results by

spraying, soon after treatment, with pure water. This also accords with the view that the injury comes from the presence of soluble arsenic.

Fourth, It would seem that spraying soon after the foliage puts out is less harmful than when it is delayed a few days, or, better, a few weeks. For ten years I have sprayed both apple and plum trees in May, and for several years with London-purple, and often used a mixture as strong as one pound to one hundred, or even fifty, gallons of water; yet in most cases no damage was done. This year I sprayed several trees in May, using one pound to one hundred gallons of water, with no damage. In June and July, spraying the same trees with a mixture only one-half as strong did no slight injury. This fact, if fact it be, accounts for the few reports of injury in the past, even with a stronger mixture, and the frequent reports of damage within a year or two, even with a dilute mixture. Then the spraying was confined⁶ to May: now it reaches to June, or even to July.

Fifth, London-purple may be used on apple, plum, cherry, pear, and most ornamental trees, but on these should never be stronger than one pound to two hundred gallons of water. If the application is to be repeated, as it must be for the curculio, to prove effective, or if it is to be used in June or July, Paris-green should be used in the same proportion as above, or else we should only use one pound of London-purple to three hundred gallons of water. I now think that this necessity is more due to time of application than to the fact of increased quantity of the poison.

Sixth, If the arsenites are to be used on the peach to defend against the curculio, Paris-green only should be used, and that not stronger than one pound to three hundred gallons of water. With the peach the poison is not only absorbed, coloring the tissue purple or brown, but even the petiole or stem of the leaf is weakened, and the leaf falls. Thus in several cases where we used London-purple (one pound to two hundred gallons of water) or white arsenic, the peach-leaves all fell off. White arsenic colors the tissue the same as does the London-purple, showing once more that it is the soluble arsenic, not aniline, that does the mischief.

Seventh, The injury done to the foliage is never immediately apparent. It usually shows somewhat the second day; but the full injury is frequently not manifest till the fifth day, and often not till the tenth.

Another important practical question which I have tried to settle this season (1889) concerns the danger of pasturing under trees which have been sprayed with the arsenites.

A gentleman wishing to spray his orchard, in which he was pasturing seventy-five hogs, consulted me as to the wisdom of doing so without first removing the swine. I told him I believed there was no danger. I said, "Use a mixture of one pound of London-purple to two hundred gallons of water, watch your hogs closely, and, if any seem affected, remove all at once, and I will be responsible for damages to the amount of twenty-five dollars." The gentleman did so, and reports no damage.

In the following experiments I used the mixture of twice the strength which should be used, that the experiment might be the more convincing. I used one pound to one hundred gallons of water. In every case the spraying was very thoroughly done. Care was taken that every twig and leaf should be drenched.

In tree No. 1 a thick paper was placed under one-half of a rather small apple-tree. The space covered was six by twelve feet, or seventy-two square feet. The paper was left till all dripping ceased. As the day was quite windy, the dripping was rather excessive. In this case every particle of the poison that fell from the tree was caught on the paper. Dr. R. C. Kedzie analyzed the poison, and found four-tenths of a grain. Tree No. 2 was a large tree, with very thick foliage. Underneath this tree was a thick carpet of clover, blue-grass, and timothy just in bloom. The space covered by the tree was fully sixteen feet square, or equal to two hundred and fifty-six square feet. As soon as all dripping had ceased, the grass under the tree was all cut very gently and very close to the ground. This was taken to the chemical laboratory and analyzed by Dr. R. C. Kedzie. There were found two and two-tenths grains of arsenic. Now, as our authorities say that one grain is a poisonous dose for a dog, two for a man, ten for a cow, and twenty for a horse, there would seem to be small danger from pasturing our

orchards during and immediately after spraying, especially as no animal would eat the sprayed grass exclusively. To test this fully, I sprayed a large tree over some bright tender grass and clover. I then cut the clover carefully, close to the ground, and fed it all to my horse. It was all eaten up in an hour or two, and the horse showed no signs of any injury. This mixture, remember, was of double the proper strength, was applied very thoroughly, and all the grass fed to and eaten by the horse. This experiment was repeated, with the same result. I next secured three sheep. These were kept till hungry, then put into a pen about a tree under which was rich, juicy June-grass and clover. The sheep soon ate the grass, yet showed no signs of any injury. This experiment was repeated twice, with the same result. It seems to me that these experiments are crucial, and settle the matter fully. The analyses show that there is no danger: the experiments confirm the conclusion.

Thus we have it demonstrated that the arsenites are effective against the codling-moth; that in their use there is no danger of poisoning the fruit, and, when used properly, no danger to the foliage, nor to stock that may be pastured in the orchard.

PLANT-LIFE OF ARABIA FELIX.

PROFESSOR SCHWEINFURTH, at a recent meeting of the Berlin Geographical Society, spoke of his journey to Arabia Felix, undertaken from November, 1888, to March, 1889, with the object of making botanic-geographical studies. Stimulated by a journey of the French botanist, A. Defflers, in the year 1888, Schweinfurth determined to make one of the chief objects of this journey to Yemen the obtaining of authentic specimens of a large number of the species of plants described by the Swede, Peter Forskal, the botanist of the Niebuhr expedition (1761), who, when barely twenty-seven years old, fell a victim to the climate after much ardent activity in exploration. For what reason the scientific world, considering the complete opening-up of this ancient land of civilization, has deferred so long the exploration of the country, it is difficult to understand; since Yemen, not only since the recent taking-possession of the country by the Turks, but for a long period, has been distinguished, above all other parts of South Arabia, for the safety of travel and the well-tested courtesy of the inhabitants towards Europeans. Several plants, useful to man and cultivated by him, have, through the medium of South Arabia, found their way to the civilized countries of the north. Some, like coffee, appear to have been converted here for the first time from their natural state into the service of man. In ancient times there were in the first place various fragrant substances exported from here. On that account the country was named, from the oldest dynasties of the Pharaohs down to the later Roman period, the holy land, the land of the gods. The Punt country of the old Egyptians is surely not only to be looked for in Africa, but denotes in the wider sense the territory on both shores of the southern part of the Red Sea. The designations "stair" mountain and "step" mountain, both in the old hieroglyphics as well as in Ptolemy and in the works of Arabian geographers, Yakut and Hamdany, refer especially to the terraced cultivated slopes of South Arabia, constructed with such a large expenditure of labor, while they possess no meaning if applied to the Somali country. The ancient Egyptians took special care of certain trees, which were dedicated to particular deities. Thus the sycamore-tree was consecrated to Hathor. From the oldest tombs found in the Pyramids, and belonging to the fourth dynasty, down to the latest lists of offerings of the Ptolemaic-Roman epoch, the fruit of the perseæ (*Mimusops schimperi*), the "aschd," appears as a continually recurring gift to the gods and to the departed. The tree was regarded as specially sacred, and was dedicated to the greatest god, Ré, the sun, and on numerous occasions the leaves and fruit of both trees have been brought from the tombs to the light of day. The foreign origin of the tree called *Perseæ* in the Grecian authors, not to be confounded with the *Perseæ gratissima* of to-day, as coming from Ethiopia, by which term Abyssinia as well as South Arabia may be understood, is attested by Strabo and Diodorus, and confirmed by the present widespread existence of wild-growing species. For several centuries the tree has entirely disappeared from Egypt. On the other hand, the sycamore, al-

though only in a cultivated state, is still to be found in Egypt and certain parts of Syria. Schweinfurth has now discovered in Yemen in numerous places fig-trees, in the case of which he has proved botanically that these trees, called in the mountainous country *chanes*, and in the lowlands *birra*, are completely identical with the Egyptian sycamore. At the same time the traveller found, in the lowest mountain regions of Yemen, the *Perseæ* of the ancients growing wild; and it was there designated with the old Arabic name *lebbach*, which was known to the Arabian geographers of the middle ages. The *Mimusops schimperi* was formerly only found in North Abyssinia. With the disappearance of the tree in Egypt, for the protection of which the Emperor Arcadius made a special law, which is still preserved, there disappeared in later Egypt also the proper meaning of the name *lebbach*; and at the commencement of the last century the term was transferred to a species of acacia (*Albizia zebbelli*) introduced from India, which is to-day the most widely spread tree in Egypt. In connection with the traditions inscribed on the ancient monuments, the fact that in Yemen to-day there are still species of trees growing wild, which several thousands of years ago and during a period of three thousand years were held in Egypt to be sacred as symbols of divine worship, throws important light upon the old relations subsisting between the two countries.

HEALTH MATTERS.

THE INHALATION OF DUST.—Dr. Kunze, in his inaugural thesis for the M.D. degree of the University of Kiel, publishes as a contribution to the diseases caused by the inhalation of dust a series of examinations of lungs so affected. In all these, as stated in a recent number of the London *Lancet*, dust was found microscopically; and, after chemical tests in the various anatomical and histological parts of the lungs and in the interior of the lymphatic vessels, numerous leucocytes were found covered with the dust. Being arrested in its progress, it causes inflammation, producing hyperplasia of connective tissue, especially where a dense network of lymphatic vessels exists. Dr. Kunze also proved that the degree of alteration in so-called "dust lungs" depends not merely on the quantity of the dust inhaled, but also on its greater or less morphological power of injuring the tissue. He concludes from his experiments that even the greatest alterations in these lungs—such as nodes, indurations, and vomice—are mainly produced by the inhaled dust, and that tuberculosis is only an occasional coincidence. The least serious alterations in the lungs resulted from the inhalation of lamp-black, the particles of which are very fine and little injurious; the most serious, from the dust inhaled by earthenware manufacturers and stone-masons. The lungs of a locksmith showed only a moderate hyperplasia of connective tissue, the dust consisting partly of the finest particles of iron. In a worker in oxides of iron the lungs were found full of small granules, and the morbid changes in the tissues were very considerable. The lungs of gold-miners were generally indurated and atrophied; the dust in these cases is exceedingly fine. Sand produced numerous circumscribed hard nodules and thick indurations. In cloth-manufacturers, the lungs, in spite of their contact with an enormous quantity of organic dust, presented but few indurations. In the lungs of two stone-masons, induration and tuberculous disintegration were observed: all the other lungs were entirely free from tubercles of any kind,—an observation which was verified by the absence of tubercle bacilli in the muco-pus in the vomice.

CONGRESS FOR TUBERCULOSIS.—The second congress for tuberculosis will be held in Paris during the latter part of July, 1890. Professor Villemain will act as president. The following questions are to be discussed: 1. The identity of human and bovine tuberculosis, also that of other animals; 2. The bacteriological and morbid associations of tuberculosis; 3. The isolation of tuberculous subjects; 4. The agents capable of destroying Koch's tubercle bacillus, with a view to the prophylaxis and therapeutics of the disease in man.

MEDICINE IN JAPAN.—In Japan there are thirty-one schools of medicine, one of dentistry, and two of veterinary surgery. The University of Tokio (the Imperial University) has over twelve hun-

dred students, and an average of one hundred medical students graduate yearly. In Tokio alone there are numerous active medical societies and over twenty hospitals.

RUSSIAN STUDY OF INFECTIOUS DISEASES.—An institute has been founded in St. Petersburg for the experimental study of infectious diseases and for prophylactic inoculations. The institute is to be under the charge of Professor B. Anrep.

FRENCH AND GERMAN TOBACCO.—The *Progrès Medical*, July 13, 1889, gives a brief account of the international congress to protest against the abuse of tobacco, which was recently held in Paris. M. Ortolan made the interesting statement that the proportion of nicotine in tobacco is less when the stalks grow close together, and when the leaves are numerous and placed very low upon the trunk. This is the reason, he said, why the German, who smokes more than the Frenchman, poisons himself less. In the former country tobacco-growing is free, whereas in France it is regulated by the government, and the number of leaves to the stalk is limited. French tobacco, he said, contains as much as six per cent of nicotine.

JELLY-FISH STING.—Bathers who have encountered the long tentacles of a medusa will be pleased to know, says *Medical News*, that the "sting," or erythema, may be speedily relieved by the application of water rendered alkaline by common washing-soda, in the proportion of an ounce of soda to about two quarts of water.

THE DANGERS OF CARBOLIC ACID.—The following letter of Dr. Th. Billroth of Vienna has been published in the *Lancet*: "I have lately seen four cases in which fingers which had suffered a most insignificant injury became gangrenous through the uncalculated application of carbolic acid. Carbolic acid is now much less used in surgery than formerly. We have only gradually become acquainted with its dangers. The acid may not only cause inflammation and gangrene, but also blood-poisoning, and so may even prove fatal. It is useful only in the hands of a skilful surgeon, and ought never to be used without his advice."

VENTILATION IN ICELAND.—The extreme cold of the winter in Iceland reduces the system of domestic ventilation in that country to very primitive principles. A traveller there was so choked one night by the close atmosphere of the air-tight little chamber in which he slept, with all the male members of the family, as to be compelled to wake his host, who sprang out of bed at the call, pulled a cork from a knot-hole in the wall for a few minutes, and then, replacing the cork with a shiver, returned to bed.

LEPROSY IN HAWAII.—It is estimated that there is one leper to every forty of the inhabitants of the Sandwich Islands. Speaking of leprosy, *Medical News* states that a Chinese leper was recently discovered in the Sacramento jail. He had been sent there for refusing to pay a poll-tax.

FREEDOM OF AIR FROM GERMS.—Dr. Le Fort says that microbes are never conveyed in the air, but only by contact with the fingers, instruments, etc.

CHOLERA.—Two cases of cholera, one of which terminated fatally, are reported to have occurred in Hungary. Cholera has appeared also in Mesopotamia, as shown by the following despatch, published in the Marine Hospital Service *Bulletin* under date Sept. 13: "Cholera, since July 27, made its entry into Mesopotamia in as mysterious a manner as it made its appearance into Egypt in 1883. It is certain that it penetrated from Bombay *via* Bassora; it could not as yet be determined how, perhaps (as in Egypt) through Arabian stokers (firemen), who are employed on the English steamers of the Bassora-Bombay line, and who, upon their arrival at Bassora, go to their homes. At first cholera appeared at Schatra (3,000 inhabitants), two and a half days' journey from Bassora, at the Schatel-Hay Canal, which connects the Tigris with the Euphrates River. In a few days, from July 27 to Aug. 6, 308 persons died. On the 1st of August it appeared at Naszie (8,000 inhabitants), southerly from Schatra, near the embouchure of the Schatel-Hay into the Euphrates, — a city which was founded in 1872 by Natir Pacha, the Montefik sheik. From the 1st to the 9th of August, 293 deaths occurred, on the 8th of August so many as 85. The houses are

situated upon the flat marsh-land, and are only reed huts. The inhabitants carry on the culture of rice and some cattle-raising. It finally made its appearance at Bassora on Aug. 6, and at first an Arabian girl died who had come there ten days before from Filie in Persia. On Aug. 9, 15 deaths occurred there. The reports of Gazzala, the sanitary physician, do not allow any doubt to arise as to the diagnosis."

MENTAL SCIENCE.

Experiments upon Association of Ideas.

In *Mind*, No. 54 ("Mental Association Investigated by Experiment," by J. McK. Cattell and Sophie Bryant, D.Sc.), is printed an account of experiments upon certain very usual mental products, which commands interest not so much for the intrinsic value of the results obtained as for the suggestiveness of the inquiry that it opens up. An association as ordinarily studied begins with the perception of a written or spoken word, includes the calling-up of another idea by the first, and ends with the expression of the associated word by mouth or pen. The characteristic element in the process is the central one, while the perception and the expression factors have a somewhat mechanical rôle to play, and must be eliminated in the study of the association process *per se*.

The two aspects of association studied in the present research are (1) the time taken up in mental association, and (2) the nature of the association. The difficulty in studying the former is that the time taken up by perception and expression is not absolutely separable from the association time, the two processes in part overlapping. In experiments specially designed to study the perception and expression times, it was found that it takes about half a second to see and name a word, so that approximately the difference between the entire time and half a second will be the association time. The same 20 nouns were used with about 500 observers, and 6 observers answered to groups of about 250 words. Former experiments in which it was possible to eliminate the mechanical elements had shown that it took Dr. Cattell, on the average, .380 of a second to make an association with a concrete noun, and .508 of a second with an abstract noun; the time for an association with a verb being intermediate, .465 of a second. The abstractness of the word renders the association process difficult, this being especially evident in extreme cases. Thus, to make the association *deliverance-hope* required 1.453 seconds; *civilization-wilderness*, 1.064 seconds; while the quickest associations were *good-bad* (.111 of a second), *father-mother* (.132 of a second), and the like. Individual variation regarding the time of association is of course large, and the stage of mental development is an equally important consideration. It was found that the boys in an upper class of a German gymnasium took considerably less time to respond with associations to a given series of words than the boys in a lower class.

A somewhat different method of investigation consisted in giving simply the first word, and asking the subject to write as many suggested words as possible within 20 seconds. From this the average association time (including the very long writing time) can be calculated. This was tried with four forms of a London girls' school, with a Dublin girls' school, with some students of Bryn Mawr College, and with some London and Irish graduates. A very distinct shortening of the time accompanies the advance in form. When the average age of the pupils was 12.7 years, the average time for concrete nouns was 6.9 seconds; at 14.8 years it was 4.76 seconds; at 16.3 years, 4.26 seconds; at 17.8 years, 3.7 seconds. The corresponding time for the Bryn Mawr collegians was 3.51 seconds. The associations with abstract words require constantly more time than with concrete words, but this difference diminishes as the mental development progresses. Furthermore, the last class-rank bears a relation to rapidity of association, the highest pupils showing a quicker time, though this relation is only a general one. Some words more readily call up a series of words than others. Fatigue and a variety of factors also enter to influence the association times, but their relative worth is not affected by these disturbances.

Turning to the nature of the association, we are at once struck by the frequency with which a word suggests the same word to the minds of different persons. Four hundred and sixty-five per-

sons were given each of the following ten concrete and ten abstract words, and were required to name a suggested idea as quickly as possible; viz., *house, tree, ship, chair, clock, bird, shoe, hat, child, hand, and time, courage, form, virtue, art, love, strength, part, beauty, number*. Of the 4,650 "concrete" words, the ten words most frequently suggested by the ten given words form no less than 1,210, or more than one in every four. Two hundred and nineteen (or nearly one-half) responded with *finger* to the word *hand*, and 212 responded with *leaf* to the word *tree*: of the 4,650 words associated with the ten abstract words, the ten most frequent associations amount to 760 occurrences, or one in six; the most frequent associations being *good* or *goodness* with *virtue* (127 times), and *painting* with *art* (115 times).

An analysis of the associating processes here involved shows that in part they harmonize with the ordinary laws of association, but in part necessitate an extension of their interpretation. Dr. Cattell, regarding *contrast* as a variety of *similarity*, makes the latter and *contiguity in space and time* the two fundamental types of association. The latter associations are given us ready-made by sensation, and so may be termed objective or outer associations, while *similarity* may be displaced by logical associations. The *objective* are subdivided into *co-existence* and *succession*; the *co-existence*, into *co-ordination, whole to part, and part to whole*; the *succession*, into *forwards and backwards*. Again, the *logical* are either cases of *specification* or *causation*. The former, again, are either cases of *correlation, specialization, or generalization*; the latter, *final* or *efficient*. These classes are not natural kinds, nor does every association fall unambiguously into one class; but they call attention to real classes, and serve as a starting-point for further investigation. Associations occur that only by straining fall into any of the classes, associations by sounds of words (alliteration, rhyming) being an important example of these. From the tables printed in their essay, the authors conclude that with concrete nouns the link is "not quite as often supplied by thought as by sensation." *Whole to part* and *specialization* are very much more frequently used than *part to whole* and *generalization*. A comparison of the associations made by the writers and two other professional persons with those made by the pupils of several schools shows that "logical and verbal associations are favored by the first four observers, who teach and write. With the students, *whole to part* is the favorite category; they seem to visualize the object and name some part of it. . . . The largest proportion of logical associations was made by E and C, who are engaged in abstract studies." The word itself often suggests the special kind of association. Thus, "*tree and hand* are natural objects which are easily pictured, and have parts (leaves and fingers respectively) readily named. With *child*, on the other hand, *specialization* was the favorite category. Final cause was the largest class in the case of *clock*, a thing made and used for the special purpose of measuring time. Conversely, *time* often suggested the means of its measurement. Of the other abstract nouns, *art* and *number* were commonly specialized, while *courage* and *love* most frequently suggested a similar or contrasted idea."

In all such experiments the subject himself, by going over his experience just after the association, can recover the lost links which the mere statement of a word and its association would neglect. A few very suggestive appendices, founded upon such introspections, are given, that show how very complicated the associative process may be, and how very cautiously one must proceed in the discussion of them. However, these uncertainties do not seriously vitiate the value of experimental studies, and it is only by such studies that a practical insight into our mental processes can be gained. The ease with which association studies can be made should lead one to expect many valuable contributions in the near future.

THE MENTAL POWERS OF THE CHIMPANZEE. — The female chimpanzee in the Zoological Gardens at London, says *Nature*, has recently been made the subject of experiments by Dr. G. J. Romanes, that shed interesting light upon animal psychology. The general intelligence of the creature is very high. She understands a great many words, is ingenious in her play, and gives expression to her feelings in a variety of ways. If, instead of being constantly

exposed to the distracting influences of an inquisitive public, she were carefully reared, Dr. Romanes suggests that a higher degree of mental development might be expected. The experiments began by asking the chimpanzee to hand out one, two, or three straws from her cage. If the wrong number of straws was given, they were refused; but, when the action was correct, she was rewarded with a piece of fruit. The straws were taken one by one, and held in the mouth until the requisite number was gathered. She soon learned to associate these three names with the number of straws, and unfaithfully gave the right number. Then *four*, and later *five*, was added to her vocabulary. Her keeper has attempted to teach the chimpanzee to count up to ten, but with only partial success. She rarely mistakes numbers up to five, and, when asked for seven, eight, nine, or ten, understands that this means "more than five;" but the accuracy of her count does not extend further than this. Dr. Romanes thinks it possible that the creature's patience may be exhausted in these high numbers, since she has to collect the straws one by one. As evidence of this, the creature has been observed to double a straw and offer it as two, thus showing a knowledge of multiplication. The mechanism of this process is hardly that of notation, but simply the appreciation of sense-impressions such as we see in a child and in savage people. Tribes to whom "more than five" is ascribed in an indefinite "many" have been observed. Dr. Romanes has also attempted to teach the chimpanzee the names of colors by holding out two straws of different colors, and requiring her to select the color named. She learned to distinguish the white straw from any other color, but never went further. Dr. Romanes sees no reason why this distinction should be easier than any other, and so regards the failure as probably due to color-blindness.

NOTES AND NEWS.

LOCOMOTIVE engineers are inclined, it is said, to obesity.

— Gum-chewers' paralysis is the latest form of professional neurosis recorded in medical literature.

— The chemists of the United States Agricultural Department are about to begin the work of investigating the different artificial foods and infant foods now on the market.

— The will of John W. McCoy, who died in Baltimore recently, contains a bequest of \$100,000 to the Johns Hopkins University. He also gives his library to this institution.

— The following appointments are announced at Clark University: Professor Arthur Michael of Tufts College, professor of chemistry; Professor J. Playfair McMurrich of Haverford College, docent in biology; Dr. Franz Boas, docent of the University of Berlin, docent in anthropology; B. C. Burt of Michigan University, docent in historical psychology; Professor Alfred Cook of Bryn Mawr College, docent in psychology; Dr. Arthur McDonald, docent in psychology; Professor Herman C. Bumpus of Olivet College, Michigan, fellow in biology.

— The English Silk Association is arranging to hold in London, next spring, an exhibition of the silk manufactures in the United Kingdom and Ireland. In order to place before the public the capabilities of the home industry for supplying its requirements, it has been decided that the exhibition should contain specimens of various branches, consisting, among others, of broad and narrow silk fabrics, including poplins, etc.; also lace, embroidery, silk hosiery, costumes, fans, trimmings, sewing and embroidery silks, twists, cords, etc.; thrown silks, Indian and British colonial raw silks, etc.; exhibits illustrative of the growth of silk, of the processes of manufacture, and of the printing, dyeing, and finishing of silk; various silk handicrafts in operation; industrial and decorative design as applied to silk fabrics.

— The recently published statistics of criminality in Germany confirm once more a fact brought out in earlier reports. For many years the character of criminal acts in that country has been undergoing a radical change: while those against property have shown a constant decrease in number, the number of crimes against life has as constantly increased. Some think they can trace a connection between an increase in the crimes against life and the increase in the use of alcoholic drinks, the greatest increase

being in Bavaria and in certain portions of Prussia where the alcohol habit has shown the greatest increase.

— Dr. Brown-Sequard is an American. His father, Capt. Edward Brown, of the American navy, was a Philadelphian, and married a French woman on the Island of Mauritius, named Sequard. He and his descendants took the name of Brown-Sequard. The distinguished scientist was the eldest child. He was educated in France, but was afterwards a professor in Harvard, and practised medicine in New York for some years after 1873. He married twice, his first wife being Miss Fletcher of Boston, a relative of Daniel Webster.

— Col. Thuillier's report on the progress of the surveys of India for the past year shows that the party employed on the trigonometrical surveys has completed the 370 miles remaining of the secondary triangulation along the east coast of India, as given in a recent number of *Engineering*. The secondary triangulation was also carried out for an aggregate length of 270 miles by parties employed in Beloochistan, as a basis for topographical surveys in that region. The work of the geodetic party comprised the measurement of seven arcs of longitude in southern India; and the tidal survey party continued its observations with self-registering tide-gauges at several stations along the coast, where tidal observatories are established, and connected with the operations of spirit-leveling. Geographical surveys have been carried out vigorously in upper Burmah, nearly 21,000 square miles having been surveyed and mapped on a half-inch scale. Reconnaissance along the Nepal boundary has supplied a rough basis for a more accurate and detailed survey of the northern frontier when an opportunity offers. Interesting additional information regarding Bhootan and Tibet has been obtained from the adventurous travels of native explorers, trained and sent thither by the department. Of the new maps, 4,062 were published during the year, and heavy demands continue to be made for transfrontier maps, and maps of upper Burmah. The photographic and lithographic offices show the large output of 1,203,861 copies during the year, including high-class illustrations for archaeological and other reports.

— M. Vénukoff, writing to the *Scottish Geographical Magazine*, says, "M. Grum-Grjimaïlo has commenced his journey in Central Asia, starting from Vernoi. His first letter, dated from Jarkent, on the Russo-Chinese frontier in Dzungaria, appeared in the Russian journal *Novosti* for July 6, 1889. It informs us that the season of spring was this year late in Dzungaria, and that the lower limit of snows on the Ala Tau Mountains reached in the month of May to an elevation above the sea-level of 7,874 feet, which was very low for that season of the year in the latitude of 43° north, and under the brilliant sky of Central Asia. The Ili and all other rivers of the region were greatly increased by the melting of the snows in June. M. Grum-Grjimaïlo will continue his journey in the Chinese provinces adjoining the Thian Shan; but it is expected that the Chinese authorities will place obstacles in his way, from the fact of his being unprovided with a passport from the Tsung-li-yamen of Peking. But if he succeeds, he will establish a precedent for all future explorers. I should add, that quite recently Jarkent has suffered greatly from a violent earthquake, and it appears that this occurred after M. Grjimaïlo's departure. Col. Pevzov reached Yarkhand towards the end of May. At about the same time, Capt. Grombtchevsky was on the Pamir, in the neighborhood of Daraout-Kourgan, whence he was to have made his way to Choungnan; but, the latter country having been again occupied by the Afghans, I do not know whether the explorer will venture to enter it." The ethnographical map prepared by M. Vénukoff in 1883, he has now brought up to date, showing the distribution of the populations in the interesting and important district of Vladivostok. The region represented is, roughly, bounded on the west by Manchuria, on the north by latitude 45° north, and a little beyond, on the east, by longitude 135° east, and on the south by the sea. Within this territory there was, in 1888, a population numbering 55,600, of whom 35,000 were Russians, 10,000 Koreans, 9,500 Chinese, 500 Japanese, 500 Goldis and Orotchis, and 100 Europeans. Among the Chinese there were nearly 1,000 nomads; the Goldis and Orotchis are also nearly all nomads (hunters and fishers). The Europeans and the Japanese inhabit Vladivostok. The Koreans

are all sedentary, and they inhabit the large villages; while the Chinese are dispersed about the country, noticeably in communities (farms) settled along the eastern river-courses. The principal centre of population is of course Vladivostok (13,000 inhabitants); then come Nicolskoé, Novo-Kief, and Kamen-Rybolov. There are in the Russian villages 9 *stanitzas* occupied by 2,877 Cossacks, whose duty it is to guard the frontier between Lake Hankai and the mouth of the Toumen-oula.

— A French military writer writes in the *République Française* as follows on the subject of melinite. His remarks are interesting, but should be accepted with a considerable amount of reserve. "Our shells for field artillery, as well as those for our forts and siege-guns, are charged with melinite. What melinite is, we do not know, and if we knew we should be very careful not to tell. Both the Italians and the Germans have sent spies to discover the secret, and to offer money for even the smallest fragment, but they have all been captured. All that can be said is, that, according to a treatise published in 1882, melinite is composed of melted picric acid. But in the interval our artillerymen have perfected the discovery of M. Turpin. They have made melinite a tractable product. The effects of this explosive were fully demonstrated at some experiments at the Fort of Malmaison in 1886. Melinite is so safe, that in three years only one accident has occurred, that at the arsenal of Belfort. On the other hand, a hundred accidents have occurred from gelatine alone in thirty years. There has never been an accident in drawing the charges, nor one from bursting in the gun. As much cannot be said for roborite, hellefite, or the other substances employed by foreign States. What will become of a fortification in face of this redoubtable agent? Some think and say they are doomed; others, like Gen. Brialmont, recommend the use of armored circular forts. It is said that the shell will glance off these without doing any damage; but experiments at Chalons have shown that turrets enjoy no immunity against a close and continuous fire."

— Those living in a locality in which the mosquitoes are troublesome, says the *Annals of Hygiene*, may make a trial of the following recipe for expelling these pests from the house: take a piece of gum-camphor, in size about the third of a hen's egg, and slowly evaporate it by holding it in a shovel or tin vessel over a lamp, taking care that it does not ignite. The smoke will soon fill the room and expel the mosquitoes, and it is said they will not return, even though the windows should be left open all night.

— The following resolutions were adopted by the international congress on hypnotism held in Paris last month: 1. Public exhibitions of hypnotism or magnetism should be forbidden by government; 2. The use of hypnotism as a therapeutic agent should be restricted to practising physicians; 3. It is to be hoped that the method and practice of hypnotism will be included in the medical education of students.

— Recognizing the difficulty that is experienced in keeping fire-pails constantly full, an American inventor has proposed to cover the pail with an air-tight sheet of tinfoil, which, while preventing the contents from evaporating, can, when wanted, be easily broken through by the hand. In order to anticipate the almost equal difficulties that may arise from the freezing of the contents, brine, or some similar liquid, may be used for filling the pails, in place of water.

— Sibley College is to have a tremendous class this year. The college will be crowded by 350 or 400 students where they were only really desirous of handling 200, the limit set four years ago as the maximum number that they were likely to find satisfactory room for. Cornell University will have a class somewhere between 425 and 450, and a total in all branches and classes of about 1,300, perhaps 1,400. They can again boast the largest freshman class entering any American university.

— It is reported from Japan (*Nature*, Sept. 12), that Viscount Ennomoto, the new minister of education, is devoting special attention to the introduction of technical education into the primary schools of the empire, and that he has turned to Italy as a model. His scheme is to include technical education in the curriculum of the preparatory schools, and to give children technical training from the outset.

— At the July meeting of the Anthropological Society of Bombay, Mr. Kitts of the Indian Civil Service read a paper on the early history of northern India, in which the theory recently put forward by Mr. Hewitt, on the early history of India, was stated and discussed. The theory of Mr. Hewitt, as stated in *Nature*, is briefly this: that the first immigrants who settled in India, and have left traces surviving, were the so-called Kolarian races, who came from the north-east; and that their descendants, to the number of ten millions or thereabouts, are still occupants of northern India. The Kolarians were succeeded and conquered by the Dravidians, who came from the north-west, and developed in India a very high state of civilization, both social and political. Large estates belonged to single owners, such as the *talukdari* tenures in northern India, and the *zemindari* and *patidari* tenures in southern India. "In short," says Mr. Hewitt, "it was the Dravidians who founded and consolidated the present land-revenue system of India." The Dravidians also organized the *punchayet* and *chowkidar* system of village government, which has survived to the present day. All the manual arts and industries practised in the India of to-day were known to and practised by the Dravidians. The Aryans, migrating into a land occupied as India then was by the Dravidians, with a strongly organized system of government, found great difficulty in obtaining a foothold, and, even when they had secured a tract of country in the north-west for themselves, did not obtain supremacy over the rest of India by force of arms. The agents of their subsequent advance were three,—religion, commerce, and military ability. Friendly alliances were concluded between the new-comers and the snake races of the Dravidians. The Aryans admitted the noble races of the Dravidians to be of royal blood, and accepted Siva or Lingam worship as not dishonoring to their religion. The Dravidians, thus recognized as of noble blood, were the ancestors of the modern Rajpoots and the Kshatriya caste. Intellectually the Aryans were far superior to the Dravidians, and the Aryan tongue was accordingly adopted as the *lingua franca* for commercial purposes. So, too, the Aryan became a necessary element in every court and in every commercial enterprise, and from this time forward (about six centuries B.C.) their supremacy was assured.

— According to *Nature*, Dr. Rudolph Koenig, the well-known constructor of standard acoustical apparatus in Paris, has just made a discovery of extreme importance in the theory of music, the details of which he will expound at the forthcoming meeting of the Naturforscher at Heidelberg. This is an extension of Helmholtz's theory of timbre to certain cases not represented in the elementary mathematical theory, and corresponding to the actual case of the timbres of certain musical instruments. The paper is certain to give rise to discussion, and will be of interest to musicians, who have never, as is notorious, taken kindly to Helmholtz's theory in its original form.

— Mr. Gustavé Guttenberg, formerly of Erie, Penn., who is conducting the Agassiz course of mineralogy, has accepted the position of teacher of biology in the Central High School at Pittsburgh, Penn., and desires his correspondents to take notice of the change of his address.

— The following topics have been selected for consideration at the seventeenth annual meeting of the American Public Health Association, Brooklyn, to be held Oct. 22-25: "The Causes and Prevention of Infant Mortality;" "Railway Sanitation."—(a) "Heating and Ventilation of Railway Passenger-Coaches," (b) "Water-Supply, Water-Closets, etc.," (c) "Carrying Passengers Infected with Communicable Diseases;" "Steamship Sanitation;" "Methods of Scientific Cooking;" "Yellow-Fever,"—(a) "The Unprotected Avenues through which Yellow-Fever is Liable to be brought into the United States," (b) "The Sanitary Requirements necessary to render a Town or City Proof against an Epidemic of Yellow-Fever," (c) "The Course to be taken by Local Health Authorities upon the Outbreak of Yellow-Fever;" "The Prevention and Restriction of Tuberculosis in Man;" "Methods of Prevention of Diphtheria, with Results of such Methods;" "How far should Health Authorities be permitted to apply known Preventive Measures for the Control of Diphtheria;" "Compulsory Vaccina-

tion;" and "Sanitation of Asylums, Prisons, Jails, and other Eleemosynary Institutions." Addresses of welcome will be delivered by Hon. Alfred C. Chapin, mayor, on behalf of the city, and by Alexander Hutchins, M.D., on behalf of the medical profession.

— Dr. George H. Cook, the New Jersey State geologist, and vice-president of Rutgers College, died Sept. 22, at New Brunswick, of heart-failure. Dr. Cook was taken ill Saturday noon, but his illness was not considered at all serious, and his death was totally unexpected. His work as State geologist has been varied and of great importance. The topographical maps of the State which have been published under his supervision have been among the best of any published by the different States. The last of the series was recently issued, and Dr. Cook was at the time of his death engaged on his final report. Two volumes had been prepared, the latter now being in print. He was seventy-two years of age, and leaves a widow and two children,—one son and one daughter.

— Among the recent scientific missions undertaken by order of the French Government, says *Nature*, are one by Professor Viault of Bordeaux, in the tablelands of Peru, Ecuador, and Bolivia, to continue the investigations of the late M. Paul Bert into rarefied air; one by M. de Coubertin, secretary of the committee for the encouragement of physical exercises in education in the United States and Canada, to visit the universities and colleges, to study the working of the various athletic associations frequented by the young people of these countries; one by M. Jacques de Morgan, mining engineer, to explore those parts of Asia Minor lying between the south of the Caspian Sea, Armenia, the Gulf of Alexandria, and Anti-Taurus (this mission will occupy two years and three months); and one by M. Candelier, to Colombia, to make ethnographical researches and collections for the State.

— Exactly a century ago—namely, in 1789—Klaproth succeeded in isolating from a dark-colored mineral known as pitchblende a yellow oxide, which, after carefully testing, he pronounced to be the oxide of a new metal. To this metallic substance he gave the name of "uranium," so calling it after the planet Uranus, then recently discovered by Herschel; and it was at once classed among the rare metals, and still remains so. Its rarity is indicated by its market price, which is about \$12,000 per ton. There are several oxides of this metal; but the best known and most important is the sesquioxide, which forms a number of beautiful yellow salts. This oxide is largely employed for imparting delicate golden and greenish yellow tints to glass, while the protoxide is much used in producing the costly black porcelain. Uranium is also found to be useful in certain photographic processes as a substitute for the chloride of gold; but its rarity and consequent high price have hitherto caused its application to be very limited, although there are uses other than those already named to which it could be put if it were less scarce and less costly. It is found in Cornwall, Saxony, and Bohemia; but up to the present time it has only been met with in isolated pockets and patches. The centenary of its discovery by Klaproth has, however, according to the *London Times*, been marked by the finding of a continuous lode at the Union Mine, Grampound Road, Cornwall, which is believed to be the only known lode in the world. This discovery is regarded as unique in the history of the metal; for the lode is what is known as a true fissure-vein, and the ore is found to contain an average of twelve per cent of the pure metal, the assays going up as high as thirty per cent in some parts of the lode. Several tons of the ore have already been raised and sold, fetching high prices. The lode traverses the mine from north to south, and the uranium occurs in it chiefly as a sesquioxide. It is anticipated that the present discovery will enable two important applications of the metal to be followed up. The first is as a substitute for gold in electroplated ware, inasmuch as with platinum and copper it forms two beautiful alloys, each having the appearance of gold, and the former also resisting the action of acids. The second application is in connection with electric installations, where its usefulness consists in its high electrical resistance. The mineral deposits generally at the Union Mine are of an exceptional character, comprising, in addition to uranium, magnetic iron, silver, lead, tin, copper, ochre, and amber.

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THE COMMITTEE ON SITES for the world's fair in New York in 1892 has recommended that the upper part of Central Park be taken for the purpose, to which shall be added some outlying unoccupied land. The point of special interest just now is that a considerable portion of the New York community object to any part of the park being used, maintaining that the upper portions are the most attractive of all, and, as is freely acknowledged by all, that these will have to be denuded of trees and scraped down to a more level surface by the city contractors, so as to ruin their beauty for a generation to come. It is to be said, also, that the lower parts of the park would be turned practically into little more than an entrance to the fair-grounds proper, thus depriving them of the character which draws so many to them on all holidays. The scheme has its advocates, however; and it is of course true that a part of its support is to be traced to the interests of real-estate owners, as would be the case if any other site were chosen, only here, the interests being the greater, the support is the more earnest.

MODERN PHOTOGRAPHY.¹

THE occupant of this chair has a difficult task to perform, should he attempt to address himself to all the various subjects with which this section is supposed to deal. I find that it has very often

¹ Address of Capt. W. De W. Abney, president of the section of mathematics and physics, of the British Association for the Advancement of Science, delivered before the association at its meeting recently (from *Nature*).

been the custom that some one branch of science should be touched upon by the president; and I shall, as far as in me lies, follow this procedure.

This year is the jubilee of the practical introduction of photography by Daguerre and Fox Talbot, and I have thought I might venture to take up your time with a few remarks on the effect of light on matter. I am not going into the history of photography, nor to record the rivalries that have existed in regard to the various discoveries that have been made in it. A brand-new history of photography, I dare say, would be interesting, but I am not the person to write one; and I would refer those who desire information as to facts and dates to histories which already exist. In foreign histories perhaps we English suffer from speaking and writing in a language which is not understood of the foreign people; and the credit of several discoveries is sometimes allotted to nationalities who have no claim to them. Be that as it may, I do not propose to correct these errors or to make any reclamations. I leave that to those whose leisure is greater than mine.

I have often asserted, and I again assert, that there should be no stimulus for the study of science to be compared to photography. Step by step, as it is pursued, there will be formed a desire for a knowledge of all physical science. Physics, chemistry, optics, and mathematics are all required to enable it to be studied as it should be studied; and it has the great advantage that experimental work is the very foundation of it, and results of some kind are always visible. I perhaps am taking an optimist view of the matter, seeing there are at least twenty-five thousand living facts against my theory, and perhaps not one per cent of them in its favor. I mean that there are at least twenty-five thousand persons who take photographs, and scarcely one per cent who know or care any thing of the "why or wherefore" of the processes, so far as theory is concerned. If we call photography an applied science, it certainly has a larger number who practise it, and probably fewer theorists, than any other.

He would be a very hardy man who would claim for Niépce, Daguerre, or Fox Talbot the discovery of photographic action on matter. The knowledge that such an action existed is probably as old as the fair-skinned races of mankind, who must have recognized the fact that light, and particularly sunlight, had a tanning action on the epidermis; and the women, then as now, no doubt took their precautions against it. As to what change the body acted upon by light underwent, it need scarcely be said that nothing was known; and perhaps the first scientific experiment in this direction was made rather more than a hundred years ago by Scheele, the Swedish chemist, who found, that, when chloride of silver was exposed to light, chlorine was given off. It was not till well in the forties that any special attention was given to the action that light had on a variety of different bodies; and then Sir John Herschel, Robert Hunt, Becquerel, Draper, and some few others, carried out experiments which may be termed "classical." Looking at the papers which Herschel published in the "Philosophical Transactions" and elsewhere, it is not too much to say that they teem with facts which support the grand principle that without the absorption of radiation no chemical action can take place on a body; in other words, we have in them experimental proofs of the law of the conservation of energy. Hunt's work, "Researches on Light," is still a text-book to which scientific photographers refer, and one is sometimes amazed at the amount of experimental data which is placed at our disposal. The conclusions that Hunt drew from his experiments, however, must be taken with caution in the light of our present knowledge, for they are often vitiated by the idea which he firmly held, that radiant heat, light, and chemical action, or actinism, were each of them properties, instead of the effects, of radiation. Again: we have to be careful in taking seriously the experiments carried out with light of various colors when such colors were produced by absorbing media. It must be remembered that an appeal to a moderately pure spectrum is the only appeal which can be legitimately made as to the action of the various components of radiation, and even then the results must be carefully weighed before any definite conclusion can be drawn. No photographic result can be considered as final unless the experiments be varied under all the conditions which may possibly arise. Colored media are dangerous as enabling trustworthy con-

clusions to be drawn, unless the characters of such media have been thoroughly well tested, and the light they transmit has been measured. An impure spectrum is even more dangerous to rely upon, since the access of white light would be sure to vitiate the results.

Perhaps one of the most puzzling phenomena to be met with in photography is the fact that the range of photographic action is spread over so large a portion of the spectrum. The same difficulty, of course, is felt in the matter of absorption, since the one is dependent on the other. Absorption by a body we are accustomed, and indeed obliged by the law of the conservation of energy, to consider as due to the transference of the energy of the ether wave-motion to the molecules and atoms comprising the body by increasing the vibrations of one or both.

In the case where chemical action takes place, we can scarcely doubt that it is the atoms which in a great measure take up the energy of the radiation falling on them, as chemical action is dependent on the liberation of one or more atoms from the molecule; while, when the swings of the molecules are increased in amplitude, we have a rise in temperature of the body. I shall confine the few remarks I shall make on this subject to the case of chemical action. The molecule of a silver salt, such as bromide of silver, chemists are wont to look upon as composed of a limited and equal number of atoms to form the molecule. When we place a thin slab of this material before the slit of the spectroscopy, we find a total absorption in the violet and ultra-violet of the spectrum, and a partial absorption in the blue and green, and a diminishing absorption in the yellow and red. A photographic plate containing this same salt is acted upon in exactly the same localities and in the same relative degree as where the absorption takes place. Here, then, we have an example of, it may be, the vibrations of four atoms, one of which at least is isochronous, or partially so, with the waves composing a large part of the visible spectrum. The explanation of this is somewhat obscure. A mental picture, however, may help us. If we consider that, owing to the body acted upon being a solid, the oscillations of the molecules and atoms are confined to a limited space, it probably happens that between the times in which the atoms occupy, in regard to one another, the same relative positions, the component vibrations of, say, two of the atoms vary considerably in period. An example of what I mean is found in a pendulum formed of a bob and an elastic rod. If the bob be made to vibrate in the usual manner, and at the same time the elastic rod be elongated, it is manifest that we have a pendulum of ever-varying length. At each instant of time the period of vibration would differ from that at the next instant, if the oscillations were completed. It is manifest that increased amplitude would be given to the pendulum-swings by a series of well-timed blows differing very largely in period. At the same time there would be positions of the pendulum in which some one series of well-timed blows would produce the greatest effect. In a somewhat similar manner we should imagine that the ethereal waves should produce increased amplitude in the swing of the atoms between very wide limits of period, and, further, that there should be one or more positions in the spectrum when a maximum effect is produced. I would here remark that the shape of the curves of sensitiveness, when plotted graphically, of the different salts of silver to the spectrum, have a marked resemblance to the graphically drawn curves of the three color-sensations of the normal eye, as determined by Clerk Maxwell. May not the reason for the form of the one be equally applicable for the other? I only throw this out as evidence, not conclusive indeed, that the color-sensitiveness of the eye is more probably due to a photographic action on the sensitive retina than to a merely mechanical action. That this is the case, I need scarcely say has several times been propounded before.

The ease with which a silver salt is decomposed is largely, if not quite, dependent on the presence of some body which will take up some of the atoms which are thrown off from it: for instance, in chloride of silver we have a beautiful example of the necessity of such a body. In the ordinary atmosphere the chloride is, of course, colored by the action of light; but if it be carefully dried and purified, and placed in a good vacuum, it will remain uncolored for years in the strongest sunlight. In this case the absence of air and moisture is sufficient to prevent it discoloring.

If in the vacuum, however, a drop of mercury be introduced, the coloration by light is set up. We have the chlorine liberated from the silver and combining with the mercury vapor, and a minute film of calomel formed on the sides of the vessel.

Delicate experiments show that not only is this absorbent almost necessary when the action of light is so strong or so prolonged that its effect is visible, but also when the exposure or intensity is so small that the effect is invisible and only to be found by development. The reason for this absorbent is not far to seek. If, for instance, silver chloride be exposed to light *in vacuo*, although the chlorine atoms may be swung off from the original molecule, yet they may only be swung off to a neighboring molecule which has lost one of its chlorine atoms, and an interchange of atoms merely takes place. If, however, a chlorine absorbent be present which has a greater affinity for chlorine than has the silver chloride which has lost one of its atoms, then we may consider that the chlorine atoms will be on the average more absorbed by the absorbent than by the subchloride molecules. The distribution of the swung-off atoms between the absorbent and the subchloride will doubtless be directly proportional to their respective affinities for chlorine, and so for the other salts of silver. If this be so, then it will be seen that the greater the affinity of the absorbent for the halogen, the more rapid will be the decomposition of the silver salt. This, then, points to the fact that if any increase in the sensitiveness of a silver salt is desired, it will probably be brought about by mixing with it some stronger halogen absorbent than has yet been done.

The question as to what is the exact product of the decomposition of a silver salt by the action of light is one which has not as yet been fully answered. For my own part, I have my strong beliefs and my disbeliefs. I fully believe the first action of light to be a very simple one, though this simple action is masked by other actions taking place, due to the surroundings in which it takes place. The elimination of one atom from a molecule of a silver salt leaves the molecule in an unsatisfied condition, and capable of taking up some fresh atom. It is this capacity which seemingly shrouds the first action of light, since when exposure is prolonged the molecules take up atoms of oxygen from the air or from the moisture in it. Carey Lea of Philadelphia has within the last three years given some interesting experiments on the composition of what he calls the photochloride of silver, which is the chloride colored by light, and Professor Hodgkinson has also taken up the matter. The conclusions the former has drawn are, to my mind, scarcely yet to be accepted. According to the latter experimentalist, the action of light on silver chloride is to form an oxidized subsalt. This can hardly be the case, except under certain conditions, since a colored compound is obtained when the silver chloride is exposed in a liquid in which there is no oxygen present.

This coloration by light of the chloride of silver naturally leads our thoughts to the subject of photography in natural colors. The question is often asked when photography in natural colors will be discovered. Photography in natural colors not only has been discovered, but pictures in natural colors have been produced. I am not alluding to the pictures produced by manual work, and which have from time to time been foisted on a credulous public as being produced by the action of light itself, much to the damage of photography, and usually of the so-called inventors. Roughly speaking, the method of producing the spectrum in its natural colors is to chlorinize a silver plate, expose it to white light till it assumes a violet color, heat till it becomes rather ruddy, and expose it to a bright spectrum. The spectrum colors are then impressed in their natural tints. Experiment has shown that these colors are due to an oxidized product being formed at the red end of the spectrum, and a reduced product at the violet end. Photography in natural colors, however, is only interesting from a scientific point of view, and, so far as I can see, can never have a commercial value. A process, to be useful, must be one by which reproductions are quickly made: in other words, it must be a developing and not a printing process, and it must be taken in the camera; for any printing process requires not only a bright light, but also a prolonged exposure. Now, it can be conceived that in a substance which absorbs all the visible spectrum the molecules can be so shaken and sifted by the different rays, that eventually they sort themselves into masses which reflect the particular rays by which

they are shaken; but it is almost — I might say, quite — impossible to believe that when this sifting has only been commenced, as it would be in the short exposure to which a camera picture is submitted, the substance deposited to build up the image by purely chemical means would be so obliging as to deposit in that the particular size of particle which should give to the image the color of the nucleus on which it was depositing. I am aware that in the early days of photography we heard a good deal about curious results that had been obtained in negatives, where red brick houses were shown as red, and the blue sky as bluish. The cause of these few coincidences is not hard to explain, and would be exactly the same as when the red brick houses were shown as bluish, and the sky as red, in a negative. The records of the production of the latter negatives are naturally not abundant, since they would not attract much attention. I may repeat, then, that photography in natural colors by a printing-out process — by which I mean by the action of light alone — is not only possible, but has been done, but that the production of a negative in natural colors from which prints in natural colors might be produced, appears, in the present state of our knowledge, to be impossible. Supposing it were not impracticable, it would be unsatisfactory, as the light with which the picture was impressed would be very different from that in which it would be viewed. Artists are fully aware of this difficulty in painting, and take their precautions against it.

The nearest approach to success in producing colored pictures by light alone is the method of taking three negatives of the same subject through different-colored glasses, complementary to the three color-sensations which together give to the eye the sensations of white light. The method is open to objection on account of the impure color of the glasses used. If a device could be adopted whereby only those three parts of the spectrum could be severally used which form the color-sensations, the method would be more perfect than it is at present. Even then, perfection could not be attained, owing to a defect which is inherent in photography, and which cannot be eliminated. This defect is the imperfect representation of gradation of tone. For instance: if we have a strip graduated from what we call black to white (it must be recollected that no tone can scientifically be called black, and none white), and photograph it, we shall find that in a print from the negative the darkness which is supposed to represent a gray of equal mixtures of black and white by no means does so unless the black is not as black nor the white as white as the original. The cause of this untruthfulness in photography has occupied my attention for several years, and it has been my endeavor to find out some law which will give us the density of a silver deposit on a negative corresponding with the intensity of the light acting. I am glad to say that at the beginning of this year a law disclosed itself, and I find that the transparency of a silver deposit caused by development can be put into the form of the law of error.

This law can be scarcely empiric, though at first sight it appears that the manipulations in photography are so loose that it should be so. It is this very looseness, however, which shows that the law is applicable, since in all cases I have tried it is obeyed. That there are theoretical difficulties cannot be denied, but it is believed that strictly theoretical reasoning will eventually reconcile theory with observation.

This want of truth in photography in rendering gradation, then, puts it out of the range of possibility that photography in natural colors can ever be exact, or that the three-negatives system can ever get over the difficulty.

One of the reproaches that in early days was cast at photography was its inability to render color in its proper monochromatic luminosity. Thus, while a dark blue was rendered as white in a print (that is, gave a dense deposit in a negative), bright yellow was rendered as black in a print, or nearly so (that is, as transparent or nearly transparent glass in the negative). To the eye the yellow might be far more luminous than the blue, but the luminosity was in the photograph reversed. I need scarcely say that the reason of this want of truth in the photograph is due to the want of sensitiveness of the ordinarily used silver salts to the least refrangible end of the spectrum. Some fifteen years ago Dr. H. W. Vogel announced the fact that when silver salts were stained with certain dyes they became sensitive to the color of the spectrum, which the

dyes absorbed. This at once opened up possibilities, which, however, were not at once realized, owing perhaps to the length of exposure required when the collodion process was employed. Shortly after the gelatine process was perfected, the same dyes were applied to plates prepared by this method, which, although they contained the same silver salts as the old collodion process, yet *per se* were very much more sensitive. A new era then dawned for what has been termed "isochromatic" and "orthochromatic" photography. The dyes principally used are those belonging to the eosine group and cyanine; not the ordinary cyanine dye of commerce, but that discovered by Greville Williams. For a dye to be of use in this manner, it may be taken as an axiom — first propounded by the speaker, it is believed — that it must be fugitive, or that it must be capable of forming a silver compound. The more stable a dye is, the less effective it is. If we take as an example cyanine, we find that it absorbs in the orange and slightly in the red. If paper or collodion stained with this coloring-matter be exposed to the action of the spectrum, it will be found that the dye bleaches in exactly the same part of the spectrum as that in which it absorbs, following, indeed, the universal law I have already alluded to. If a film containing a silver salt be dyed with the same, it will be found, that, while the spectrum acts on it in the usual manner, — viz., darkening it in the blue, violet, and ultra-violet, — the color is discharged where the dye absorbs, showing that in one part of the spectrum it is the silver salt which is sensitive, and that in the other it is the coloring-matter. If such a plate, after exposure to the spectrum, be developed, it will be found that at both parts a deposit of silver takes place; and, further, when the experiment is carefully conducted, if a plate with merely cyanine-colored collodion be exposed to the spectrum and bleached in the orange, and after removal to the dark-room another film containing a silver salt be applied, and then a developer, a deposit of silver will take place where the bleaching has occurred. This points to the fact that the molecules of a fugitive dye, when altered by light, are unsatisfied, and are ready to take up an atom or atoms of silver; and other molecules of silver will deposit on such nuclei by an action which has various names in physical science, but which I do not care to mention. This is the theory which I have always advocated; viz., that the dye by its reduction acts as a nucleus on which a deposit of silver can take place. It met with opposition; a rival theory which makes the dye an "optical sensitizer" — an expression which is capable of a meaning which I conceive contrary to physical laws — being run against it. The objection to what I may call the nucleus theory is less vigorous than it has been, and its diminution is due, perhaps, to the more perfect understanding of the meaning of each other by those engaged in the controversy. To my mind, the action of light on fugitive dyes is one of the most interesting in the whole realm of photography, as eventually it must teach us something as to the structure of molecules, and add to the methods by which their coarseness may be ascertained. Be the theory what it may, however, a definite result has been attained, and it is now possible to obtain a fair representation of the luminosity of colors by means of dyed films. At present the employment of colored screens in front of the lens, or on the lens itself, is almost an essential in the method, when daylight is employed; but not till some dye is discovered which shall make a film equally sensitive for the same luminosity to the whole visible spectrum will it be possible to make orthochromatic photography as perfect as it can be made. The very fact that no photograph of even a black and white gradation will render the latter correctly, must of necessity render any process imperfect, and hence in the above sentence I have used the expression "as perfect as it can be made."

The delineation of the spectrum is one of the chief scientific applications to which photography has been put. From very early days the violet and ultra-violet end of the spectrum have been favorite objects for the photographic plate. To secure the yellow and red of the spectrum was, however, till of late years, a matter of apparently insurmountable difficulty; while a knowledge of that part of the spectrum which lies below the red was only to be gained by its heating effect. The introduction of the gelatine process enabled the green portion of the spectrum to impress itself on the sensitive surface; while the addition of various dyes, as before mentioned, allowed the yellow, the orange, and a portion of the red

rays to become photographic rays. Some eight years ago it was my own good fortune to make the dark infra-red rays impress themselves on a plate. This last has been too much a speciality of my own, although full explanations have been given of the methods employed. By preparing a bromide-of-silver salt in a peculiar manner, one is able so to modify the molecular arrangement of the atoms that they answer to the swings of those waves which give rise to these radiations. By employing this salt of silver in a film of collodion or gelatine, the invisible part of the spectrum can be photographed, and the images of bodies which are heated to less than red heat may be caused to impress themselves upon the sensitive plate. The greatest wave-length of the spectrum to which this salt is sensitive, so far, is 22,000 λ , or five times the length of the visible spectrum. The exposure for such a wave-length is very prolonged; but down to a wave-length of 12,000 it is comparatively short, though not so short as that required for the blue rays to impress themselves on a collodion plate. The color of the sensitive salt is a green-blue by transmitted light. It has yet to be determined whether this color is all due to the coarseness of the particles, or to the absorption by the molecules. The fact that a film can be prepared which by transmitted light is yellow, and which may be indicative of color due to fine particles, together with an absorption of the red and orange, points to the green color being probably due to absorption by the molecules. We have thus in photography a means of recording phenomena in the spectrum from the ultra-violet to a very large wave-length in the infra-red, — a power which physicists may some day turn to account. It would, for instance, be a research worth pursuing to photograph the heavens on a plate prepared with such a salt, and search for stars which are nearly dead or newly born; for in both cases the temperature at which they are may be such as to render them below red-heat, and therefore invisible to the eye in the telescope. It would be a supplementary work to that being carried out by the brothers Henri, Combon, Roberts, Gill, and others, who are busy securing photographic charts of the heavens in a manner which is beyond praise.

There is one other recent advance which has been made in scientific photography to which I may be permitted to allude; viz., that, from being merely a qualitative recorder of the action of light, it can now be used for quantitative measurement. I am not now alluding to photographic actinometers, such as have been brought to such a state of perfection by Roscoe, but what I allude to is the measurement and interpretation of the density of deposit in a negative. By making exposures of different lengths to a standard light, or to different known intensities of light, on the same plate on which a negative has to be taken, the photographic values of the light acting to produce the densities on the different parts of the developed image can be readily found. Indeed, by making only two different exposures to the same light, or two exposures to two different intensities of light, and applying the law of density of deposit in regard to them, a curve is readily made from which the intensities of light necessary to give the different densities of deposit in the image impressed on the same plate can be read off. The application of such scales of density to astronomical photographs, for example, cannot but be of the highest interest, and will render the records so made many times more valuable than they have hitherto been. I am informed that the United States astronomers have already adopted the use of such scales, which for the last three years I have advocated, and it may be expected that we shall have results from such scaled photographs which will give us information which would before have been scarcely hoped for.

One word as to a problem which we may say is as yet only qualitatively and not quantitatively solved. I refer to the interchangeability of length of exposure for intensity of light. Put it in this way. Suppose that with a strong light, L , a short exposure, E , being given, a chemical change, C , is obtained: will the same change, C , be obtained if the time is only an n th of the light, L , but n times the exposure? Now, this is a very important point, more particularly when the body acted upon is fairly stable; as, for instance, some of the water-color pigments, which are known to fade in sunshine, but might not be supposed to do so in the light of an ordinary room, even with prolonged exposure. Many experiments have been made at South Kensington as regards this,

more especially with the salts of silver; and it is found, that, for any ordinary light, intensity and exposure are interchangeable, but that when the intensity of light is very feeble, say the $\frac{1}{100000}$ of ordinary daylight, the exposure has to be rather more prolonged than it should be supposing the exact interchangeability always held good. But it has never been found that a light was so feeble that no action could take place. Of course, it must be borne in mind that the stability of the substance acted upon may have some effect; but the same results were obtained with matter which is vastly more stable than the ordinary silver salts. It may be said, in truth, that almost all matter which is not elemental is, in time, and to some degree, acted upon by light.

I should like to have said something regarding the action of light on the iron and chromium salts, and so introduced the subject of platinotype and carbon printing, the former of which is creating a revolution in the production of artistic prints. I have, however, refrained from so doing, as I felt that the president of Section A. should not be mistaken as the president of Section B. Photogravure and the kindred processes were also inviting subjects on which to dwell, more especially as at least one of them is based on the use of the same material as that on which the first camera picture was taken by Niépce. Again, a dread of trenching on the domains of art restrains me.

Indeed, it would have been almost impossible, and certainly impolitic, in the time which an address should occupy, to have entered into the many branches of science and art which photography covers. I have tried to confine myself to some few advances that have been made in its theory and practice.

The discovery of the action of light on silver salts is one of the marvels of this century, and it is difficult to overrate the bearing it has had on the progress of science, more especially physical science. The discovery of telegraphy took place in the present reign, and two years later photography was practically introduced; and no two discoveries have had a more marked influence on mankind. Telegraphy, however, has had an advantage over photography in the scientific progress that it has made, in that electrical currents are subject to exact measurement, and that empiricism has no place with it. Photography, on the other hand, has labored under the disadvantage, that, though it is subject to measurement, the factors of exactitude have been hitherto absent. In photography we have to deal with molecules the equilibrium of whose components is more or less indifferent according to the process used. Again, the light employed is such a varying factor that it is difficult to compare results. Perhaps more than any other disadvantage it labors under, is that due to quackery of the worst description at the hands of some of its followers, who not only are self-asserting, but often ignorant of the very first principles of scientific investigation. Photography deserves to have followers of the highest scientific calibre; and, if only some few more real physicists and chemists could be induced to unbend their minds and study the theory of an applied science which they often use for record or for pleasure, we might hope for some greater advance than has hitherto been possible.

Photography has been called the handmaid of art: I venture to think it is even more so the handmaid of science, and each step taken in perfecting it will render it more worthy of such a title.

ELECTRICAL NEWS.

Recent Fatalities from Electricity.

ONE death and several serious injuries from electric-light wires have occurred during the past two weeks. Some days ago the eight-year-old son of Charles Kern of Baltimore came in contact with an electric-light wire while looking out of a window, lost his balance, and fell to the street. A New York daily newspaper, alluding to the fact, stated that the boy was "fairly lifted out of the room, and hurled into the street;" all of which is interesting, if true. John Powers, an employe of The Brush Electric-Light Company, thoughtlessly took hold of a live wire with one hand, and with the other made an excellent ground connection with the Elevated Railroad structure on East 34th Street. He was standing on a step-ladder at the time; and the shock of the fall, not the current, killed him. Some days after this occurrence a poor vagrant,

while standing on a curbstone, was struck a light tap by a coil of dead wire which a lineman dropped from a telegraph-pole. After considering the subject for some minutes, he concluded he had received a dangerous electric shock, and communicated the fact to the lineman and various passers by. A medical examination showed no injuries from electricity.

With regard to these accidents, which as a rule receive sensational and exaggerated notice in the daily papers, it should not be forgotten that two connections with the body are always necessary for an electric shock; the "deadly wire" being of course one, while the other is the damp surface of the sidewalk, ground, a wet telegraph-pole, or other conductor. A person touching a live wire with no other electrical connection would feel nothing; neither would there be any perceptible shock should he stand upon dry boards or other insulated or insulating material.

Another thing to be borne in mind is that writers of sensational articles regarding electrical accidents, like all reporters, make up two or three columns of such matter more with regard to interest than accuracy, for the reason that the managing editor of the paper in which they appear will receive them, and the writers will be rewarded at the rate of from four to eight dollars per column for their work.

According to one of these articles in a New York daily, Mayor Grant is said to believe that the only way wholly to prevent accidents of this kind is by burying the wires, and that, when this shall be done, "there will be no more deaths resulting from people coming accidentally in contact with electric currents of sufficient force to render medical assistance useless." No doubt, many of the accidents already reported would never have occurred had the wires been under ground; but, as ex-Mayor Hewitt said before the National Electric Light Association in 1888, "Gentlemen, when you once have your wires under ground, the next thing is to get them out for use."

Arc-lighting has evidently come to stay, and wherever the arc-light is, there its connections must be more or less exposed. The experiments of the ignorant, and the carelessness of reckless linemen, will continue to result in casualties as long as arc-lights are used, whether the wires are buried or not.

FUTURE RAPID-TRANSIT FOR MAIL AND EXPRESS MATTER. — There are at present two systems before the public for the rapid transit of mail and other light matter, either or both of which will no doubt prove successful in the near future. The Weems system, an experimental track for which has been built at Laurel, Md., has been illustrated and described at length in *Science*; and the results from the small experimental section already equipped have seemed to justify the construction of a five-mile track, which will soon be completed. This system employs actual electric motors in connection with a light elevated structure, the weight of the car with the motors being something like three tons. Whether such a mass, with its complicated and delicate electrical machinery, will come finally into commercial use, remains to be seen. The other system referred to is known as the Portelectric system, and the motto of the inventor is, "To dispense with mass and machinery." In this system a number of helices are used, taking their current from a metallic circuit on an elevated structure. The car itself is nothing more than a magnetized steel cylinder, pointed at both ends, running on a single track. The mail or other matter is placed in this receptacle, and the successive attractions of the different helices through which it passes augment its speed to a velocity the limit of which is so far unknown. A small section has been on exhibition for some time past in the Old South Church, Boston, and thousands of visitors have witnessed the phenomenal speed of the light steel cylinder, even in the narrow confines of the church. The New England Portelectric Company is now building a demonstrative section on a similar principle in Dorchester district, Boston, Mass., and the results will be looked forward to with interest. The electrical pressure used will be somewhere between two hundred and one thousand volts. The track will be elliptical, and the curves laid at an angle which will justify a speed of at least three miles per minute. The material is now on the ground, and the work is to be pushed rapidly forward. The inventor, Mr. John T. Williams of New York, is considering the extension of this principle to the projection of dynamite cartridges.

THE EIFFEL TOWER AND LIGHTNING. — It has been claimed from the first that the conductivity of the Eiffel Tower is sufficient not only to protect it against lightning, but to protect a large area contiguous to it. It is now claimed that the tower and some of its occupants have recently suffered from a stroke of lightning, and various accounts of "blue flames playing about the structure" have been current in the public press. These reports would be almost incredible, were it not for the fact that the directors have taken cognizance of the matter, and are seriously considering whether the conductivity of the tower is sufficient as it now stands. The safety of the structure is of considerable moment, not only to visitors, but from a financial point of view, when it is considered that a recent week's receipts, exclusive of rentals and privileges, have amounted to the round sum of sixty-seven thousand dollars.

BOOK-REVIEWS.

Institutes of Economics. By E. BENJAMIN ANDREWS. Boston, Silver, Burdett, & Co. 12°.

THIS book has been written because the author thinks that the existing manuals on the subject involve two serious faults of method. One is that they explain every thing too fully, thus leaving too little for teacher and student to do; and the other is that they do not mark by difference of type the distinction between the principles of the science and the examples used to illustrate them. Accordingly, his own presentation of the subject is very succinct, so much so as to deprive his book of all literary form; and his illustrations and much other matter are given in the form of notes. We are strongly of opinion that in both respects he has made a mistake. Economics is too difficult a subject to be adequately taught in so succinct a form as that of this treatise; and the separation of principle and illustration, besides being a literary fault, increases the difficulty of understanding the science. However, nothing but actual use can determine the merits of Mr. Andrews's method, and his work certainly contains a large amount of matter, and shows a thorough mastery of the best works on the subject. His views are substantially those of the English writers, with some modifications due to German thought. The concise character of the work renders some of its expositions obscure, and insufficient for a proper understanding of the subject, this being particularly the case with the account of supply and demand, which is only presented in a note, and very insufficiently there. The author's views are in the main sound, but his theory of "ideal money" can hardly be called so. He would have the State issue all money, both coin and paper; and, when there occurred a general fall or rise of prices, the government should "correct the same by expanding or contracting the circulation." Let us hope that "ideal money" will never come into use.

Handbook of Psychology, Senses and Intellect. By JAMES MARK BALDWIN. New York, Holt. 8°.

THIS volume is the first part of a general treatise on psychology, the second volume being designed to treat of the emotions and the will. It is both descriptive and theoretical, and is intended to present the latest views on the science, so far as these are accepted by the author. The style is plain and easily understood, except in a few places where the writer does not seem to have a perfect mastery of the thought he wishes to convey. Professor Baldwin considers the introspective method as the main instrument of psychological study, though he recognizes the value of the experimental method, so far as its reach extends. He rejects the theory of unconscious intelligence, and gives good reasons for doing so. His discussion of consciousness and of the nature and methods of psychology are among the best portions of the work. His views are to a certain extent eclectic, and reflect the present unsettled state of both psychology and philosophy. He tells us that he studied philosophy under one of the leaders of the Scottish school, and his work reflects in many respects the influence of that school. His classification is similar to theirs, and in particular he follows them in his treatment of reason as the "regulative faculty," the faculty of intuitions. In other parts his work shows the influence of Kant, while that of the empirical school and the physiologists is also apparent. Take, for example, his theory of the perception of

space. He rejects Kant's view that space is a product of our own mental action, and also the empirical theory, which reduces space to sensation, and gives as his own view that "the mind has a native and original capacity for re-acting upon certain physical data in such a way that the objects of its activity appear under the form of space." This theory he expounds at considerable length, but fails to make clear what this "mental reconstruction of space" really is, or even what he considers space itself to be. It is plain, however, that this theory is a compromise, or medium, between the Kantian view and that of the empiricists, and thus illustrates what we mean in saying that Professor Baldwin's work reflects the unsettled state of philosophy. If space permitted, we might incline to criticise some of his other views, and particularly his theory that perception and representation are fundamentally the same, and also some of his views on association. In the present state of opinion, however, no treatise on psychology can be entirely satisfactory; and Professor Baldwin's work, in spite of what we consider its errors, has much in it that is good.

An Elementary Class-Book of General Geography. By HUGH ROBERT MILL. London and New York, Macmillan. 12°. 90 cents.

MR. MILL is the lecturer on physiography and on commercial geography in the Heriot-Watt College, Edinburgh. His book is a descriptive geography, without maps, for which the student is referred to some good atlas, but with a few scattered illustrations intended to convey an idea of specially characteristic features of this or that country, or of scenes typical of the life. For instance, there are given views of a street in London, of a street in Cairo, of the Brooklyn Bridge, and of a hotel in the Blue Mountains, Australia.

In his descriptions we fear Mr. Mill has occasionally, for the sake of vividness, preferred to tell of one phase of the life he is handling, leaving his readers ignorant of the great variations that may exist in different branches of the same people. He tells of the Eskimo as living in their snow-huts in an atmosphere rendered so warm by the oil-lamps that they throw off all their clothing. That this is not the constant practice is well known. Again, the tendency to be a little hasty is shown in the statement that "when the sun is rising at Labrador, it is noonday at Vancouver Island."

The general narrative runs smoothly, however; and the book will be found suggestive by American teachers, though its being written markedly for the young of Great Britain will not inure to its advantage in this country.

AMONG THE PUBLISHERS.

THE Harrisburg (Penn.) *Telegram* is preparing to publish in book form a history of the Johnstown disaster. The volume will meet the popular demand for a full description of the great calamity. Besides, the fact that the net proceeds from the sales will be applied for the benefit of printers' orphan children, and aged men and women who suffered by the flood, commends the work to the

favorable consideration of the public. The book will be sold by subscription only.

—The October *St. Nicholas* has contributions from Noah Brooks, Joel Chandler Harris, Celia Thaxter, Elizabeth Robins Pennell, Harriet Prescott Spofford, Julian Ralph, Margaret Johnson, Elizabeth Cavazza.

—Seven writers—clergymen, college professors, and public men, some of them specialists of acknowledged standing—have associated themselves to discuss special questions of social interest and import, and to prepare papers to be afterwards given to the public from time to time in the pages of *The Century*. The writers include the Rev. Professor Shields of Princeton, Bishop Potter of New York, the Rev. Dr. T. T. Munger of New Haven, the Hon. Seth Low of Brooklyn, and Professor Ely of the Johns Hopkins University. For each paper the author will be responsible, but he will have had the benefit of the criticism of the other members of the group before giving it final form. The opening paper will be printed in the November number. *The Century* also has in preparation a series of papers on topics relating to the gold-hunters of California. The articles will be prepared for the most part, as were the war papers, by prominent participants in the events which they describe; and they will include accounts of early explorations, life in California before the gold discovery, the finding of gold in 1848 at Sutter's Fort, the journey to California by the different routes (around the Horn, across the plains, by Nicaragua, and by Panama), life in the mining-camps and in San Francisco, and other important aspects of California life at the time. It is believed that these papers will be in the nature of a revelation to the reading public of the present day as to many interesting aspects of the pioneer period, its romance and adventure, its tragedy and pathos, and its poetry and humor. A careful search in California and elsewhere has already brought to light many interesting pictures never yet engraved. The publication of the papers will not be begun until the series is further advanced.

—Mr. M. F. Sweetser, for the past seventeen years connected with James R. Osgood & Co. and Ticknor & Co. as writer of their capital series of American guide-books, has become editor-in-chief for the Moses King Corporation. For a long time he will be exclusively engaged on the mammoth "King's Handbook of the United States," the most important and costly work of the kind ever published, and which will be issued next year.

—The success of Marshall P. Wilder's book, "The People I've Smiled With" (Cassell & Co.), has surprised no one more than that amiable little fellow, its author. He knew that he had a great many good friends, who would buy it and read it, but he did not know that they were to be counted by the thousands. The sale of this book has been second only to that of Max O'Rell's "Jonathan and his Continent."

—Messrs. G. P. Putnam's Sons announce as in preparation "An Experimental Study in the Domain of Hypnotism," by R. von Krafft-Ebing, professor of psychiatry and nervous disease in the University of Graz, Austria, translated by Charles G. Chaddock,

D. APPLETON & CO.

PUBLISH THIS WEEK.

EUROPEAN SCHOOLS;

OR, WHAT I SAW IN THE SCHOOLS OF GERMANY, FRANCE, AUSTRIA, AND SWITZERLAND. By L. R. KLEMM, Ph.D., Principal of the Technical School, Cincinnati, Ohio. Vol. XII of "The International Education Series," edited by WILLIAM T. HARRIS, LL.D. Fully illustrated. 12mo. cloth. Price, \$2.00.

In this volume the author reports the results of a ten months' journey among the schools of Europe. Lessons which the author heard are sketched as faithfully as a quick pencil could gather and the memory retain them. The author saw the best that Europe could offer him, and in this volume he has pictured the best results, described the most advanced methods, and given a great number of valuable hints that will be serviceable to all teachers who wish to advance the standard of their work.

THE STRUCTURE AND DISTRIBUTION OF CORAL REEFS.

By CHARLES DARWIN. With Notes, and an Appendix giving a summary of the principal contributions to the history of Coral Reefs since the year 1874, by Prof. T. G. BONNEY. From the third English edition just published. With Charts and Illustrations. 12mo. cloth. Price, \$2.00.

The publishers have taken the occasion of a new English edition of this work to issue the first American edition, which is made especially valuable by the important additions by Prof. Bonney.

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THE BERMUDA ISLANDS:

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ACADEMY OF NATURAL SCIENCES, Philadelphia.

HEAVEN AND HELL, by EMANUEL SWEDENBORG, 416 pages, paper cover. Mailed pre-paid for 14 Cents by the American Swedenborg Printing and Publishing Society, 20 Cooper Union, New York City.

M.D., assistant physician Northern Michigan Asylum; "The Story of the Bacteria and their Relations to Health and Disease," by T. Mitchell Prudden, M.D., author of "A Manual of Practical Normal Histology;" and "Through the Ivory Gate," being studies in psychology and history, by William W. Ireland, author of "The Blot on the Brain."

— Ex-Postmaster-General Thomas L. James has prepared an explanation of needed postal reforms, which will appear in the October *Forum*. Mr. James declares that the railway mail service is twenty years behind the times, and ought to be very greatly improved; that small offices near to one another ought to be consolidated under one management, so as to save expense; and that ocean postage ought greatly to be cheapened. Senator Cullom of Illinois will have an article in the same number on "Protection and the Farmer," to show that the farmers are benefited by a protective system more than any other class. Mr. Edward Wakefield, a member of the Australian Parliament, who has been elected and defeated many times under the Australian ballot system, will contribute to this number an explanation of the practical workings and of some defects of the system which has been so much discussed in this country. Professor William T. Harris, United States commissioner of education, writes a critical examination of Edward Bellamy's "Looking Backward."

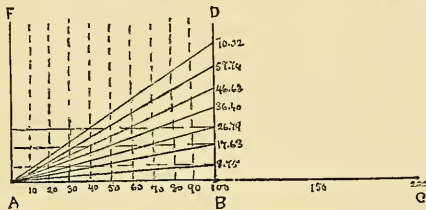
LETTERS TO THE EDITOR.

A New Method for ascertaining Heights and Distances in Right-angled Triangles.

ABOUT four years ago I devised a method whereby the solution of right-angled triangles, for the taking of distances and heights, is much facilitated by a tangent scale on the instrument.

The principle depends upon the well-known fact that the perpendicular of a right-angled triangle is equal to the tangent of the included angle multiplied by the base.

The graduation is accomplished as follows: we take a base-line (say, of 100, for convenience), and an angle of five degrees. Com-



FA and *DB* represent the rights of an ordinary surveying-compass; *DB* containing the scale, and sliding upon *ABC*, which contains the numbers 1-100 marked in equal divisions.

putting this, we find the perpendicular to be 8.75 feet, yards, or metres, in whatever system the base was measured.

This is marked on the arm *BD* instead of five degrees. The computation is continued for the various angles, and the results marked upon the scale. This for a base of 100. Now, if the observer is placed only 50 distant from the object, *DB* is moved to that point on the scale *ABC*, and the height is seen to be the same as before; for, at a distance of 50, an angle of ten degrees, which is observed by going one-half nearer, is subtended by a perpendicular of 8.75, as before: so by moving the scale backward or forward, corresponding to the base-line taken, the height of an object can be immediately read off, provided the side of the object contains the height; if it does not, other means of triangulation have to be adopted, several methods of which can be readily improvised by one accustomed to such work. Horizontal angles can be solved in the same manner by having the rim of the compass-box graduated for a given base-line; then by using this base-line, and taking the distance between the observed points to represent the perpendicular of the triangle, the distance can be read directly from the instrument.

HARVEY B. BASHORE.

West Fairview, Penn., Sept. 13.

Brocken Spectre.

THIS phenomenon has been associated with the Brocken, one of the Hartz Mountains in Germany, about 3,700 feet in height, because more often observed from there. It has given rise to a large number of remarkable theories in explanation, many of which originated with those who had never seen it. An exhaustive article, giving a *résumé* of records regarding it, will be found in the *Quarterly Journal of the Royal Meteorological Society* for 1887, at p. 245. The explanation having the widest acceptance was published in the above article, and later in the *American Meteorological Journal*, August, 1889, and is as follows: the eye is deceived by the apparition, and thinks it much farther away than it really is. It seems to me that this is hardly tenable. The only way in which the eye could be deceived would be in case the shadow were formed a long way off; but, if it were really formed near the eye, it would appear in its natural size. When one looks into a concave mirror, the eye is at first deceived, thinking the mirror plane; but in this case the deception is very plainly due to the action of the mirror.

The very singular explanation is given in "Johnson's Cyclopædia," that "the vapors of the atmosphere act as a vast concave mirror." Singular as it may seem, however, it is probable that this is, undesignedly, more than half correct. A short stay on the summit of Mount Washington has shown this spectre in all its phases. The best time to see it is either in the early morning or just before sunset, and when the fog is not too dense to hide the sun. If the observer turns his back to the sun, he will see on a bank of fog, if it does not envelop him, a slightly diminished shadow of himself. The eye is not deceived in any case as long as the fog forms a nearly vertical wall at fifty or more feet distance. If, now, the fog envelops the person, the shadow appears to start directly from him, and often seems very large. There is no deception of the eye at all, if one is accustomed to careful observations.

The following is advanced as a probable explanation. The shadow of the person is cast upon the fog in solid form; that is, the object shuts off the light of the sun, and one sees only the surface of his own solid shadow looking into its axis. The arms and legs also cast solid shadows, and the person sees the movement of these outside of the shadow of his body. It may be better understood to call to mind the shadow one sees on the ground as the sun is setting. This gradually grows longer and longer, and at last disappears in the distance. The fog forms a sort of "ground," and the shadow is cast upon it. It is possible to form the same shadow with a lantern which concentrates its rays by a reflector. There is no difficulty, in a fog, in seeing the shadow enormously enlarged. Scores have seen it on Mount Washington. It might be thought that the nearness of the light was the cause of the enlargement; but this was not the case, for the shadow began exactly at the person where it could have been only the natural size.

The familiar appearance of "sun drawing water" will help to explain this phenomenon. In this case the air is full of haze or fog, and a small cloud casts a solid shadow thousands of times as large as itself. The surface of this is what we see. If an eye were placed in the edge of the cloud casting the shadow, the latter would appear on all sides. In the case of the spectre, this same solid shadow could be seen by a second person standing and looking across it, provided the light of the sun were not dimmed by the fog. It is to be hoped that we may have more observations of this interesting phenomenon.

H. A. HAZEN.

Washington, Sept. 23.

Note on the Anserine Affinities of the Flamingoes.

A CLOSER study of the structure of a member of the groups of existing birds is throwing a new light upon their relationships, and at the same time somewhat disturbing some very crude and preconceived notions as to their affinities.

For a great many years past, some of the most distinguished of zoologists have insisted that the position of the flamingo was "so completely intermediate between the anserine birds on the one side, and the storks and herons on the other, that it can be ranged with neither of these groups, but must stand as the type of a division by itself." Recently, Professor Parker (*Ibis*, April, 1889) has said, in reviewing the structure of the wing in the flamingo (*Phanicopte-*

ris), that "on the whole, this is a very perfectly formed wing, and is more like that of an ibis than that of a goose, as, indeed, is much of the structure of *Phanicopterus*."

No less eminent an authority than Professor Huxley has strongly contested the point that the flamingoes are more nearly related to the geese than any other birds known to him; and I believe here-

fore all American ornithologists had the same idea. From my own studies, I am confident that the above opinion of Professor Parker will prevail in the future, and fuller researches into the structure of the several types in question will prove it to be the correct one.

R. W. SHUFELDT.

Takoma, D.C., Sept. 19.

INDUSTRIAL NOTES.

A Good Record from Buffalo.

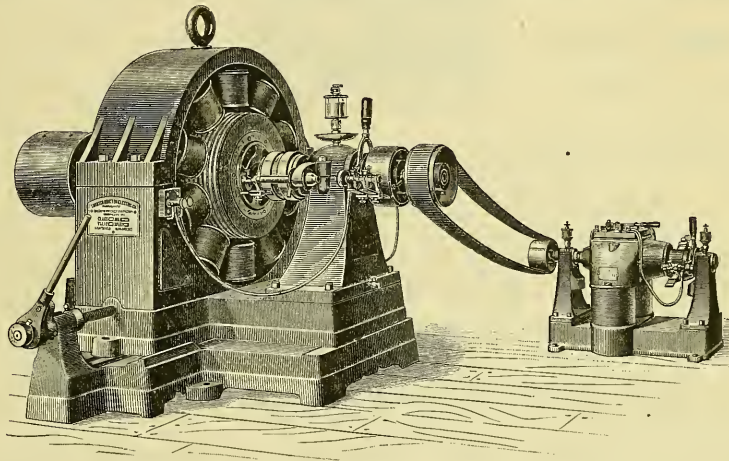
AMONG the cities which are now adopting electricity as a motive power on their roads is Buffalo, N.Y. The Buffalo Street-Railway Company of that city, about two months ago, made a contract with the Sprague Electric Railway and Motor Company of New York for the equipment of four electric cars. This equipment was intended only to try the electric system; and, if the trial should be successful, it was contemplated that an equipment of a very large number of cars would be operated upon this road. The cars have been in operation about four weeks, and carry large numbers of passengers. Upon a recent Sunday, the four cars and four trail cars carried twenty-five thousand passengers without the loss of a single trip. This is a notable record, considering the small number of cars operated and the grades upon this line. The people in Buffalo are enthusiastic over the new system of propelling street-

motors has been built for a long-distance transmission power plant which the Sprague Company have ordered for erecting in South Africa. Other machines of the same size and type go to other parts of the world through the large demand for motors of this size in long-distance power transmissions, mining-work, and general industries.

The efficiency of this machine is claimed to be high, while at the same time the speed is kept quite low; the motor making only about 500 revolutions a minute while operating under full load.

The Thomson-Houston Alternating-Current Dynamo.

UNQUESTIONABLY the most economical and valuable dynamo in central-station use for long-distance lighting is the alternating-current machine; and its recent adoption for its practical working in this country, although but a matter of a short time, has caused a great change in the methods of supplying illumination by incandescent lamps. The economy with which the electric light can be



THE THOMSON-HOUSTON ALTERNATING-CURRENT DYNAMO.

cars, and say that the management will soon give an order for an increased equipment.

New 75 Horse-Power Electrical Motor.

Up to this time, nearly all the electrical manufacturers have confined themselves to small motors; and although all have acknowledged that the transmission of power on a large scale is feasible and practicable, yet, so far, it has been found commercially more desirable to keep down the size of motors to something like 25 horse-power or less.

We understand the Sprague Electric Railway and Motor Company of New York has departed from this routine, and that they have received a number of orders recently for a larger motor, which have had the result of calling forth the present new 75 horse-power motor, which is by far the largest electric motor which has ever been built. This machine is not dissimilar in appearance to the ordinary Sprague standard electric motor of smaller sizes.

The first one of these motors manufactured was for the Kearney Paper Company of Kearney, Neb., where about 120 horse-power of electric motors built by the Sprague Company will be used for operating the entire mill. The current for driving these motors is generated by water several miles away. The second of these

produced is dependent primarily upon the source of power for operating the dynamos, and the use of the alternating current renders it possible to locate a central station with particular reference to coal and water supply; and the fact that a high-potential current can be transmitted long distances over a small wire, and at a small loss, renders it possible to make use of available water-powers, which could not be done by any other system. Then, again, the cost of maintenance and construction is greatly reduced, as a current can be conducted to a centre of distribution, from which the circuits for the immediate supply of current to the lamps can be taken.

We illustrate herewith the improved alternating-current dynamo made by the Thomson-Houston Electric Company, which has met with such a deserved success in central-station work. It is a feature of this machine that it is of simple construction, and can readily be taken apart to allow examination, or replacement of any part which may have become injured. This machine embodies most excellent features in construction of the armature, whereby all tendency to overheating is obviated, and its regulation is such that extreme changes in load do not cause any change in the intensity of the light. The dynamo has been largely introduced by the company, and has everywhere met with success.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

"I wish to exchange *Lepidoptera* with parties in the eastern and southern states. I will send western species for those found in other localities."—P. C. Truman, Volga, Brookings Co., Dakota.

Shells and curiosities for marine shells, curiosities or minerals address W. F. Lerch, No. 308 East Fourth St., Davenport, Iowa.

I want to correspond and exchange with a collector of beetles in Texas or Florida.—Wm. D. Richardson, P.O. Box 223, Fredericksburg, Virginia.

100 botanical specimens and analyses for exchange. Send list of those desired and those which can be furnished, and receive a similar list in return. Also cabinet specimens and curiosities for the same. Scientific correspondence solicited.—E. E. Bogus, Orwell, Ashta, County, O.

I will sell to chapters or individual members of the Agassiz Association, 25 fine specimens of fossil plants from the Dakota group (cretaceous), correctly named, for \$2.50. Send post-office order to Charles H. Sternberg

(author "Young Fossil-Hunters"), 1033 Kentucky Street, Lawrence, Kan.

One mounted single achromatic photographic lens for making 4 × 5 pictures, in excellent condition; also one "new model" double dry-plate holder (4 × 5"), for fine geological or mineralogical specimens, properly classified.—Charles E. Frick, 1019 West Lehigh Avenue, Philadelphia, Penn.

Drawings from nature—animals, birds, insects, and plants—to exchange for insects for cabinet; or I will send them in sets of ten each for ten cents in stamps. My drawings in botany are in detail, showing plant, leaves, flowers, seed, stamens, pistils, etc.—Alda M. Sharp, Gladbrook, Io.

The undersigned wishes to make arrangements for the exchange of *Lepidoptera* of eastern Pennsylvania for those from other localities. All my specimens are named and in good condition.—Charles S. Westcott, 613 North 17th Street, Philadelphia, Penn.

California onyx for minerals and coins not in my collection.—W. C. Thompson, 612 East 141st Street, New York, N.Y.

A few first-class mounted birds, for first-class birds' eggs of any kind in sets.—J. P. Babbitt, secretary Chapter 755, 10 Hodges Avenue, Taunton, Mass.

Mineral Lands.

MANGANESE DEPOSITS.—A rich deposit of Manganese is for sale. Apply to H. N., care of *Science*, 47 Lafayette Place, New York.

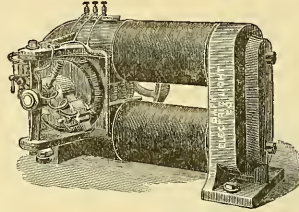
GOLD-BEARING QUARTZ VEINS.—Any one wishing to engage in gold mining will learn of a newly discovered vein by applying to H. N., care of *Science*, 47 Lafayette Place, New York.

RED SLATE.—A valuable deposit of red slate for sale. Apply to H. N., care of *Science*, 47 Lafayette Place, New York.

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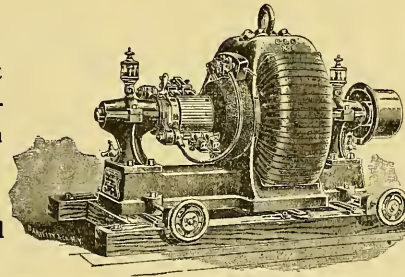
V. Exhibitions in New York at frequent intervals, of Kansas and Nebraska Farm Products. The Exhibition at the American Institute in the fall of 1888, received the *HIGHEST AWARD* of superiority.

VI. Monthly Bulletins giving full information about all Mortgages offered for sale.

*Address for Monthly Bulletin and Investors' Committee Report for 1888,***HENRY A. RILEY, General Eastern Manager, 191 Broadway, N.Y.**

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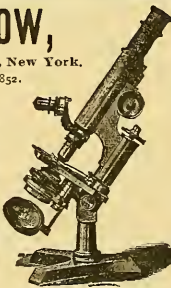
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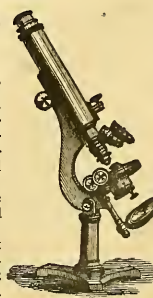
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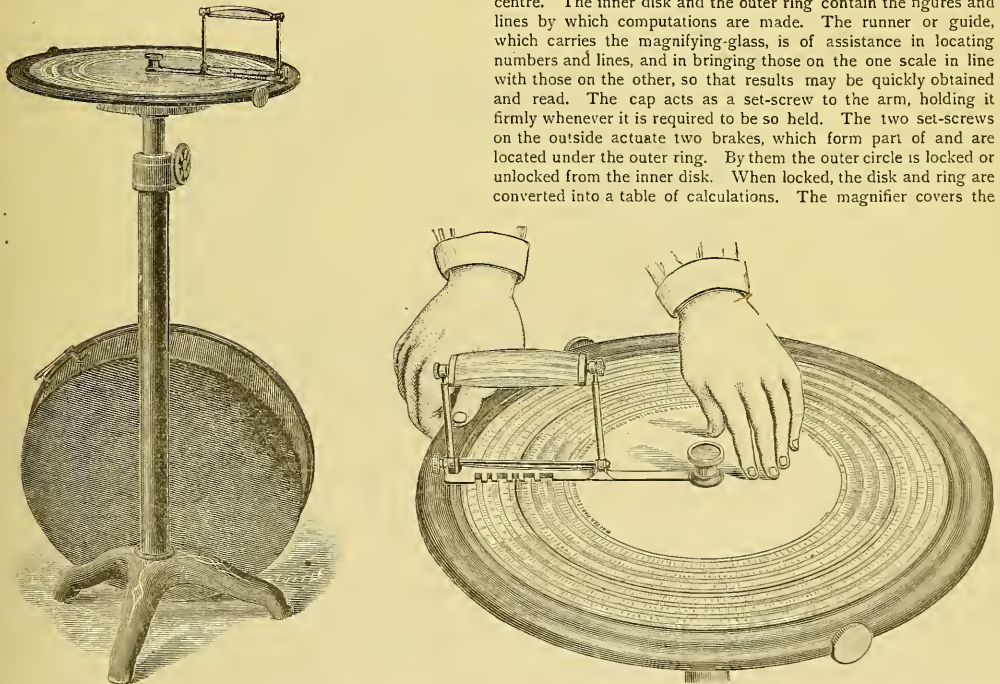
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THE PROPORTIOR.

A NOVEL and exceedingly simple form of calculating-machine, called by its inventor a "proportior," is being brought to the attention of accountants, statisticians, and others, in this city. The general appearance of the device is shown by the accompanying engravings. Fig. 1 shows the instrument on its revolving stand, Fig. 2 indicates the first position in solving problems, and Fig. 3 the second position. The magnifier, by which the operator is able to read the divisions of the disk with accuracy, is clearly shown in

Referring to Fig. 1, it will be seen that the outer circle rotates around the inner disk. The relation of the parts is perhaps better shown in Figs. 2 and 3, which are on a larger scale. Stops are provided by which the disk may be fastened to the outer circle at any desired point. The frame that supports the disk and circle is of metal, the disk and ring being of wood, constructed to overcome expansion and contraction, and on which is affixed the scales. The other parts consist of an outer ring, a runner or guide, a cap, two set-screws, and two brakes. The metal frame supports and holds all the other parts. The movements are adjusted to a true centre. The inner disk and the outer ring contain the figures and lines by which computations are made. The runner or guide, which carries the magnifying-glass, is of assistance in locating numbers and lines, and in bringing those on the one scale in line with those on the other, so that results may be quickly obtained and read. The cap acts as a set-screw to the arm, holding it firmly whenever it is required to be so held. The two set-screws on the outside actuate two brakes, which form part of and are located under the outer ring. By them the outer circle is locked or unlocked from the inner disk. When locked, the disk and ring are converted into a table of calculations. The magnifier covers the



FIGS. 1 AND 2.—THE PROPORTIOR.

the two latter figures, the reader being supposed to be looking toward the operator. This calculating-machine, the scale part of which is but fifteen inches in diameter, may be described as a slide rule of greatly extended length, reduced to a small circle. In the language of the inventor, it is a mechanical device which performs with ease, rapidity, and correctness, operations in commercial and mechanical arithmetic. It is further asserted to be an arithmetical library in itself, in which, for the purpose of computation, the unit can be divided into 1,000,000 parts, while the whole numbers range from 1 to 1,000,000.

entire width of both scales, and is an important assistant to the sight in reading the finer divisions. It is mounted upon the runner, and is adjustable.

The operation is as follows. The instrument being set on a suitable surface, and at a convenient height so that the eyes can be directly over it, the caps and set screws are loosened, so that the runner is free to move and the circle to revolve around the disk. The operator then assumes the position shown in Fig. 2, and exercises just force enough to hold the entire apparatus steady. His right hand grasps the edge of the outer ring, moving it either to or from

him, as may be necessary to bring the recorded figures in line. To assist in this, the runner is used.

It is impossible to give here a full description of the process, but it seems to be little more than finding and aligning certain figures in the two concentric tables. It is claimed by its inventor, Mr. Walter Hart of this city, that with it the simplest as well as the most complicated problems in multiplication, division, proportion, compound proportion, common divisor, common multiple, interest, involution, evolution, compound percentages, averaging of accounts, etc., can be readily solved. He has prepared for distribution a pamphlet giving a full description of the device, and of the method of using it.

OIL AND IRON IN NEW ZEALAND.

THE New Zealand Government have recently published a report upon the petroleum-deposits of the Taranaki district, which apparently have a great future before them. The oil comes to the surface in many places near New Plymouth, besides impregnating the surrounding country to such an extent that farmers have had to abandon many wells, on account of the petroleum gushing into them with the water. To ascertain whether there was a probability of these oil-deposits proving a mercantile success, the govern-

ment of New Zealand deputed Mr. Gordon, inspecting engineer of the Mines Department, to visit the locality. Mr. Gordon made a careful survey of the country, and in his lengthy report he affirms that "petroleum exists over a large area, and that it is only a question of boring to the requisite depth to get at the source." According to *Engineering*, these deposits have a twofold advantage: if successfully developed, they not only have at their disposal the Australasian market, now dependent on America for oil, but they would further provide with fuel the local iron industry, at present resting upon limited supplies of coal and charcoal.

Along the shores of the Taranaki district stretch the famous iron-sand beaches of New Zealand, — beaches composed almost entirely of pulverized iron ore. Countless millions of tons of this material lie along the western coasts of the North Island of New Zealand. The ore produces splendid iron, but is somewhat refractory. This would be a trifle, however, if an abundant supply of cheap fuel were available for smelting purposes. This seems to be now forthcoming in the shape of petroleum. For some time past oil has been largely used for smelting in America, and there is no reason why it should not be successfully adopted in New Zealand; the Taranaki oil having plenty of body, and being admirably adapted for fuel purposes. It may be noted, that, while the oil-deposits of America and Russia are several hundred miles inland, those of New Zealand are actually on the coast; so close, indeed,

that the beach at New Plymouth is pitted with petroleum oozings. What is now wanted is some trial drills to test the quantity and character of the oil-supply. A few drills in the vicinity of New Plymouth ought to bring to the surface not only enough oil to provide the locality with smelting fuel, but also sufficient for several refineries.

It is curious, that, while millions are invested by the public of this country in purely speculative gold-mines, hardly any funds are devoted to sinking wells for petroleum in Burmah, Canada, and New Zealand. In America, hundreds of times over, a single well has proved as remunerative as a gold-mine; yet, although petroleum can be easily enough turned into gold, such is the demand for it, English investors have hitherto ignored petroleum undertakings. Presently they will rush into it, just as shippers have rushed into the oil-steamer business, building sixty tank-vessels in less than five years, after a prolonged period of similar indifference.

THE ORIGIN OF PETROLEUM.¹

THE enormous consumption of petroleum and natural gas frequently raises the question as to the probability of the proximate exhaustion of the supply; and, without doubt, many fear to adopt the use of oil, from a feeling that if such use once becomes general,

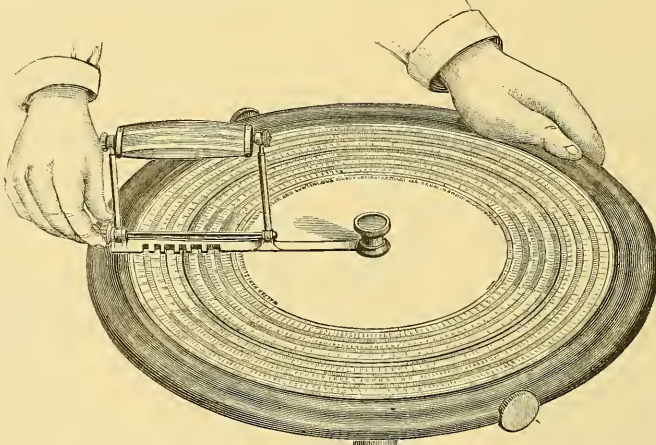


FIG. 3.—THE PROPORIOR.

the demand will exceed the production, the price will rise indefinitely, and old methods of illumination and old forms of fuel will have to be reverted to. From this point of view, it is most interesting to inquire what are the probabilities of a continuous supply; and such an investigation leads at once to the question, "What is the origin of petroleum?" In the year 1877, Professor Mendeleeff undertook to answer this question; and as his theory appears to be very little known, and has never been fully set forth in the English language, I trust you will forgive me for laying a matter so interesting before you. Dr. Mendeleeff commences his essay by the statement that most persons assume, without any special reason, — excepting, perhaps, its chemical composition, — that naphtha, like coal, has a vegetable origin. He combats this hypothesis, and points out, in the first place, that naphtha must have been formed in the depths of the earth. It could not have been produced on the surface, because it would have evaporated; nor over a sea-bottom, because it would have floated up and been dissipated by the same means. In the next place, he shows that naphtha must have been formed beneath the very site on which it is found; that it could not have come from a distance, like so many other geological deposits, and for the reasons given above, namely, that it could not be water-borne, and could not have flowed along

¹ Extracted from Mr. Anderson's presidential address to Section G (Mechanical Science) of the British Association.

the surface; while in the superficial sands in which it is generally found no one has ever discovered the presence of organized matter in sufficiently large masses to have served as a source for the enormous quantity of oil and gas yielded in some districts; and hence it is most probable that it has risen from much greater depths under the influence of its own gaseous pressure, or floated up upon the surface of water, with which it is so frequently associated.

The oil-bearing strata in Europe belong chiefly to the tertiary or later geological epochs; so that it is conceivable that in these strata, or in those immediately below them, carboniferous deposits may exist, and may be the sources of the oil. But in America and in Canada the oil-bearing sands are found in the Devonian and Silurian formations, which are either destitute of organic remains or contain them in insignificant quantities. Yet, if the immense masses of hydrocarbons have been produced by chemical changes in carboniferous beds, equally large masses of solid carboniferous remains must still exist; but of this there is absolutely no evidence while cases occur in Pennsylvania where oil is obtained from the Devonian rocks underlying compact clay-beds, on which rest coal-bearing strata. Had the oil been derived from the coal, it certainly would not have made its way downwards; much less would it have penetrated an impermeable stratum of clay. The conclusion arrived at is, that it is impossible to ascribe the formation of naphtha to chemical changes produced by heat and pressure in ancient organized remains.

One of the first indices to the solution of the question lies in the situation of the oil-bearing regions. They always occur in the neighborhood of, and run parallel to, mountain ranges; as, for example, in Pennsylvania, along the Alleghanies; in Russia, along the Caucasus. The crests of the ranges, formed originally of horizontal strata which had been forced up by internal pressure, must have been cracked and dislocated, the fissures widening outwards, while similar cracks must have been formed at the bases of the ranges; but the fissures would widen downwards, and would form channels and cavities, into which naphtha, formed in the depths to which the fissures descended, would rise and manifest itself, especially in localities where the surface had been sufficiently lowered by denudation or otherwise.

It is in the lowest depths of these fissures that we must seek the laboratories in which the oil is formed; and, once produced, it must inevitably rise to the surface, whether forced up by its own pent-up gases or vapors, or floated up by associated water. In some instances the oil penetrating or soaking through the surface layers loses its more volatile constituents by evaporation, and in consequence deposits of pitch, of carboniferous shales, and asphalt, take place; in other cases, the oil, impregnating sands at a lower level, is often found under great pressure, and associated with forms of itself in a permanently gaseous state. This oil may be distributed widely, according to the nature of the formations or the disturbances to which they have been subjected; but the presence of petroleum is not in any way connected with the geological age of the oil-bearing strata, it is simply the result of physical condition and of surface structure.

According to the views of Laplace, the planetary system has been formed from incandescent matter torn from the solar equatorial regions. In the first instance, this matter formed a ring analogous to those which we now see surrounding Saturn, and consisted of all kinds of substances at a high temperature; and from this mass a sphere of vapors, of larger diameter than the earth now has, was gradually separated. The various vapors and gases which, diffused through each other, formed at first an atmosphere round an imaginary centre, gradually assumed the form of a liquid globe, and exerted pressures incomparably higher than those which we experience now at the base of our present atmosphere. According to Dalton's laws, gases, when diffused through each other, behave as if they were separate: hence the lighter gases would preponderate in the outer regions of the vaporous globe, while the heavier ones would accumulate to a larger extent at the central portion; and at the same time the gases circulating from the centre to the circumference would expand, perform work, would cool in consequence, and at some period would assume the liquid or even the solid state, just as we find the vapor of water diffused through our present atmosphere does now. That which is true of changes of

physical condition, Henri St. Claire Deville, in his brilliant theory of dissociation, has shown to be equally true with respect to chemical changes; and the cooling of the vapors forming the earth while in its gaseous condition was necessarily accompanied by chemical combinations, which took place chiefly on the outer surface, where oxides of the metals were formed; and, as these are generally less volatile than the metals themselves, they were precipitated on to what there then was of liquid or solid of the earth, in the form of metallic rain or snow, and were again probably decomposed, in part at least, to their vaporous condition. The necessary consequence of this action is that the inner regions of the earth must consist of substances the vapors of which have high specific densities and high molecular weights,—that is to say, composed of elements having high atomic weights,—and that the heavier elementary substances would collect near the centre, while the lighter ones would be found nearer the surface. Our knowledge of the earth's crust extends but to an insignificant distance; yet, as far as we do know it, we find that the arrangement above indicated prevails. Hydrogen, carbon, nitrogen, oxygen, sodium, magnesium, aluminium, silicon, phosphorus, sulphur, chlorine, potassium, calcium,—substances whose atomic weights range from 1 to 40,—became condensed, entered into every conceivable combination with each other, and produced substances the specific gravity of which averages about $2\frac{1}{2}$, never exceeds 4, and are found near the immediate surface of the globe.

But the mean specific gravity of the earth as determined by Maskelyne, Cavendish, and others, certainly exceeds 5, and consequently the inner portion of our globe must be composed of substances heavier than those existing on the surface; and such substances are only to be found among the elements with high atomic weights. The question arises, "What elements of this character are we likely to find in the depths of the earth?" In the first place, since gases diffuse through each other, a certain proportion of the elements of high atomic weight will also be found on the surface of the earth. Second, the elements forming the bulk of the earth must be found in the atmosphere of the sun—if, indeed, the earth once formed part of its atmosphere. Of all the elements, iron, with a specific gravity exceeding 7, and with an atomic weight of 56, corresponds best with these requirements, for it is found in abundance on the surface of the earth; and the spectroscope has revealed the very marked presence of iron in the sun, where it must be partly in the fluid and partly in the gaseous state, and consequently iron in large masses must exist in the earth: so that the mean specific gravity of our planet may well be 5, the value of which has been determined by independent means.

It is not easy, however, to define in what condition the mass of iron which exists in the heart of the earth is likely to be. Iron is capable of forming a vast number of combinations, depending on the relative proportion of the various elements present. Thus, in the blast-furnace, oxygen, carbon, nitrogen, calcium, silicon, and iron are associated, and produce under the action of heat, besides various gases, a carburet of iron and slag, the latter containing chiefly silicon, calcium, and oxygen; that is to say, substances similar to those which form the bulk of the surface of the earth. But these same elements, if there be an excess of oxygen, will not yield any carburet of iron; and the same result will follow if there be a deficiency of silicon and calcium, because of the large proportion of oxygen which they appropriate. In the same way, during the cooling of the earth, if oxygen, carbon, and iron were associated, and if the carbon were in excess of the oxygen, the greater part of the carbon would escape in the gaseous state, while the remaining part would unite with the iron. It is certain that in the heart of the earth there must have been a deficiency of oxygen, because of its low specific gravity; and the argument is supported by the fact that free oxygen and its compounds, with the lighter elements, abound on the surface. Further, it must be presumed that much of the iron existing at great depths must be covered over and protected from oxygen by a coating of slag; so that, taking all these considerations into account, it is reasonable to conclude that deep down in the earth there exist large masses of iron, in part at least in the metallic state, or combined with carbon.

The above views receive considerable confirmation from the composition of meteoric matter; for it also forms a portion of the solar

system, and originated, like the earth, from out of the solar atmosphere. Meteorites are most probably fragments of planets, and a large proportion of them include iron in their composition, often as carbides, in the same form as ordinary cast iron; that is to say, a part of the carbon is free, and a part is in chemical union with the iron. It has been shown, besides, that all basalts contain iron, and basalts are nothing more than lavas forced by volcanic eruptions from the heart of the earth to its surface. The same causes may have led to the existence of combinations of carbon with other metals.

The process of the formation of petroleum seems to be the following: It is generally admitted that the crust of the earth is very thin in comparison with the diameter of the latter, and that this crust encloses soft or fluid substances, among which the carbides of iron and of other metals find a place. When, in consequence of cooling or some other cause, a fissure takes place through which a mountain-range is protruded, the crust of the earth is bent, and at the foot of the hills fissures are formed; or, at any rate, the continuity of the rocky layers is disturbed, and they are rendered more or less porous, so that surface waters are able to make their way deep into the bowels of the earth, and to reach occasionally the heated deposits of metallic carbides, which may exist either in a separated condition or blended with other matter. Under such circumstances, it is easy to see what must take place. Iron, or whatever other metal may be present, forms an oxide with the oxygen of the water. Hydrogen is either set free or combined with the carbon which was associated with the metal, and becomes a volatile substance; that is, naphtha. The water which had penetrated down to the incandescent mass was changed into steam, a portion of which found its way through the porous substances with which the fissures were filled, and carried with it the vapors of the newly formed hydrocarbons; and this mixture of vapors was condensed wholly or in part as soon as it reached the cooler strata. The chemical composition of the hydrocarbons produced will depend upon the conditions of temperature and pressure under which they are formed. It is obvious that these may vary between very wide limits; and hence it is that mineral oils, mineral pitch, ozokerite, and similar products differ so greatly from each other in the relative proportions of hydrogen and carbon. I may mention that artificial petroleum has been frequently prepared by a process analogous to that described above.

Such is the theory of the distinguished philosopher, who has framed it not alone upon his wide chemical knowledge, but also upon the practical experience derived from visiting officially the principal oil-producing districts of Europe and America, from discussing the subject with able men deeply interested in the oil industry, and from collecting all the available literature on the subject. It is needless to remark that Dr. Mendeleeff's views are not shared by every competent authority; nevertheless the remarkable permanence of oil-wells, the apparently inexhaustible evolution of hydrocarbon gases in certain regions, almost forces one to believe that the hydrocarbon products must be forming as fast as they are consumed, that there is little danger of the demand ever exceeding the supply, and that there is every prospect of oil being found in almost every portion of the surface of the earth, especially in the vicinity of great geological disturbances. Improved methods of boring wells will enable greater depths to be reached; and it should be remembered, that, apart from the cost of sinking a deep well, there is no extra expense in working at great depths, because the oil generally rises to the surface or near it. The extraordinary pressures, amounting to three hundred pounds per square inch, which have been measured in some wells, seem to me to yield conclusive evidence of the impermeability of the strata from under which the oil has been forced up, and tend to confirm the view that it must have been formed in regions far below any which could have contained organic remains.

At Reykjavik a society has just been established, under the presidency of Professor B. Grondal, called the Icelandic Naturalists' Society, the chief aim of which is to found a museum of natural history for Iceland, to be the property of the country. For this purpose it is not only intended to collect specimens of the fauna, flora, and mineral deposits of Iceland, but also to obtain by exchange, or in any other convenient manner, specimens from abroad.

OPEN-AIR TRAVEL AS A CURER AND PREVENTER OF CONSUMPTION, AS SEEN IN THE HISTORY OF A NEW ENGLAND FAMILY.¹

¹ For my own part, I intend to hunt twice a week during my stay with Sir Roger; and I shall prescribe the moderate use of this exercise to all my country friends as the best kind of physic for mending a bad and preserving a good one."—*Sir Roger de Coverley*, chapter xliii. p. 101, Goldschmidt, Edinburgh, 1889.

It is a curious coincidence, that, at the same meeting of the Climatological Association, the president should give you some information gleaned from my recorded cases as to the connection of pleurisy with phthisis, and I should present the history of my father,² cured, as I believe, of severe phthisical symptoms by a journey in an open chaise, and by persistent daily walking of from five to six miles during the rest of his life. In connection with this, I shall endeavor to show, that, by the same persistent open-air treatment of his children during their periods of growth, he was able to prevent the occurrence of the same disease in a large number of his descendants, who, in consequence of himself and his wife being tuberculous, and also first-cousins, must have been very strongly predisposed to it.³

I have a record of this journey as kept by my father in 1808, when he was thirty-five years of age. I found it recently, tied up in a bundle of old papers which had been resting quietly hidden for over half a century. It is a very compact, precisely written statement of that journey, showing, indirectly at least, its benign effects upon him.

It is eminently suggestive to me of the proper treatment of certain cases of phthisis; and, in the hope that it will be suggestive to others also, I now lay it before this society. To some sensitive minds it may seem to be of too private and personal a character to be placed thus freely before any public assembly. I have no such feeling when questions of human health and happiness are involved.

In 1808 my father was undoubtedly threatened with consumption. He had cough, hemoptysis, anorexia, diarrhoea, and general malaise, with fever and great debility. On Aug. 29 of that year, when thus ill, he started, with a friend as his companion and driver, in an open, one-horse chaise for a tour through New England. At that time it will be recollected that there were no cars, and travel was had in one's own carriage or in public coaches holding nine persons. These were driven over turn-pikes or private roads. There were hotels, more or less comfortable, at which travellers could sleep and get food, in every town. This record lets us more or less distinctly into the feelings, physical and mental, of every day of the month during which the journey lasted. A glance at the map⁴ will show that the travellers went from Salem, Mass., down into Rhode Island, thence by way of Connecticut up through the hills of western Massachusetts to Albany and Troy, and back through Massachusetts to New Hampshire, Vermont, and Maine, and then to the home from which he started. During the trip he travelled 748 miles, passed through 113 towns and cities, and the time spent in this daily open-air exercise was thirty days. During that time he went through all stages of feeling of mental discouragement and of physical weakness up to a real enjoyment of life.

Allow me to refer briefly to these changes. Starting from Sa-

¹ Read before the American Climatological Association, June, 1889, by Henry L. Bowditch, M.D., of Boston, Mass.

² Capt. Nathaniel Bowditch, the father of American mathematics.

³ I am well aware, that, since the brilliant discovery by Koch of the bacillus tuberculosus, some writers deny that phthisis can be inherited. But surely this opinion I cannot think true. All my medical experience is directly against it. Moreover, we all admit that a certain deterioration of the vital power of the whole, or an abrasion of a part, of the body, is necessary for the life and propagation of the bacillus and consequent production of tubercular phthisis. Hence, as far as active out-of-door life tends to the production of perfect health in a person or a family, it would seem, *a priori*, that the course pursued by my father, which undoubtedly was of such infinite service in his own case toward the cure of phthisis, must have been of great use to his children as a preventive, by making them all robust from their earliest years. By so doing he opposed any tendency to poor constitutions, impressed on them from their births; which tendencies, if they had not been counteracted from early life, would, I believe, have made his descendants easy recipients of phthisis.

⁴ A large map was shown at the meeting, marked by circles on the towns where the nights were passed. These circles were entirely black at first, indicating great depression of mind and body, and they became gradually lighter as the patient got better. Those over the last half of the journey were not only free from any shade, but were surrounded by a red border, indicating the comfortable feeling of returning health.

lem (black) with the prominent signs of phthisis, he was so much exhausted, and had hemoptysis after a drive of twenty-five miles to Milton, that the landlord of the hotel advised his friend to take him home to die, as he could not possibly drive to Taunton the next day, as proposed. I derive this last statement, not from the journal, but from family tradition. The travellers were both of them plucky, and not only made that next day's journey, but the sick man felt somewhat better at evening, and notes in the latter part of his record the condition of the country before arriving at Taunton. His fifty miles since leaving Salem had evidently done no harm, but rather good. Anorexia had gone, as he "dined" (with relish, apparently, because he could get nothing else) "on bacon and eggs." Arrived at New Bedford next day, he feels able to visit a friend. He examines a factory. He makes remarks on the inhabitants he met and their employments. Though still having some fever, he feels so much better that much darkness is removed from the circle. Still more refreshed after a night's sleep, and having still less fever, he visits a coal-mine recently discovered in the vicinity.

From this time there is almost steady improvement. He visits Newport (109 miles from Salem), admires the harbor, but notices its lack of shipping (to which in Salem, with its fleets of ships and their long, wealth-bringing East India voyages, he had been long accustomed). At Providence (141 miles from Salem) he finds friends, and has pleasant meeting with them. Nothing is said of illness. On the contrary, he has his "Rosinante harnessed" the next day, with the intention of driving out of his intended route, in order to visit the cotton-factories at Pawtucket Falls. Arriving at Hartford (195 miles from Salem), he is altogether better, finds good fare and a fine hotel. He meets there the judges in their circuit, and has pleasant and profitable conversation with them at the hotel at which they were stopping for the night.

At New Haven (256 miles from Salem, and twelve days of open-air travel) he calls on President Dwight of Yale College, and regrets that the eminent Professor Silliman is absent. He visits the library, and finds it wanting in most of the modern English, French, and German scientific works he had been so long acquainted with, and had studied in Salem. At New Haven he makes, for the last time, any allusion to his health, in the following words: "I have a little pain in my breast, but my appetite and general health are good."

After this date, till he arrived home, his record seems like that of a common traveller. He makes no complaints, but describes brightly the places, friends, and others met, exactly as if he were well, and travelling for pleasure only.

At Albany he makes an especial and extra journey to Troy with a party of transiently met friends, leaving his chaise for nearly two days in the former city. He found the trip "very pleasant." On return to Albany from Troy, he had driven 432 miles in nineteen days.

Starting for home, he appears delighted while travelling through a "picturesque" country, and meeting at the various hotels intelligent company whose society he was able generally to enjoy.¹ He visits the village of Canaan, and describes in detail what he saw of the Shakers, and heard an extraordinary sermon delivered at him, among others, as one of the "outside mankind." I forbear quoting from it. His appetite was becoming ravenous. They would not give him at one tavern, as he says, "half as much as I wanted for my dinner." Finally he arrived home at Salem, so the record states, "in much better health than he had when starting."

His subsequent course in regard to himself and to his children induces me to believe that the journey, though benefiting him immensely, had not wholly cured him; but it had proved to him the absolute need he had of regular, daily, physical, open-air exercise. Afterward, under walks of one and a half to two miles, taken three times daily during thirty years of life, all pulmonary troubles disappeared. He died in 1838, from carcinoma of the stomach, one lung presenting evidences of an ancient cicatrix at its apex, both being otherwise normal. He was sixty-five years old; i. e., thirty years after the journey.

¹ This was not always the case, however, for at one town he met one gentleman, "a member of Congress," who was apparently stupid enough. "He scarcely spoke a syllable during the evening."

Having thus experienced in his own case the vast benefits resulting from constant, regular exercise out of doors, he apparently determined that his children should be early instructed in the same course. As soon as we were old enough, he required of us daily morning walks down to a certain well-known divine's meeting-house, about three-quarters of a mile or a mile from our home. I remember them very well for the tricks played with my brothers on our way down, and for sundry twinges of conscience, felt even at this moment, at the thought that we sometimes decided that the sight of the "weathercock on Dr. Bentley's steeple," though seen more than a quarter of a mile from our proper destination, was near enough to our father's directions.

If any of us, while attending school, were observed to be drooping, or made the least pretence even to being not "exactly well," he took us from school, and very often sent us to the country to have farm-life and out-of-door "play to our hearts' content." Once he told me to go and play, and to "stay away from study as long as you choose." In fact, he believed heartily in the old Roman maxim of "a healthy mind in a healthy body." In consequence of this early instruction, all of his descendants have become thoroughly impressed with the advantages of daily walking, of summer vacations in the country, and of camping out, etc., among the mountains. These habits have been transmitted, I think, to his grandchildren in a stronger form, if possible, than he himself had them.

You will readily agree with me that such habits are among the surest guaranties against the prevalence of phthisis in a family. Before detailing the actual result of these habits upon our family, I must state the prospective chances of our escape from the malady. My father married his cousin, who, after long invalidism, died of chronic phthisis in 1834. Certainly a consanguineous union of two consumptives forboded nothing but evil. They had eight children (born respectively in the years 1805, 1806, 1808, 1809, 1813, 1816, 1819, 1823). Two (born 1809 and 1813; i. e., one and five years after the journey) died, one at eleven, and the other at birth. All the others either are now alive, or they arrived at adult life and married, and have had children and grandchildren, but not a trace of phthisis has appeared in any of these ninety-three persons.

Now, I ask the consideration of this question: To what cause can we attribute this extraordinary immunity from the disease which is generally regarded as showing the influence of heredity and of consanguineous unions more, perhaps, than most other complaints?

If any one can see any other explanation than the influence of this original journey upon the health of one of the great-grand-parents, conjoined with his wise management of his own health subsequently, and his fastening upon his descendants, even to the present day, the virtues of open-air life, I hope he will frankly say so. Truth should be forever our motto; and the man who will convince me of the error of any scientific, or apparently scientific, statement I may utter, and which, if not corrected, may lead others astray, I regard not as an opponent, but as my foremost friend.

I submit these facts and thoughts for candid, mature, and practical consideration and use in the treatment all are called to make of this terrible scourge of all parts of this Union. For my own part, I fully believe that many patients now die from want of this open-air treatment. For years I have directed every phthisical patient to walk daily from three to six miles; never to stay all day at home unless a violent storm be raging. When they are in doubt about going out, owing to "bad weather," I direct them to "solve the doubt, not by staying in the house, but by going out."

A cloudy day, or a mild rain, or the coldest weather, should not deter them. If the weather be very cold, let them put on respirators before leaving the house, and be thoroughly wrapped in proper clothing for the season. I direct them never to stand still and gossip with friends in the open street, as by so doing they are much more liable to get a chill than while walking. Hence, summer and winter alike, my patients usually get plenty of fresh air, uncontami-

¹ The number of their descendants amounts now (1889) to 8 children, 31 grandchildren, 50 great-grandchildren, 4 great-great-grandchildren: total 92. It may be noted, that, of the two who were born in 1809 and 1813, one died when eleven years old (1820), and the other at birth (1813); while the writer and reader of this paper was born twenty days before the journey began.

nated, in a great part at least, by the previous breathing of it by themselves or by other occupants of the house. This course, I believe, might be pursued in any part of our common country. I am certain that I know of patients who have become well, and able to attend to the business of life, under this course. May we not also at times send our patients over short distances in open vehicles, instead of thousands of miles off in ill-ventilated cars to an entirely different climate? Have any of us ever sufficiently tried this open-air journeying at home, so to speak; that is, in the region of the country where the patient lives, wherever that may be?

Certainly this proposed course has at least two sound physiological principles in its favor: viz., a gentle exercise, for many hours in each day, of the whole frame; and an almost perpetual change of air drawn in with each respiratory act, as occurs while driving in a carriage open at the front, and in walking. I have no objection to drugs, properly chosen, and I almost always administer them; but if the choice were given me to stay in the house and use medicines, or to live constantly in the open air without them, I should infinitely prefer the latter course in case of my being threatened with pulmonary consumption.

HEALTH MATTERS.

Typhoid-Fever should be reported to the Health-Officer.

TYPHOID-FEVER is a disease which the State Board of Health of Michigan has declared to be "dangerous to the public health," and as such it comes under the law requiring physicians to report to the health-officials. Any physician who shall neglect to immediately give such notice "shall forfeit for each such offence a sum not less than fifty nor more than one hundred dollars." After Oct. 1, any householder who shall refuse or wilfully neglect immediately to give such notice shall be deemed guilty of a misdemeanor, and is liable to a fine of one hundred dollars, or, in default of payment thereof, may be punished by imprisonment in the county jail not exceeding ninety days.

It seems important that the people generally shall understand this new law, which applies to scarlet-fever, diphtheria, small-pox, and all such dangerous diseases, as well as to typhoid-fever; but at this time of the year typhoid-fever is usually most prevalent, and it is especially dangerous in times of drought: therefore the safety of the people may now be greatly promoted by having every case of typhoid-fever reported to the health-officer, who is by law (Section 1, Act 137, Laws of 1883) required to promptly attend to the restriction of every such disease. A new law, which takes effect Oct. 1, makes it a misdemeanor, punishable by fine or imprisonment, for the health-officer knowingly to violate that section of the law, or for any person knowingly to violate the orders of the health-officer made in accordance with that section. But the actual penalties which are incurred by the violation of these laws are the death penalties to many of the people, about one thousand being lost in Michigan in each year from typhoid-fever. The saving of a large proportion of these lives is the real reason for the effort, in which it is hoped all the people will join, for the restriction of typhoid-fever and other dangerous diseases.

HOW MUCH SHOULD A CITY PAY ITS HEALTH-OFFICER?—The Michigan State Board of Health has recently published a paper by its secretary, Dr. H. B. Baker, in which he asks the question how much the average city or village can afford to pay its health-officer. He answers this question in this way: "Statistics which cannot be questioned prove, that, in those localities in Michigan where the recommendations of the State Board of Health are carried out, about eighty per cent of the deaths from diphtheria and scarlet-fever are prevented by the thorough isolation of all infected persons, and the thorough disinfection of all infected persons, things, and places. Statisticians usually value a person in the prime of life as worth to the community about one thousand dollars." Dr. Baker thinks that in a village of fifteen hundred inhabitants a health officer can easily save the lives of two children and one grown person in each year, and he concludes that such a village can well afford to pay its health-officer two thousand dollars for the prevention and restriction of scarlet-fever, diphtheria, and typhoid-fever—and make money by the transaction.

INGENUITY OF CRIMINALS.—The *Medical Press and Circular* finds in an Indian contemporary some curious instances of misapplied ingenuity on the part of certain habitual criminals in that country. The discovery on a prisoner of a heavy leaden bullet about three-quarters of an inch in diameter led to an inquiry into the object to which it was applied. It was ascertained that it served to bring about the formation of a pouch-like recess at the base of the epiglottis. The ball is allowed to slide down to the desired position, and it is retained there for about half an hour at a time. This operation is repeated many times daily until a pouch the desired size results, in which criminals contrive to secrete jewels, money, etc., in such a way as to defy the most careful search, and without interfering in any way with speech or respiration. Upwards of twenty prisoners at Calcutta were found to be provided with this pouch formation. The resources of the professional malingeringer are exceedingly varied, and testify to no small amount of cunning. The taking of internal irritants is very common, but would-be in-patients very frequently overshoot the mark, and render recovery impossible. Castor-oil seeds, croton beans, and sundry other agents are employed with this object in view, and the medical officers of Indian prisons have to be continually on the lookout for artificially induced diseases, which baffle diagnosis and resist treatment. Army surgeons are not altogether unfamiliar with these tricks, but the British soldier is a mere child in such matters compared with the artful Hindoos.

REGULATION OF BREATHING IN SEASICKNESS.—Dr. Ivan A. Mitropolsky of Moscow recommends, on the ground of his own experience, the following simple method for preventing or aborting all symptoms of seasickness. According to *The Medical Record*, as soon as giddiness, nausea, etc., appear, the author shuts his eyes, and begins to make deep and slow inspirations and expirations. In a few moments (sometimes after three or four respiratory cycles) the symptoms disappear to yield to a comfortable subjective sensation. On their re-appearance, the same procedure is repeated again and again. If the recurrence be rather frequent, it is better to perform the procedure in a recumbent posture (with closed eyes). Since the time the author has begun to practise the method, he never yet suffered from vomiting when on board. In referring to this case in the *London Medical Recorder*, Dr. Idelson says that Dr. Mitropolsky seems to think that the means proposed by him is novel. Meanwhile, in the *British Medical Journal*, March 24, 1888, p. 676, he will find a very interesting note by Dr. J. J. Leiser, in which the writer says (1) that seasickness is caused by irregular and imperfect respiration, leading necessarily to an inadequate aëration of the patient's blood, which consequently becomes poisonous to his brain, and gives rise to sympathetic sickness; (2) that a system of regular, free breathing prevents sickness, or rapidly relieves it; and (3) that his experiments were successfully repeated by Drs. G. C. Stockman and C. W. C. Prentice, who, having selected ten suffering passengers, each seated himself with five of them, and "timed the breathing in the following manner: they (the doctors) raised the hand from the knee, indicating an inspiration, and down again for an expiration, thus timing the respirations to exactly twenty per minute. At the expiration of one hour the active symptoms in each case had entirely subsided." By this time the doctors had thoroughly educated their patients in the *modus operandi* of the cure. The cases continued to be permanent "cures" during the remainder of the voyage from Queenstown to the United States. The writers conclude by asserting that "the cure is infallible in all cases that persist in carrying it out."

HOT-AIR INHALATIONS IN CONSUMPTION.—From experiments in a number of cases, Dr. E. L. Trudeau of Saranac Lake, N.Y., concludes that (1) the therapeutic value of hot-air inhalations in phthisis is doubtful; and (2) the evidence obtained by the bacteriological study of the cases presented does not confirm the assumption that inhalations of heated air can either prevent the growth of the tubercle bacillus in the lungs of living individuals or diminish the virulence of this microbe when it has gained access to them.

THE BREEDING OF SINNERS.—The French Government hopes, apparently, by promoting marriages between male and female convicts, to bring back these stray sheep into the fold of morality and

good conduct. Arrangements have accordingly been made, says the *Hospital Gazette*, to facilitate these unions; but physiologists and pathologists must feel sundry qualms as to the expediency of such a course. The physical and moral degradation of many of these social waifs is distinctly hereditary; and a careful moral training (which is not provided for) would, at the most, only modify the tendencies which have brought them within the clutches of the criminal law. The son of a poet is not of necessity a poet, but the offspring of a bawd or an assassin is extremely likely to develop the same proclivities. If even one of the parties to the transaction were worthy of respect, some regeneration might be hoped for; but the association of two hopelessly abandoned bodies and souls is not calculated to improve matters in any respect whatever.

A CENTENARIAN SURGEON.—The *Patria* of Buenos Ayres affirms that there is now in Bolivia a surgeon, Luca Silva by name, whose age is not less than one hundred and twenty-nine years. He was born in Cochabamba in 1760, and devoted himself, after graduating in medicine, to the practice of surgery. He rendered important service to his country, when, after the famous manifesto of June 16, 1809, she entered on her struggle for independence. His treatment of the wounded, particularly his operations on the field of battle, won him high distinction. He also earned signal honor in the combatant ranks. This parallels the case of Dr. Holyoke of Salem, Mass., who practised his profession for upward of eighty years, his visit-books being still extant showing the record from beginning to end.

BACILLI ON A BALD HEAD.—Dr. Saymonne claims to have isolated a bacillus, called by him "bacillus crinivorax," which is the cause of alopecia. It is, he says, found only on the scalp of man, other hirsute parts of the body and also the fur of animals being free from it. The bacilli invade the hair-follicles, and make the hair very brittle, so that they break off to the skin. Then the roots themselves are attacked. If the microbes can be destroyed early in the disease, the vitality of the hairs may be preserved; but after the follicles are invaded, and all their structures injured, the baldness is incurable. The following is Dr. Saymonne's remedy to prevent baldness: Ten parts crude cod-liver oil, ten parts of the expressed juice of onions, and five parts of mucilage or the yolk of an egg, are thoroughly shaken together, and the mixture applied to the scalp, and well rubbed in, once a week. This, he asserts, will certainly bring back the hair if the roots are not already destroyed; but the application of the remedy, as *The Medical Record* well observes, must be very distressing to the patient's friends and neighbors.

ELECTRICAL NEWS.

ELECTRIC LIGHTING FROM PRIMARY BATTERIES.—The chromic chloride primary batteries of Commandant Renard seem to be enjoying some success abroad. Thirty-six cells of this battery are deemed sufficient to run a 300-candle-power arc-lamp, and it is claimed that a 900-candle-power arc-lamp can be run from 42 of these cells. The cost per candle-power hour is estimated to be about one-fifth of a penny. A number of primary batteries have been introduced in this country for the purpose of electric lighting, and much money has been spent in patenting and placing them upon the market. As far as we know, they have never realized an approach to commercial success.

ST. LOUIS ELECTRICAL EXPOSITION.—This exposition is being held at St. Louis, and is certainly a very attractive feature in that city just now. A number of prominent exhibitors are represented. Among the miscellaneous exhibits are those of the Writing Telegraph Company of New York, the Electric Date and Time Stamp Company of St. Louis, the Graphophone-Phonograph Company of New York, and the American Waltham Watch Company of Boston, Mass., to say nothing of other companies manufacturing miscellaneous devices. The parent electric manufacturing companies are well represented, both as to *personnel* and machinery. Besides apparatus of a strictly electrical character, one finds leather belting, steam-engines, feed-water heaters, water-wheels, wire, etc., which all are day by day assuming a closer relation to the electrical industry. One of the most interesting exhibits is the elec-

tric welding apparatus shown by the Thomson Electric Welding Company of Boston. It is not generally known just how complete and satisfactory this process is, and the company are taking advantage of the splendid opportunity now offered them in St. Louis to show and do all varieties of welding-work in the exposition building. Another device that seems to be appreciated by ladies and practical-minded husbands is the electric heater of the Burton Electric Heater Company of Richmond, Va. This heater is in actual use, cooking beefsteak, eggs, etc.; the inventor taking this opportunity of showing just what electricity is destined to do in the way of culinary and general heating attainment. Almost every thing and every body electrical are represented, notwithstanding which fact the exposition cannot be said to equal that in Chicago on the occasion of the annual meeting of the National Electric Light Association last February.

VOLATILIZATION OF METALS.—A correspondent of the *Revue Internationale de l'Electricité* writes, "We have received from M. Gaston Seguy, who is not only a clever glass-blower, but also an intelligent observer, two samples of tubes in which the volatilization of metals in a vacuum by the passing of the electric current has given rise to some curious phenomena, which we are unable to explain satisfactorily. We therefore confine ourselves to submitting to our readers the result of these experiments, hoping that perhaps one of them will be able to indicate on what theory we can



base our facts. A glass tube three centimetres in diameter is closed at the two extremities, and to each end is soldered an electrode of platinum or copper of the form shown in the adjoining figure. Through a nipple on the side of the tube a vacuum equal to that of the Geissler tubes is produced by means of a mercury-pump; then the current of a powerful induction-coil (three-tenths of a metre spark at least) is passed through. The metal is then volatilized at the negative pole, and is deposited on the sides of the glass, producing a black discoloration for platinum, and yellow for copper. The metallization of the sides of the tube is more rapid in proportion as the diameter is smaller; but in any case it produces this curious phenomenon, to which we wish to call attention: it does not take place at all on either side on that part of the tube placed directly opposite the plane of the electrode, as we can easily see by placing the tube before a sheet of white paper. The reservation thus obtained exactly reproduces the external form of the electrode; but what is still more curious is, that the angles of this outline do not correspond to the angles of the electrode, but come opposite the straight lines, as shown in the accompanying figure. These are phenomena similar to those observed by Crookes, Jamin, and Goltein; and we think, that, in order to facilitate an explanation of them, it is better not to pass them by in silence, but, on the contrary, to note them with all their peculiarities every time we observe them."

NOTES AND NEWS.

On Friday evening, Sept. 6, the Nevada Academy of Sciences held its first working meeting, upon which occasion Gen. C. W. Irish read a very interesting paper on "The Air-Currents of Western Nevada." The officers of this new scientific society are, president, Gen. C. W. Irish, surveyor-general of Nevada; vice-president, C. W. Friend, director Nevada State Weather Service; secretary, Professor R. D. Jackson, State University; treasurer, J. Rankin; executive committee, the president, secretary, and the following.—Dr. LeRoy D. Brown, State University; Professor W. McN. Miller, State University; and E. M. Van Harlingen.

— Dr. S. Weir Mitchell of Philadelphia has been elected president of the Congress of American Physicians and Surgeons, which meets in Washington in September, 1891.

— Herbert Spencer, according to a London correspondent of the *New York Sun*, has returned to London with his autobiography completed up to the present time. It is not to be published until after his death, but he is making preparations for it to be produced then on both sides of the Atlantic simultaneously. The manuscript has been put into type, and three proofs only are taken, all of which are sent to him. Before the type is distributed, two moulds are taken for stereotyping, one of which is to be sent to America, where Spencer is more widely read than in England, to be used immediately upon his death.

— Professor L. H. Bailey, of the Agricultural Experiment Station of Cornell University, sent a large number of circulars to leading fruit-growers in New York and Michigan, asking for definite information in regard to windbreaks, and, as a general summary of the result, makes the following statements: — 1. A windbreak may exert great influence upon a fruit plantation. 2. The benefits derived from windbreaks are the following: protection from cold, lessening of evaporation from soil and plants, lessening of windfalls, lessening of liability to mechanical injury of trees, retention of snow and leaves, facilitating of labor, protection of blossoms from severe winds, enabling trees to grow more erect, lessening of injury from the drying-up of small-fruits, retention of sand in certain localities, hastening of maturity of fruits in some cases, encouragement of birds, ornamentation. 3. The injuries sustained from windbreaks are as follows: preventing the free circulation of warm winds and consequent exposure to cold, injuries from insects and fungous diseases, injuries from the encroachment of the windbreak itself, increased liability to late spring frosts in rare cases: (a) The injury from cold, still air is usually confined to those localities which are directly influenced by large bodies of water, and which are protected by forest belts (it can be avoided by planting thin belts); (b) The injury from insects can be averted by spraying with arsenical poisons; (c) The injury from the encroachment of the windbreak may be averted, in part at least, by good cultivation and by planting the fruit simultaneously with the belt. 4. Windbreaks are advantageous wherever fruit plantations are exposed to strong winds. 5. In interior places, dense or broad belts, of two or more rows of trees, are desirable; while, within the influence of large bodies of water, thin or narrow belts, comprising but a row or two, are usually preferable. 6. The best trees for windbreaks in the North-eastern States are Norway spruce, and Austrian and Scotch pines, among the evergreens. Among deciduous trees, most of the rapidly growing native species are useful. A mixed plantation, with the hardest and most vigorous deciduous trees on the windward, is probably the ideal artificial shelter belt.

— By permission of the trustees of the Lowell Institute, Boston, the curator, Professor Alpheus Hyatt, is enabled to distribute a limited number of tickets to teachers of private schools and members of the Boston Society of Natural History who desire to attend the course of lectures described below. Applications for tickets should be made immediately at the library in the society's building. Professor W. O. Crosby will give a course of ten lessons during the winter of 1889-90, upon the physical history of the Boston Basin. The course of lessons on the geology of Boston and vicinity given last winter was devoted to a general and systematic study of the geological phenomena of the Boston Basin, in which the various principles of dynamical and structural geology were taken up in the order of the text-book, and studied in connection with those localities in which they could be most satisfactorily illustrated, each class of phenomena being referred only to that part of the basin in which it had its finest development. This comprehensive course in geology may therefore be regarded as having formed a suitable preparation for the lessons to be given during the coming winter. The principal object of this second series of lessons will be to apply the principles of the first series to a thorough and detailed study of the physical history of the Boston Basin. Each important locality or natural division of the Boston Basin will form the subject of a separate lesson, in which its structural features, and, so far as they can be made out, the more important events of its history, will be

presented as fully as the time will permit. Special attention will be given to tracing the relations of the existing surface feature of each district to its geological structure, and thus connecting the physical geography and geology of the region. The concluding lessons will summarize the results of these detailed studies; and an attempt will be made to present a picture of the Boston Basin at each principal epoch of its history. The course will be freely illustrated by specimens, maps, and diagrams, and also by a relief map or model of the Boston Basin, which will be colored to represent geological features. The lessons will be given, as usual, in Huntington Hall, in the Massachusetts Institute of Technology, beginning Oct. 12. Doors will be closed at 3 P.M.

— A tramcar line is being constructed in the Argentine Republic which will connect Buenos Ayres with the outlying towns, and will, when finished, extend over two hundred miles. The cars will be drawn by horses, which are cheap and plentiful in South America; while fuel, both wood and coal, is scarce and expensive. The rolling-stock consists of five sleeping-cars eighteen feet long, each with six beds, which in the day-time are rolled back to form seats; four two-storied carriages; twenty platform-carriages; six ice-wagons; four cattle-trucks; and two hundred goods vans.

— Professor J. B. Smith, entomologist of the New Jersey Experiment Station, in a recent bulletin, tells the farmers and gardeners of the State how they can help him in his investigation of insect-pests. His first counsel is to be prompt, instead of waiting till the damage is done and the pests have disappeared; and he adds, "Do not waste time in describing insects. Send specimens, and send plenty of them. If an insect is really injurious, it is as easy to get a dozen as it is to get one, and it makes it a great deal easier for the entomologist. He wants two or three to put in alcohol, so that he will know them next time; the others he wants to bring to maturity, or to describe or figure so as to complete his knowledge of them. Such specimens, if dead, should be packed in some soft material, as cotton or wool, and put into a stout tin or wooden box. They go by mail for one cent per ounce. Never send insects loose in a letter. The postal-clerk always smashes them flat, so that they are never of any use as specimens, and frequently not recognizable. With the specimen send also, so far as possible, a sample of the kind of injury caused by it, — a bored twig or root, or gnawed stem, fruit, or leaf, — any thing to show how the insect works. If at all possible, send the insects alive, along with a supply of their ordinary food sufficient to last during the journey. Pack them in a tight box, and do not punch air-holes in it. Insects need very little air, and the tight box keeps the food moist. Send with the insect an account of what you know of it, — how it works, whether on leaves, twigs, or fruit, whether above ground or under ground; how long you have known it; how much damage it has done; what experiments looking to its destruction have been made, and what the result has been. Such facts are often not only of the highest scientific interest, but also of the greatest practical importance."

— Among other reports received by the United States Hydrographic Office, we would call attention to two, — one from Capt. James P. White, of the American schooner "Ada Bailey," who reports that he used oil with wonderful effect in the late storm, and did not ship any water after he got his oil-bag over the side of the vessel. He always uses a cone-shaped bag stuffed half full of oakum, and prefers kerosene to any other oil. He says that he has been using it for five or six years, and believes that it is better than a thicker oil, although he has mixed fish-oil with kerosene, obtaining good results. It is his custom to keep a supply of oil always on hand for this purpose, and he uses from one to three barrels of oil every long cruise. The other was from Capt. McCrae, of the British schooner "Atwood," dated Sept. 9, in which he stated that when about 45 miles south of Sandy Hook, wind north-east, and a tremendous sea running, the jibs were washed away from off the bowsprit and jibboom, and bowsprit and mainmast sprung. Tremendous seas coming aboard smashed down the after-companion-way, bent the stern boat-davits, carried away the boat, and broke the rails. He used paint-oil mixed with kerosene and grease in canvas bags, hung from forward aft on the weather side, keeping them replenished every six hours. The oil proved a great benefit,

as the seas broke over no more; and the captain is of the opinion that the vessel was saved from further damage. During the 9th the vessel was hove to a drag.

— The Natural Science Association of Staten Island was organized Nov. 12, 1881, with a membership of fourteen, and during the first two years of its existence no records were published. It was thought better to first ascertain, by actual experience, whether the association was reasonably sure of becoming a permanent institution. At the end of this period the steady growth which it showed both in membership and contributions, and the encouraging recognition which was received from all directions, seemed to justify the experiment. Accordingly the publication of the "Proceedings" was begun. These have since been issued, without interruption up to the present time, partly in the form of records of the regular meetings of the association, and partly as "extras" or "specials," which latter were published at such times as were found to be most convenient. It was decided at the beginning to print only such material as was of strictly local interest, in the firm conviction that the chief value of the "Proceedings" would be to serve as authentic records of facts in regard to the natural history and antiquities of the island. If such records had been kept during the past fifty years, many items of value and interest would have been preserved, which are now either lost entirely or else amount to mere uncertain tradition. Even within the past five years the rapid growth of the community has obliterated many of the most interesting natural objects, and these "Proceedings" are now the only definite records that they ever existed, and contain the only published authentic facts in connection with them.

— A congress composed of planters, exporters, and persons interested in the sugar-production of Java, has been held at Samarang. The object of this congress was mainly to discuss the cause and cure of the nematode attacks on the cane-roots, there called the "serah" disease, which is now spreading most rapidly and disastrously through the cane-fields of western and central Java, having been first discovered on the island only three years ago in plantations near Cheribon, a seaport town on the north coast 125 miles to the eastward from Batavia. The congress subscribed a fund of \$90,000 for the purpose of engaging a bacteriologist from Europe to visit the island, investigate the disease, and propose its remedy. The nematodes reduce not only the quantity of the sugar-crop, but its quality as well, and the subject is therefore of the utmost importance in cane-growing regions.

— The second report of the Chinese prize-essay scheme, in connection with the Chinese Polytechnic Institution and Reading-Rooms, Shanghai, has been printed, and the following particulars are extracted from it: Since the last report, which was published in 1887, the scheme has been steadily worked, and has now expanded into far more extensive proportions. By its means the existence of the Polytechnic Institution has become known far and wide, the co-operation of some of the highest officials in the empire secured, and an interest in Western ideas has been created in some of the most influential quarters. By the annual expenditure of only a hundred taels or thereabouts, and by working in harmony with the Chinese methods of thought, and time-honored systems of literary competition, a result has been obtained which the use of large sums of money in other ways would have failed to produce. The various other officials who have taken part in this undertaking have generally shown a wonderful insight into the needs of China at the present time; and although their questions relate, perhaps, more to political economy and commerce than to the severer branches of science, it is still gratifying to see how patriotic they are, and how they regard knowledge from the practical, utilitarian point of view rather than from the theoretical alone. The following questions are taken from the list of subjects given by the various high officials: Write a discourse on the naval defences of China. What ought China at the present time to regard as of the foremost importance in her endeavors to improve in wealth and power? What advantages and disadvantages would China realize by the establishment of railways? Compare the sciences of China and the West, showing their points of difference and similarity. How can the evils attending the introduction of telegraphs and steamboats in China be removed, and the benefits be rendered per-

manent? What is the cause of the present unprofitable state of the trade in tea and silk, and how can the difficulties be remedied? The calamities of inundations and droughts, how can they be provided against in ordinary times; and when they happen, how can they be remedied or ameliorated?

— The annual meeting of the American Forestry Congress will begin in Philadelphia Oct. 15, and continue four days. The sessions are to be held in Horticultural Hall, Broad Street, and Gov. James A. Beaver will preside. A number of interesting papers upon forestry and kindred subjects have been prepared, while, through the liberality of citizens and organizations, courtesies have been promised to those attending the congress which will make the meeting most enjoyable.

— Recent advices from one of the California agents of the United States Entomological Bureau, Mr. D. W. Coquillett, show that the published statements in the California newspapers of late date, to the effect that the plum curculio has made its appearance in Los Angeles County, are entirely unfounded. Fuller's rose-beetle (*Aramigus fulleri*) has been mistaken for *Conotrachelus nenuphar*. The rose-beetle has been found to be very destructive in that vicinity to the leaves of evergreen oaks, camellias, palms (*Washingtonia filifera*), *Canna indica*, and several other plants.

— At Marseilles, Bordeaux, and Poitiers public exhibitions of hypnotism have been forbidden. The Paris correspondent of the *British Medical Journal* writes, "The Departmental Council of Public Health advised the rectors of the Academy to take this step in the districts under his authority, and he wisely followed the good advice. In Belgium, Geneva, and Mecklenburg-Schwerin they are likewise forbidden. In Paris, unfortunately, unwise doctors can show off their patients, and quacks follow in their steps with unwholesome imitations."

— Dr. George M. Sternberg, surgeon in the United States Army, has just returned from a six-months' stay in Cuba, where he has been continuing his researches with reference to yellow-fever. He has brought with him specimens of microbes, with which he will continue his investigations during the winter at the Johns Hopkins University. At the end of this time he hopes to present a general report of his investigations to President Harrison. "My researches," says Dr. Sternberg, "have not led to a positive demonstration of the specific cause of the disease; but I have isolated a considerable number of pathogenic bacilli, disease-producing germs, from the intestines of yellow-fever cases, and have strong hopes that one or more of these may prove to be the specific germ. I have confirmed my previous conclusions as to the absence of a specific micro-organism in the blood and tissues of the patients, and have failed to find in any of my cases the germ which Dr. Frere of Brazil has claimed to be the cause of the disease. For this reason I have given my attention entirely to the bacilli of the alimentary canal."

— "The American Electrical Directory" for 1889, published by the Star Iron Tower Company of Fort Wayne, Ind., possesses many features of interest and value to electricians and to all persons interested in electrical matters. In its thousand pages it gives a report of the proceedings of the National Electric-Light Association meetings in New York and Chicago, 1888 and 1889; lists of the isolated arc and incandescent plants in the United States and Canada; the Philadelphia schedule for public lighting; a carefully compiled list of the prices charged for gas in cities and towns having a population of over ten thousand; and reports of the various electric light and power companies in the United States, Canada, and Mexico. There are also lists of electric-light and railroad companies and their officers, of electric manufacturing, construction, and supply companies; rules of the New England Insurance Company, and of the New York Board of Fire Underwriters and Board of Electrical Control; and many tables and formulas of use to electricians.

— Harold Roorbach will issue shortly a handy volume for the aspiring dramatist in "The Art of Play-Writing." Written by a well-known playwright, it treats on every class of dramatic composition, and gives withal some hardheaded advice.

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THE "PILOT CHART" of the North Atlantic Ocean for October, issued Sept. 27 by the Hydrographic Office, Navy Department, is of especial interest as showing the tracks of the hurricanes that have been experienced on the Atlantic during the past month, and the positions of the many derelicts and wrecks reported off the coast, — the results, most of them, of the great storm that raged between Hatteras and Block Island from the 9th to the 12th of September. So great is the interest that attaches to this storm, that a special supplement to the chart has been issued, entitled "The St. Thomas-Hatteras Hurricane of Sept. 3-12, 1889." This gives, by means of ten synoptic charts and descriptive text, the entire history of the hurricane from the time it passed St. Thomas till it had spent its fury off the coasts of New Jersey and Long Island. In spite of the brief interval of time that has elapsed, an astonishingly large number of reports have been collected from masters of vessels; and each chart contains data as far east as the 50th meridian, and as far south as the 10th parallel. A new and very important factor in the history of the hurricane is brought out very clearly. It seems that a second hurricane originated in the tropics almost simultaneously with the first, but about a thousand miles farther east. Both moved off along a track toward west-north-west, but the second recurved to the north-east below Bermuda. To this second hurricane was due the building-up and persistency to the southward of Newfoundland of a ridge of high pressure that held the great storm off our coast, instead of allowing it to follow its

normal track toward the north-east. Special credit is given to the many navigators whose cordial assistance has made it possible to publish this report so promptly.

AMERICAN PUBLIC HEALTH ASSOCIATION.

The following is a partial list of papers to be presented at the annual meeting of the American Public Health Association, to be held in Brooklyn beginning Oct. 22 (a full list will appear in the daily programmes); address of welcome, by Hon. Alfred C. Chapin, mayor, on behalf of the city; address of welcome, by Alexander Hutchins, M.D., on behalf of the medical profession; president's address, by Professor Hosmer A. Johnson, M.D., Chicago, Ill.; "The United States Census in its Relation to Sanitation," by Dr. John S. Billings, LL.D., Washington, D.C.; "Recent Researches relating to the Etiology of Yellow-Fever" (illustrated with the stereopticon), by George M. Sternberg, M.D., Baltimore, Md.; "More Yellow-Fever Problems," by Jerome Cochran, M.D., State Health-officer, Montgomery, Ala.; "Forms of Statistics," by Henry B. Baker, M.D., secretary State Board of Health, Lansing, Mich.; "A Suggestion for the Limitation and Detection of Adulterations in Food and Drink," by Henry Leffmann, M.D., Philadelphia, Penn.; "The Prevention of Consumption," by J. N. McCormack, M.D., secretary State Board of Health, Bowling Green, Ky.; "The Necessity for a More Rigorous Inspection of Meat-Producing Animals at the Time of Slaughter," by D. E. Salmon, D.V.M., chief of Bureau of Animal Industry, Washington, D.C.; "The Causes of Infant Mortality," by Dr. R. O. Beard, assistant commissioner of health, Minneapolis, Minn., and professor of physiology in the medical department of the Minnesota State University; "Causes and Prevention of Infant Mortality," by Jerome Walker, M.D., Brooklyn, N.Y.; "The Utilization and Purification of Sewage," by John H. Rauch, M.D., secretary State Board of Health, Chicago, Ill.; "The Art of Cooking," by Edward Atkinson, LL.D., Boston, Mass. (this paper will be practically illustrated by cooking apparatus devised by Mr. Atkinson, and various foods will be cooked in the presence of the association; the system which will be illustrated is the result of several years' labor, and has been in practical operation for many months under his supervision; as Mr. Atkinson is one of the world's most noted economists and statisticians, the paper will undoubtedly be of great value); "New Method of Dealing with the Dead" (illustrated with the stereopticon), by Rev. Charles R. Treat, New York City; "Report of the Committee on the Disposal of Garbage and Refuse Matter," by S. S. Kilvington, M.D., commissioner of health, Milwaukee, Wis.; "A Suggested Minimum Basis of Compensation to Local Health-Officers," by George Homan, M.D., secretary State Board of Health, St. Louis, Mo.; "Do the Sanitary Interests of the United States demand the Annexation of Cuba?" by Benjamin Lee, M.D., secretary Pennsylvania State Board of Health, Philadelphia; "Railway Sanitation," by Samuel W. Latta, M.D., medical examiner Pennsylvania Railroad Voluntary Relief Department, Trenton, N.J. Papers and reports of an interesting and valuable character are expected from several of the committees.

A daily programme will be issued each morning, giving the title of papers, reports, etc., that will be presented, with such other information as may be of interest in connection with the work of the day. The headquarters of the executive committee will be at the Pierpont House. A meeting of the committee will be held at this house, at the room of the secretary, on Monday, Oct. 21, at 4:30 P.M.

The local committee of arrangements have provided for an exhibition of every thing available adapted to the promotion of health. The exhibit will be divided into nine sections, as follows: 1. The Dwelling; 2. Schools and Education; 3. Factories and Workshops; 4. Clothing and Dress; 5. Food; 6. Sanitary Engineering; 7. Public Health Administration in Cities and Towns; 8. The Laboratory; 9. Red Cross Section. The exhibition of any article does not carry with it the indorsement of the American Public Health Association. At the close of the exhibition the association will award testimonials to exhibitors of especially meritorious articles, based upon the judgment of experts. The exhibition will be held in the hall at the north-west corner of Fulton and Pineapple Streets,

one block from the Brooklyn Institute, where the sessions of the association will be held, and but three blocks from the Bridge. It will be open to the public on Oct. 22, at 1 P.M., and will continue open until Dec. 1. Admission free. For particulars relative to the exhibit, address the chairman of the committee, Dr. A. N. Bell, 113A Second Place, Brooklyn, N.Y.

By invitation of Dr. William M. Smith, health-officer of the port of New York, the association will visit the New York Quarantine Station. For this purpose Dr. Smith has placed at the service of the association a commodious steambot. The trip will probably be made Wednesday afternoon, Oct. 23.

The local committee of arrangements will issue a circular giving full information regarding reduced hotel rates, railroad fares, etc., a copy of which will be sent to every member of the association. Others desiring a copy should make application to the chairman of the committee, Dr. J. H. Raymond, 173 Joralemon Street, Brooklyn, N.Y., to whom all communications relative to local matters in connection with the meeting should be addressed. The usual rate of one and one-third fare for the round trip has already been secured over the Trunk Line, Central, and Southern Traffic Associations, and it is expected that the same rates will be obtained from the other traffic associations. To secure the reduced rates, a certificate must be obtained from the ticket-agent at the starting-point, certifying that the holder has paid full fare going to the meeting, over what lines he has travelled, etc., which certificate must be countersigned at the meeting by the secretary in order to secure the one-third return fare.

EXHIBITERS TO WHOM AWARDS HAVE BEEN MADE AT PARIS.

THE principal awards to American exhibitors at the Paris Exposition are as follows:—

GRAND PRIZES.—Boston public schools; Washington Bureau of Education; Washington Bureau of Ethnography; United States Service of Meteorology; United States Commission of Geology; United States Ministry of War; New York University; Rensselaer Polytechnic Institute, Troy; Smithsonian Institution, Washington; Johns Hopkins University, Baltimore; the Century Company, New York; Fairchild, New York, gold pens; United States Geological Survey; United States Signal Service, A. W. Greely, chief officer; United States Naval Observatory; Mr. Howland; United States Coast and Geodetic Survey; United States Army, Corps of Engineers; T. G. Hawkes, New York, crystal; Tiffany & Co., New York, silverware; J. B. Stetson, Philadelphia, fine fur hats; Winchester repeating arms; J. A. Fay & Co., Cincinnati, timber machines; Healey & Co., New York, carriages; Pennsylvania Railroad Company; Bell Telephone Company; Thomas A. Edison; Elisha Gray, Illinois, telegraphy; Elihu Thomson, Lynn, Mass., electrical appliances; Government Bureau of Engineers; United States Exhibit of Cereals; Bergher & Engel Brewing Company, Philadelphia; C. A. Wetmore, California, wines; United States Department of Agricultural Statistics; United States Farms; C. V. Riley, specimens of phylloxera work; United States Agricultural Department of Viticulture; Labor Departments of the United States reports.

GOLD MEDALS.—E. Barnes & Co.; Ivison, Blakeman, & Co.; Board of Education, Wisconsin; Buffalo public schools; Department of Public Instruction, California; Department of Public Instruction, Iowa; Elizabeth (N.J.) public schools; Moline (Ill.) public schools; Bureau of Education, Washington; National Deaf-Mute College, Washington; Ohio, commissioner of schools; Perkins Institute for the Blind, Massachusetts; Pittsburgh public schools; Suckanosssett School for Boys; State Public School, Coldwater, Mich.; Indiana Industrial School; Galveston public schools; Boston public schools; State of Massachusetts, Department of Public Instruction; public schools, California; public schools, Wisconsin; public schools, Michigan; American Museum of Natural History, New York; Chicago Public Library; Eastman College, Poughkeepsie; Manual Training School, Philadelphia; Massachusetts Institute of Technology, Boston; Houghton, Mifflin, & Co., Cambridge, Mass.; Lippincott & Co., Philadelphia; Merriam, Springfield, Mass.; New York Bank Note Company; Warren

& Co., papers, Boston; Tiffany & Co., jewelry; Prang & Co.; Barker, photographs, New York; H. A. Rowland; Eastman Dry Plate Company; Manual Training School, St. Louis; University of California; Darlin, Brown, & Sharpe, Providence; Herman Hollerith, Washington; Mr. Gardner; J. P. Lesley, State geologist of Pennsylvania; Heywood Brothers, New York, furniture; C. E. Henry, Indianapolis, glass; John Lafarge, New York, stained glass; Rookwood Pottery Company, Cincinnati; Gorham Silverware Company; Meriden Britannia Company; Colgate & Co., New York, perfumery; Ladd & Coffin, New York, perfumery; William Demuth, New York, pipes; Tiffany, leather goods; Marks's folding-chair, New York; Boston Rubber Shoe Company; Mayer, Strouse, & Co., New York, corsets; Beneke Brothers, New York, boots; Dunlap, New York, hats; War Department, uniforms; N. J. Schloss & Co., New York, clothing; Colt's fire-arms; Smith & Wesson; Union Metallic Cartridge Company; White Sewing-Machine Company, Cleveland; Mackellar, Smith, & Co., New York, printing type; American Writing Machine Company, Hartford; Remington typewriter; Hammond typewriter, New York; Cobb Vulcanite Wire Company; Heisler Electric Light Company, St. Louis; Okonite Company, New York; Western Electric Company, Chicago; Sprague Tramway Company; Volta Graphophone Company; Herring & Co., New York, safes; Yale Manufacturing Company; Inman Steamship Company; Chicago and Minneapolis Boards; Glen Cove Manufacturing Company; C. A. Pillsbury of Minneapolis; Green Mountain Stock Farm; J. H. Michener & Co., Philadelphia, lard; Armour & Co., Chicago, canned meats; Curtice Brothers, canned meats; Cassard & Co., Baltimore, dried meats; Michener & Co., dried meats; Morris & Co., Chicago, canned meats; Swift & Co., dried meats; Maillard, New York, bonbons; Beadleston & Co., lager beer; California State Viticultural Commission; Chauche & Co., California, wines; J. Kunz, New York, beer; Montgomery Brewery Company; Megliavalla, California, wines; J. Osborn & Sons, New York, whiskey; United States agricultural maps and charts; Enterprise Manufacturing Company; Richmond Cedar Works; Clayton & Co., gratings; H. O. Nelson; N. P. Gilman; C. D. Wright; Publication Agency for Johns Hopkins University; Universal Peace Union, Philadelphia; New York and Massachusetts Labor Departments; Woman's Christian Temperance Union.

BOOK-REVIEWS.

Essays upon Heredity and Kindred Biological Problems. By AUGUST WEISMANN. Authorized translation by Edward B. Poulton, Selmar Schönland, and Arthur E. Shipley. Oxford. 8°.

PROFESSOR WEISMANN'S essays on various general problems of biology have never been collected, but have remained more or less inaccessible in sundry journals or as separate pamphlet publications. Being now brought together in a single handsomely printed volume, they will doubtless attract a wider attention not only from naturalists, but also from thoughtful general readers. The author's presentation of his subject is, except in two or three minor essays, such that his arguments may be followed without the detailed knowledge of a specialist.

The translations are very well done, for the English, while idiomatic, renders accurately the meaning of the original German; so that the volume is a thoroughly trustworthy reproduction of Professor Weismann's theories. These theories are full of suggestiveness, and contain many original conceptions. It must be recognized that their influence will be far felt, especially as opposing some of the ideas concerning heredity, sexuality, death, etc., which tradition has rendered current, one might almost say orthodox, in the biological world. There is in biology, around the finished area,—the woven tissue of science,—a fringe of dogma; and playing with this fringe is to certain minds a favorite occupation. We see sober investigators, who are conscientious within the region of the provable, become intoxicated when they attempt to pass outside this region. They then madly maintain dogmas, asserting positive views as to the nature of life, which is entirely beyond their power to justify. This special tendency is so infectious that the majority of biologists are affected by it, and defend their par-

ticular idea as to vitality with an acrimony which makes it unbecoming for any biologist to speak slurringly of the *odium theologicum*. Now, Professor Weismann leads attention back to scientific sobriety as regards these wide-reaching problems about fundamentals, and thereby renders a most welcome service; for, after all, it is pleasant to leave the *feux follets* for the sake of genuine light and real safety.

One is obliged to dissent from many of Professor Weismann's views, which are marked by that vagueness that is so characteristic of German philosophic generalizations. Some of his conclusions we already know to be deficient and even erroneous. This is notably the case with his conception of death, to which he recurs frequently, for he fails to make the obvious distinction between the death of a unicellular and that of a multicellular organism. A colony is not homologous with its units, and the breaking-up of a colony is not homologous with the destruction of an individual; yet Professor Weismann makes it so. But the value of a book lies not in its faults or deficiencies; and, though these need to be noted as making its limitations, a book is to be judged by its merits.

The book before us is one of many and signal merits. The first essay, on the duration of life, was originally presented to the world in the form of an address to the German Naturforscherversammlung at Salzburg in September, 1881, and was shortly after published in pamphlet form at Jena. It deals with the duration of life, and constitutes the basis of the subsequent essays of the series. The second essay, on heredity, followed two years later, and completes in outline the author's theories. The remaining six essays serve essentially to elaborate and supplement the first two. The most important contribution to thought is the defence of the theory of germinal continuity against Darwin's theory of pangenesis as an explanation of heredity. The hypothesis of germinal continuity was originated by Moritz Nussbaum, to whom the first credit belongs: but Weismann has so identified himself with its defence and amplification, that we may say that the gradual acceptance of the hypothesis in place of that of pangenesis is due principally to his teaching. He has adduced numerous facts, and numerous interpretations in favor of his position; and it is, we believe, not too much to say that within a short time the new theory of heredity must find general acceptance. Those, therefore, who wish to keep abreast with the tendencies of biological advance must read Weismann, and *must* not only on account of the theory we have specially referred to, but also on account of other fresh thoughts and ideas which vivify his interesting pages.

European Schools. By L. R. KLEMM. New York, Appleton. 12°. \$2.

THIS book is the latest issue in the International Education Series, in which it well deserves its place. The author spent a year or so in visiting the schools of Germany and France, with short trips to Switzerland and Vienna. Most of his attention was given to the German schools, and his account of these is full and interesting. He is evidently a keen observer, and studied the schools he visited with great care and diligence. The matters of which he treats are generally of great interest, though manual training and drawing are accorded altogether too much space in proportion to their importance. These subjects and some others are largely illustrated from drawings by the author himself. Mr. Klemm reports nothing of special interest from France or Vienna, while in Switzerland he seems to have been almost disgusted with what he saw. He condemns the Swiss schools in unmeasured terms as ill furnished and worse taught, and it is only in Germany that he finds much that he regards as an improvement on what we have in America.

The difference of method between the German schools and ours is indeed great; but whether we should do well to abandon our methods for theirs is questionable. The distinctive characteristic of German teaching as described in this book is the absence of text-books, the instruction being conveyed orally by the teacher. This is the case, for instance, in geography, physics, and natural history; and it is obvious that the introduction of such teaching into American schools would amount to a revolution. But the method of question and answer employed by the German teachers, of which Mr. Klemm gives many interesting examples, is unquestionably

of great value, being fitted not only to test the pupil's knowledge, but also to make him think. Object-lessons, it appears, have gone out of favor in Germany; but, on the other hand, drawing is employed to illustrate every subject that requires such illustration. A particular account is given of a "school for dullards" at Elberfeld, which has proved a very useful institution.

Mr. Klemm attributes the excellence of the German schools largely to the careful training of the teachers, and accordingly devotes some space to a description of the normal schools. He reports, however, that there is at present a scarcity of teachers in the kingdom of Prussia, — a fact which he attributes to the low salaries paid, it being easy for intelligent men to get higher pay in other employments. The teachers, nevertheless, are enthusiastic in their work, and, though subject to strict rules, show a good deal of individuality in their teaching. Women teachers are comparatively rare in Germany, and there is a strong prejudice against them; but this will doubtless disappear in the course of time. We cordially commend Mr. Klemm's book to the attention of American teachers.

The Key to Theosophy. By H. P. BLAVATSKY. London, Theosoph. Publ. Co.; New York, W. Q. Judge. 12°.

THIS work is intended as an introduction to theosophy, and is written in the form of a catechism. It gives some account of the character and objects of the Theosophical Society, and then goes on to expound the leading doctrines that theosophists believe in — or pretend to believe in. The doctrines chiefly dwelt on in this book are pantheism and metempsychosis; but we think the reader will understand them less after perusing Mrs. Blavatsky's account of them than he did before. The practical aims of theosophists, it seems, are virtually identical with Christian charity, and it is only on speculative questions that the new sect antagonizes the world. It is very unfortunate that the real esoteric doctrines of the sect are so profound, that, as we are told, only a very few persons can comprehend them; and we are sorry to say that we are not among the favored few. Indeed, we should incline to characterize much of this book as rank nonsense, if we were not solemnly assured by the authoress that "theosophy is synonymous with everlasting truth." She refers feelingly to the fact that the Society for Psychical Research had employed a man to investigate some of her statements, and had characterized her as "the most accomplished impostor of the age," and says that she regards them with contempt, and that she will not abandon her principles because they have been attacked by "a flock of stupid old British wethers, who had been led to butt at them by an over-frolicsome lambkin from Australia." Evidently theosophy and modern ideas don't agree well together, and we fear that Mrs. Blavatsky and her co-religionists will have a hard task to convert the world to their views.

Iron and Steel Manufacture. By ARTHUR H. HIGGINS. London and New York, Macmillan. 16°. \$1.

BEGINNERS in the study of metallurgy will find this an excellent little work from which to gain a knowledge of the fundamental principles of the various processes employed in the manufacture of iron and steel. They will also find it a compendium of the various properties of those metals, so far as those properties can be treated in an elementary manner.

The book, of course, will not supersede any of the larger and more exhaustive manuals on the subject, nor is it intended by the author that it should do so. It is designed merely as an elementary treatise to prepare the student for a more advanced course of study, though manufacturers and workmen connected with trades in which iron and steel are used will find much of its contents of value to them. For the convenience of those having but a limited knowledge of chemistry, a chapter is devoted specially to a discussion of chemical principles and changes, so far as they have a bearing upon the subject of which the volume treats. The book is fully illustrated, and furnished with a very complete index.

AMONG THE PUBLISHERS.

THE Elder Publishing Company, Chicago, have nearly ready "Birds and Butterflies," a book for boys and girls, by M. G. Musgrave.

— Admiral David D. Porter's forthcoming book is to be entitled "Arthur Merton."

— One of the important announcements of fall publications is that of a volume of "Orations and After-Dinner Speeches," by Chauncey M. Depew, which Cassell & Co. (Limited) have in preparation. Very few of these have ever been printed in their entirety, and many of them have only been dealt out in fragments by the daily papers, and yet he has won a world-wide reputation by them. It may be said, by the way, that it took no little diplomacy to induce Mr. Depew to consent to the publication of his orations and after-dinner speeches; but he was finally convinced that the public wanted them, and, as he is a great believer in the public, he consented. The book is now on the press, and will be published with a steel portrait of Mr. Depew.

— *School* is the title of a new educational journal which will be published weekly from No. 10 East 14th Street, New York City. It will be edited by H. S. Fuller, an experienced journalist, and one who is entirely familiar with every thing that pertains to the public schools. *School* intends to cover in some degree every department of its chosen field, and to offer something that will be acceptable to every worker in that field.

— Mr. Andrew Lang has edited a collection of some forty of the best of the good old fairy-stories, to be published shortly by Longmans, Green, & Co. as "The Blue Fairy Book." He has sought to set down in strict accord with accepted tradition the most familiar of the popular tales of Greece, Germany, France, and England. "The Blue Fairy Book" will have numerous illustrations by Mr. Jacob-Hood and Mr. H. J. Ford.

— The series of articles upon "Nursery Cookery," which has been running in *Babyhood*, has proved valuable, and has helped to popularize the fact, that, however skilfully and judiciously food for children may be selected, such labor is frequently lost by being supplemented by poor cooking. Parents who wonder that their little ones do not thrive, although the best of food is provided, may find here an important hint. The chapter in the October number deals with rice, potatoes, and bread. *Babyhood* is published in New York, at \$1.50 a year.

— Lea Brothers & Co., will shortly publish a "Text-Book of Chemical Diagnosis," by Dr. Rudolph von Jaksch, translated by James Cagney, M.D., and William Sterling, M.D., in one handsome octavo volume, with numerous illustrations.

— J. W. Bouton is taking subscriptions for a limited edition of "The Soft Porcelain of Sevres," with an historical introduction by Edward Garnier, translated by H. F. Andresen. There will be ten parts, each having five plates.

— A. Lovell & Co., New York, have published the two concluding parts (Nos. 1 and 6) of the "Graphic System of Object-Drawing," by Hobart B. Jacobs and Augusta L. Brower. This system, which is based on the methods of the best Paris art teachers, is designed to give the pupil a clear idea of form, to help him to express that idea on paper, and to give him command of his pencil, so that he can draw the objects about him. The plan is quite simple, and a manual for teachers makes the system plain even to teachers unskilled in the art. The price per dozen is \$1.20. A sample set, with manual, will be sent for examination for sixty cents.

— Cassell & Co. have in press an important work on New Zealand by Edward Wakefield, who has held many high official positions under the New Zealand Government, now being one of the commissioners for that region at the Paris Exposition. It is to be entitled "New Zealand after Fifty Years."

— Alongside of the Volapuk enthusiasts there are a few men in this country, as well as in Europe, who are working to reinstate Latin as the language of science, if not of general communication between the nations of the world. These may be encouraged to learn that a periodical, written in chaste and elegant Latin, has recently appeared in Aquila degli Abruzzi, in Italy. It is edited by Carlo A. Ulrichs, a young Latin scholar of considerable reputation, and is published semi-monthly. Six numbers have already appeared, and the editor announces that the subscription-list is increasing in a very satisfactory manner, and contains the names of many scholars in Europe and America. The name of the periodical is *Aulauda* (Larks). It is a purely secular journal, being filled with poems, stories, anecdotes, jokes, and news.

Publications received at Editor's Office,

Aug. 26-Sept. 21.

AMERICAN Electrical Directory for 1889. Fort Wayne, Ind., Star Iron Tower Co. 598 p. 8°. \$5.
 ANDREWS, E. B. Institute of Economics. Boston, Silvery, Burdett, & Co. 227 p. 12°.
 ASTRONOMICAL OBSERVATORY of Harvard College, Annals of the. Vol. XIX, Part I. Cambridge, University Pr. 123 p. 4°.
 — Same, Vol. XX, Part II. Cambridge, University Pr. 267 p. 4°.
 BAKER, C. W. Monopolies and the People. New York and London, Putnam's, 263 p. 12°. \$2.35.
 BALDWIN, J. M. Handbook of Psychology. New York, Holt. 343 p. 8°.
 DUMAS, A. Les 'Trois Mousquetaires. Ed. by F. C. Sutherland. Boston, Ginn. 72 p. 12°.
 EGGLESTON, E. A First Book in American History. New York, Appleton. 203 p. 12°. 70 cents.
 GEORGE, A. J. Selections from Wordsworth. Boston, Heath. 434 p. 12°. \$1.35.
 GORE, J. H. A Bibliograph of Geodesy. (Appendix No. 16—Report for 1887.) Washington, Government. 198 p. 4°.
 HELPBRIK, A. The Bermuda Islands. Philadelphia, The Author. 213 p. 8°.
 HICHOBERG, P. Report on European Dock-Yards, Washington, Government. 90 p. 4°.
 HIGGINS, A. H. Iron and Steel Manufacture. London and New York, Macmillan. 180 p. 16°. \$1.
 LITTLEHALS, G. W. The Development of Great Circle Sailing. Washington, Government. 52 p. 8°.
 MAJORS, R. H. Report of the Board of Health of the State of, for 1888. Augusta, State. 336 p. 8°.
 MARKHOLTZ-BULGOW, Baroness. The Child and Child Nature. Syracuse, Bardeen. 207 p. 8°. \$1.50.
 MORNS, J. T., Jr. Benjamin Franklin. (American Statesmen Series.) Boston and New York, Houghton, Mifflin, & Co. 498 p. 12°. \$1.25.
 MYERS, P. V. N. A General History for Colleges and High Schools. Boston, Ginn. 729 p. 12°. \$1.65.
 NAVAL Mobilization and Improvement in Materiel. (General Information Series, No. VIII.) Washington, Government. 425 p. 8°.
 OHIO Agricultural Experiment Station, Seventh Annual Report of, for 1888. Columbus, State. 216 p. 8°.
 PENNSYLVANIA GEOLOGICAL SURVEY, Annual Report of, for 1887. Harrisburg, Geol. Surv. 115 p. 12°. \$2.
 PROCTOR, R. A. Strength: How to get Strong and keep

Strong. London and New York, Longmans, Green, & Co. 128 p. 12°. 75 cents.
 SMITHSONIAN INSTITUTION, Sixth Annual Report of the Bureau of Ethnology to the Secretary of the, 1884-85. By J. W. Powell, director. Washington, Government. 695 p. 4°.
 WEIR, H. Our Cats and All about Them. Boston and New York, Houghton, Mifflin, & Co. 248 p. 12°. \$2.
 WENTWORTH, G. A., and REED, E. M. Wentworth's Primary Arithmetic. Boston, Ginn. 290 p. 12°. 35 cents.
 ZUBLAUR, J. P. Quelques Mots sur l'Instruction Publique et Privée dans la République Argentine. Paris, P. Monillot. 112 p. 8°.

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JUST PUBLISHED.

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— The following incidents are from an interesting illustrated paper by Dr. J. Emmet O'Brien of this city, in *The Century* for September, on "Telegraphing in Battle." "In Butler's advance on the Petersburg and Richmond Railroad, May 7, a line was carried along with the column to within sight of that road, and worked until Beauregard struck us at Drewry's Bluff, on the 16th, when Gen. Butler ordered his chief operator to 'bring the line within the intrenchments.' In these trenches one night Maynard-Huyck was awakened from sleep, not by the familiar voice of his instrument, but by the shriek of a Whitworth bolt, a six-pound steel shell, which passed through the few clothes he had doffed, then ricocheted, and exploded beyond. Congratulating himself that he was not in his 'duds' at the moment, the boy turned over and slept through the infernal turmoil of an awakening cannonade until aroused by the gentle tick of the telegraph relay. We used no 'sounders' in those days at the front. In illustration of the sensibility of hearing acquired by the military operators for this one sound, the writer may be pardoned another personal incident. At Norfolk, in April, 1863, he happened to be alone in charge of the telegraph when Longstreet with a large force laid siege to Suffolk. In the emergency he remained on duty, without sleep, for three days and nights, repeating orders between Fort Monroe and the front. Toward morning on the third night he fell asleep, but was aroused by the strenuous calls of the fort, and asked why he had not given 'O. K.' for the messages just sent. He replied that none had been received. 'We called you,' said the operator at the fort; 'you answered, and we sent you two messages, but you failed to acknowledge them.' The despatches were repeated and forwarded, when, on taking up a volume of Scott's novels, with which he had previously endeavored to keep awake, the writer was astonished to find the missing telegrams scrawled across the printed page in his own writing, some sentences omitted, and some repeated. It was a curious instance of somnambulism."

— Funk & Wagnalls will publish this month a work entitled "The Life-Work of the Author of Uncle Tom's Cabin." The writer, Florine Thayer McCray, who is a personal friend of Mrs. Stowe, received permission two years ago to write this work from both Mrs. Stowe, and her son, Rev. C. E. Stowe, and received valuable assistance from them and other members of the family. It is to be finely illustrated, and contains about 450 pages. *The Publishers' Weekly* is informed, that, while this work dwells at some length on the history of "Uncle Tom's Cabin,"—that masterpiece which thrilled the world and contributed so largely toward the overthrow of American slavery,—it also gives an interesting account of Mrs. Stowe's habits, travels, methods of work, and reviews and commentaries upon the numerous other books that fell from her facile pen. The forthcoming work is likely to have a wide circulation.

— Macmillan & Co. publish early in October "Pen Drawing and Pen Draughtsmanship," by Joseph Pennell. The work will contain numerous photogravures and other illustrations, including examples after Sir Frederick Leighton (president Royal Academy), E. J. Poynter, Frederick Walker, Randolph Caldecott, George Du Maurier, Linley Sambourne, Harry Furniss, William Small, W. L. Wyllie, Charles Keene, Ford Madox Brown, Frederick Sandys, E. A. Abbey, Alfred Parsons, Walter Crane, Hugh Thomson, Arthur B. Frost, Blum, Madame Le Maire, Rico, Cazenova, Lhermitte, Menzel, and numerous other well-known artists. The same firm also announce the following for publication: a new volume of poems by Lord Tennyson; a new volume of essays by Professor Huxley; "The Elements of Politics," by Professor Henry Sidgwick; "Problems of Greater Britain," by Sir Charles Dilke; "Wild Beasts, and their Ways in Asia, Africa, America, from 1845 to 1888," by Sir Samuel W. Baker, with illustrations; "On Style: with Other Studies in Literature," by Walter Pater; "Royal Edinburgh: her Saints, Kings, and Scholars," by Mrs. Oliphant, with illustrations by George Reid; "The Pre-Raphaelite Brotherhood," by W. Holman Hunt, with illustrations; "Cults and Monuments of Ancient Athens," by Miss Jane Harrison and Mrs. A. W. Verrall, with numerous illustrations; "A History of the Later Roman Empire from Arcadius to Irene, A.D. 395-800," by John B. Bury;

"The Development and Character of Gothic Architecture," by Professor Charles H. Moore, with illustrations; "Eminent Women of Our Times," by Mrs. Fawcett; "Letters of Keats," edited by Sidney Colvin; "The Cradle of the Aryans," by G. H. Rendall; "The Makers of Modern Italy: Mazzini, Cavour, Garibaldi," by J. A. R. Marriott; "A Reputed Changeling; or, Three Seventh Years Two Centuries Ago," by Charlotte M. Yonge; "The Rectory Children," by Mrs. Molesworth, with illustrations by Walter Crane; "Text-Book of Physiology," by Professor Michael Foster, with illustrations, fifth edition, largely revised, in three parts; "Absolute Measurements in Electricity and Magnetism for Beginners," by Professor Andrew Gray, abridged edition; "Thermodynamics of the Steam Engine and other Heat Engines," by Cecil H. Peabody of the Massachusetts Institute of Technology; a new part (Vol. II., Part II.) of "A New Dictionary, founded mainly on the Materials collected by the Philological Society," edited by Dr. J. A. H. Murray; also Vol. III., Part I. (beginning with the letter E), edited by Henry Bradley, of the same work. A new edition of Chaucer's "Canterbury Tales," by Mr. John Saunders, assisted by Dr. Furnival, is promised shortly. The Chaucer Society has permitted its Ellesmere manuscript cuts of the Tale-tellers to be used in the book. It was originally published in three of Charles Knight's "Weekly Volumes," and carries on the story of every tale by prose bits between the extracts, making it as easy to read as a modern novel.

— After writing about fairy-stories for years, Mr. Andrew Lang has now taken to writing them himself. Messrs. Longmans, Green, & Co. will shortly publish his "Prince Prigio," with illustrations by Gordon Browne. The prince is a great-grandson of the Giglio of Thackeray's "Rose and the Ring;" and many of the old fairy-ticks serve a new purpose in Mr. Lang's story.

— There are ten articles in the October *Magazine of American History*. The frontispiece is a portrait of the late Samuel L. M. Barlow, accompanied with a poetical tribute from George Ticknor Curtis; also a sketch of the great lawyer by the editor. The opening article of the number, "The Romantic Beginnings of Milwaukee," by Roy Singleton, is one of those contributions which help to make American history grow more real and inviting to all classes; it is illustrated with portraits of some of the founders of Milwaukee. Following it is a study entitled "Georgia, the only Free Colony—How the Negro Came," by Professor H. A. Scomp of Emory College. Then comes "Kings, Presidents, and Governors of Georgia, 1732-1889," by Col. Charles C. Jones, jun., LL.D., of Georgia, which places material of curious significance on record. Opportune at this moment is a paper by Dr. George H. Moore of Lenox Library, on "The Discovery of America by Columbus," describing the celebrations in Boston and New York a hundred years ago, and showing the part taken in them by the Tammany Society. "The Antiquity of the Tupper Family," by Professor Tupper, is readable. "The Financial Condition of New York in 1832," contributed by Susan Fenimore Cooper, includes a letter written by J. Fenimore Cooper; "A Trip to Niagara in 1835—Miss Caroline Spencer's Journal," gives views of the methods of travel and the sights to be seen in western New York fifty-four years ago; and among the shorter articles is a tribute to Oliver Wendell Holmes on his eightieth birthday.

— Bulletin No. 3 of the Ohio Agricultural Experiment Station, "Silos and Ensilage," is an account of some preliminary work done in 1888 in the study of the silo question. It includes an illustrated description of the silo of the station, hints respecting the culture and harvesting of corn for silage, and the report of a feeding experiment in which corn-silage was contrasted with sugar-beets. Bulletin No. 4, "Small-Fruits at the Ohio Experiment Station," gives the results of this season's experiments with strawberries, raspberries, and blackberries, also of an experiment showing the effect upon the keeping-quality of early and late picking of apples. Bulletin No. 5, "Wheat at the Ohio Experiment Station," gives the results of this season's experiments with wheat, including thick and thin seeding, early and late sowing, methods of sowing, and a comparison of sixty-five differently named sorts of wheat. Any of these bulletins will be sent free to any Ohio farmer on application to the experiment station, Columbus, O.

LETTERS TO THE EDITOR.

The United States, their Growth in Population in Two Hundred Years.

[The following letter was received from the Hon. W. E. Gladstone, in response to a copy of *Science* mailed him, containing Gen. M. C. Meigs's article on the above subject.]

Dear Sir your estimate, the boldness there seen, is full of interest. Essentially there is to be a vast development of material power in the world, & most full in America. Every one here would know it to keep pace with it, there will ensue a corresponding growth in the sentiments of humanity and more extended the giving of every good and helpful gift.

Yours faithfully &c

W. E. Gladstone
Sept 13. 89

The Pennsylvania Weather Review.

THE monthly weather review of the Pennsylvania State Weather Service for August last contains an isothermal map of the State for the normals of the month, whose atrocious absurdity is paralleled only by the isothermal maps of New Hampshire in the report on the geology of that State several years ago. The isotherm of 67° performs the extraordinary feat of branching three times in its traverse of Pennsylvania. Three other isotherms end abruptly within the limits of the State, apparently not knowing how to get out. The lobate isotherm of 71°, that enters the State from the south and includes Gettysburg, fails to surround the adjacent isotherm of 74°, which reaches Harrisburg. It is remarkable that a travesty like this should appear under the direction of the committee on meteorology of the Franklin Institute of Philadelphia.

W.

Reformed Spelling.

So far, all attempts to introduce a reformation in spelling seem to have failed. The changes that are recommended by the philological societies and approved by scholars are disregarded, Mr. Ellis's "Glossic" has been before the public nearly twenty years, Dr. Hill's efforts for six years at Waltham produced no permanent effect, it is doubtful if Mr. Bell's "World English" will fare better, and Hosea Bigelow spelling is dropped by every one after they have wearied themselves over a few lines.

While so much study has been given to the changes that are desirable, the best way to introduce them has perhaps been less

considered. The eye is educated to catch syllables and words at a glance, and soon tires of picking out letters, although their combination may represent the sounds of words correctly. It is true that children can be easily taught to read phonetics; but, as one who has learned a foreign language lays it aside in his native land, so does the phonetic expert for the printed matter he finds in daily use, and the language floats on, unchanged and stationary.

How much, then, is it wise to attempt? Can any changes be proposed acceptable to readers, and such that printers will use them? Instead of attempting to introduce a phonetic system that is perfect, it may be well to employ one that is practical, and better than that at present in use, but not differing from it enough to embarrass the reader, and to keep words of uniform spelling if the correct sound of the letters in them is misused. No new letters should be used; nor does the eye tolerate new symbols, nor the use of accents, to determine sounds. This narrows the field in which changes can be made, yet leaves it large enough to furnish a spelling that will recommend itself to printers, foreigners, and illiterates; while children instinctively adopt it, when they can escape from the tyranny of the spelling-book, because it is uniform, and regulated by analogy.

First as regards the vowel-sounds. There seems to be no good reason to change the short sound of *a*. Its sound as in *trade* is fixed by *e* mute in all words except four. Its sound as in *marry* is fixed by the double consonant. "Glossic" doubles *a* in *father*, and adds *u* in *water*. Short *e* need not be changed. It is lengthened when it is in a final syllable or followed by *e* mute, which Professor Marsh tells us requires four per cent of all printed matter. "Glossic" uses *ei* for long *i*, which does not displease the eye. Of the four sounds of *o*, that as in *tone* is controlled by *e* mute or by accent in pronunciation. The sound as in *move* occurs in twelve words, which may be memorized. Words with the sound as in *dove* might perhaps drop *e* mute. The *bête noire* *ou*, with its seven sounds, has already caused a rebellion, as in *plow* for the time-honored *plough*, and may gradually drop most of them.

Of the consonants, *c* is hard before *a*, *o*, *u*, which can easily be remembered, as it will be difficult to displace it by *k*; *g* has both hard and soft sounds before *e* and *i*, where *j* could be substituted, as *genuine*. There would be few mourners at its burial should the printers condescend to drop *u* after *g*. The change to *tion* for *shun* is displeasing, and its pronunciation is uniform. The printing *dthis* for *this* is a stumbling-block in the way of any change.

The changes noted above are the principal ones that would go far to conform the spelling of the language to its pronunciation.

Perhaps the best way to have any changes adopted would be to have the most desirable printed on cards, to be kept in plain sight at every case of type, and have some editor who has the improvement of the language at heart print one article in his daily paper, with the approved spelling. If it is favorably received, increase it gradually as the readers approve it. The end can be gained by keeping the changes before the eye until they are accepted by habit.

W. C. Bryant used to say, "When you reformers agree among yourselves as to what you want, it will be time enough for us of the press to give the matter our attention." It cannot now be said that there is uncertainty as to the proposed reform. The action of the phonological societies, the efforts of linguists, the whole literature of phonetics, furnish a magazine to supply all that is needed to move upon the conservative forces that delay reform. But the press should take the initiative; for with little effort they can make it familiar to every reader, and give it success. The results on the brotherhood of mankind will be such that every one who is in a position to forward the reform should take an active share in its introduction.

M.

INDUSTRIAL NOTES.

Electric Apparatus for South Africa.

OUR readers are well acquainted with the many electric-railway installations which have been made during the past two years, and with the fact that the manufacture of electric apparatus for this work has grown rapidly. It is now estimated that there are from 150 to 200 electric street-railways in this country, either in operation or in course of construction.

Electricity promises to be the coming medium for transmission of power not only for street-railways, but also for mining industries; and it is hard to imagine an agent for transmitting power which is more easily handled, and the apparatus for which is, on the whole, more economical and inexpensive.

Among the electric mining plants which are now being installed by American manufacturers of electric apparatus, who lead the rest of the world, are a number not only in this country, but

abroad; and it is no unusual thing to hear of another mining company which has decided to adopt electric power in its mines.

Among recent contracts which have been awarded the Sprague Electric Railway and Motor Company of New York for electric-mining apparatus is one which comes from Transvaal, South Africa; and it is interesting to note that the fame for American electric-mining apparatus for durability, economy, and convenience, is recognized in these fields as well as in this country. The company which is now installing Sprague apparatus in Transvaal is the Forbes-Reef Gold-Mining Company, who have ordered through Chester & Gibb, winding engineers of London, Eng., a complete electrical equipment for transmitting power, including four Sprague long-distance motors, and dynamos for transmitting 140 horse-power over a distance of three miles. The primal source of power is a waterfall situated about three miles distant from the mines as the crow flies. These points are connected by insulated wires, which are carried on poles.

At the power-station will be placed three Pelton wheels furnished by Frazer & Chalmers of Chicago. To each of two of these wheels will be belted one long-distance transmission constant potential Edison dynamo of 50,000 watts, or 67 horse-power, capacity each. To the other wheel will be belted a dynamo of the same type and voltage as the others, but of only 40,000 watts, or 55 horse-power, capacity. These dynamos are similar in appearance to the standard Edison dynamo which is used in incandescent lighting; but their winding is modified according to the regular Sprague system, adapting them for the long-distance transmission of power. These machines have an efficiency of over 95 per cent.

At the mines are located the four Sprague motors, which are belted direct to the mining-machinery. These motors are divided into two groups; two 20 horse-power Sprague motors and one 80 horse-power motor forming one group, and a single 20 horse-power Sprague motor forming the other group. Each group is supplied with current by a separate set of wires, thus practically insuring a constant flow of electricity under all circumstances.

The method of regulating the motors and keeping up a constant speed in spite of the varying loads thrown on the mining-machinery is accomplished by winding the motors in a special way, so that there is no mechanical governor to get out of order. The governor being in the winding, and consequently acting without making any movement, the motors are more durable, and the use of any complicated mechanical governor is avoided. The motors are to run on a constant potential circuit, and all the motors of each group are connected together from positive to negative wires, thus equalizing the strain on the dynamos when the loads are thrown on the motors. This method of connecting dynamos and motors is in use in all Sprague stations for the transmission of power; and it is much superior in reliability and economy to the series method of putting each motor on a separate connection. In principle it is the same as supplying a city with water by running city mains instead of using a separate conductor for each consumer.

The question of efficiency, or the amount of the primal power which is delivered at the farther end after the transmission, is one which is very important. Upon this point electric transmission compares very favorably with all other methods of transmitting power. In this case the efficiency of the entire system, from the turbine pulley to the mining-machines at the farther end, is about 70 per cent; that is, 70 per cent of the energy which is delivered from the turbine pulleys at the power-station is given off the motor pulleys for work.

New Electric Street-Railways.

DURING the last week there have been a number of street-railway companies which have contracted for electric-railway apparatus in spite of the lateness of the season. The latest contracts closed by the Sprague Electric Railway and Motor Company of New York are for street-railways in Piqua, O., and South Nashville, Tenn.

The road at Piqua is an entirely new road, never having been operated by any power before. The number of cars which will be equipped will be four, and the line will extend for a few miles on the main streets of Piqua.

The South Nashville Street Railway Company will equip eight

cars at present, but it is expected that the entire road will be run by electric power before long.

The Elliott Non-Electric Telephone.

A PATENT was recently issued to Larkin V. Elliott of Moores-town, Ind., for an improved form of mechanical or non-electric telephone, which seems to possess several advantages over other instruments of its class. The general appearance of this telephone is shown in the accompanying illustration. The mouth-piece is bell-shaped, and about four inches in diameter at its larger part, the bore narrowing to about an inch and a quarter where it joins the base. The aperture in the latter is cone-shaped, narrowing from about four inches in diameter where it joins the mouth-piece to half that size at the rear. Between the mouth-piece and the base the diaphragm is securely fastened. The diaphragm consists of two sheets of stretched rawhide, with an interposed layer of soft fibrous material and a covering of some soft fabric. It is made in the following manner. A sheet of thick rawhide is first stretched tightly across the aperture in the base, preferably while wet, so that when it dries it will be still more tightly drawn. Over this is laid a layer of cotton batting or other soft fibrous material. Over this a sheet of thin rawhide is stretched, but not as tightly as the



first sheet. Lastly comes a sheet of velveteen. The whole is secured firmly between the base and mouth-piece.

The line-wire passes through an opening in the centre of the diaphragm, being provided on its end with a button, which bears against the velveteen surface of the diaphragm. The inventor claims that this peculiar construction of the diaphragm, together with the shapes of the apertures in the base and mouth-piece, not only prevent the usual roaring sound in the receiver, but improve the sound by rendering it more distinct, reproducing a clear, natural tone of voice, similar to that which acts upon the diaphragm at the other end of the line-wire.

The claims of the inventor in regard to the good qualities of these telephones are borne out by the testimonials of many business-men who have had them in use for several months. They are intended only for short lines, from a few rods up to a couple of miles. Proper suspension devices are provided, so that the line-wire may be carried around angles without impairing the efficiency of the instruments. An electric call-bell may be used in connection with this telephone if desired.

American Apparatus in Italy.

WORK on the electric-railway apparatus for the Florence and Fiesole Road has been commenced upon at Schenectady, N.Y., which will be ready for shipment before long. This road will be operated entirely by electric power, and Sprague electric cars will be used throughout the entire line.

The road connects the city of Florence with the city of Fiesole, a distance of about five miles. The grades upon this line will be very severe, sufficiently so to have precluded the use of horses upon it. The regular Sprague system of overhead wires, using main conductor with feeders, will be used.

The fact that American railway apparatus have been adopted on this line is extremely flattering to the company to whom the order is given, and gratifying to the patriotism of every American. The fact that the Sprague system was brought into direct competition, in the matter of equipment of this road, with all the systems of electric street-railways in Europe, shows in an additional way the favorable reputation of American apparatus.

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"I wish to exchange *Lepidoptera* with parties in the eastern and southern states. I will send western species for those found in other localities."—P. C. Truman, Volga, Brookings Co., Dakota.

Shells and curiosities for marine shells, curiosities or minerals address W. F. Lerch, No. 308 East Fourth St., Davenport, Iowa.

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100 botanical specimens and analyses for exchange. Send list of those desired and those which can be furnished, and receive a similar list in return. Also cabinet specimens and curiosities for the same. Scientific correspondence solicited.—E. E. BOGUE, Orwell, Ashtab. County, O.

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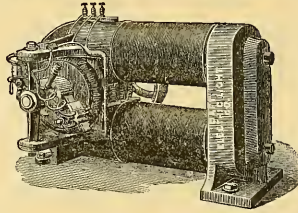
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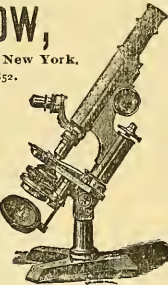
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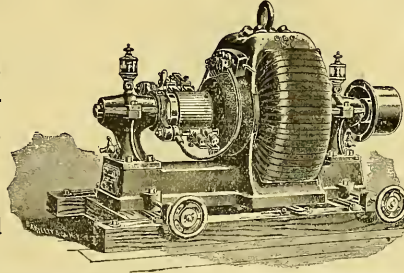
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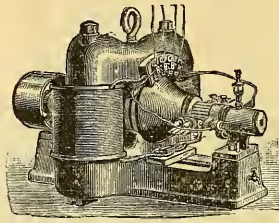
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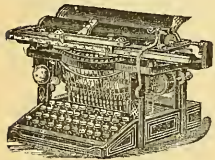
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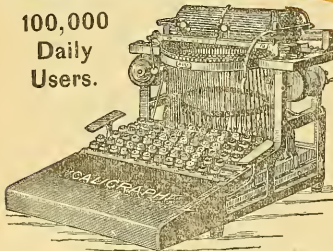
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VOL. XIV. No. 340

NEW YORK, OCTOBER 11, 1889

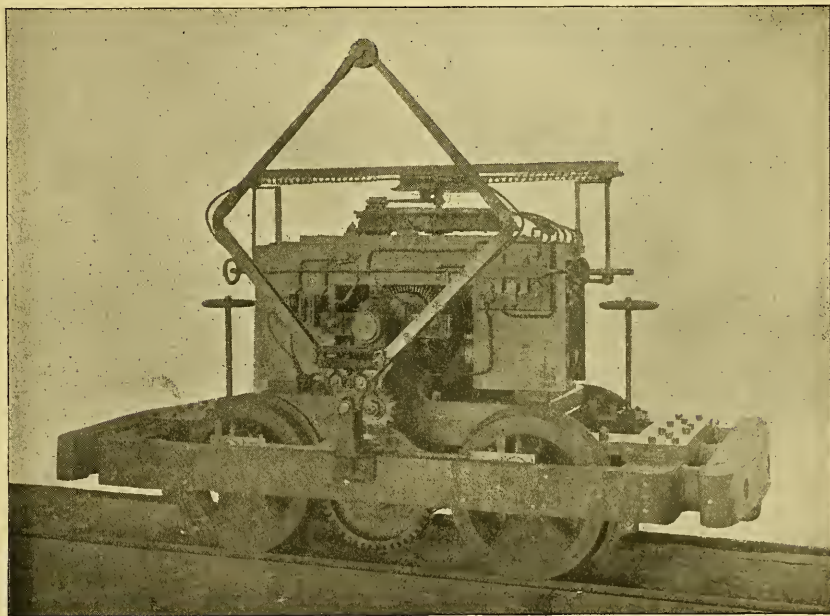
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ELECTRICITY IN MINING.

THAT the electric current can be easily adapted to mining and engineering operations is a fact which is abundantly attested by mines in which it has already come into general use for both lighting and transmission of power. The contrast between the wire-rope, compressed-air, and other methods, with electrical transmission of power, cannot fail to be in favor of the latter system. Existing water-powers miles away from the mines may be used, and electric motors employed for hoisting, haulage, pumping, ventilating, and many other purposes, with greater ease and economy

operation on a three-foot gauge, is 9 feet 7 inches in length over all, width 5 feet 3 inches, and height 5 feet 6 inches. Although the weight is 10,500 pounds, there is not a pound of it which is not utilized in the construction of the machine; and the tests for traction which have been made have given the most excellent results. The speed is six miles an hour under full load.

The motor used is the type "G" railway motor, 40 horse-power, embodying designs and inventions of Mr. Charles J. Van Depoele. Its motion is transmitted to the wheels by gears and connecting rods. On the top of the machine is placed a rheostat controlled by the wheel shown at each end, and on the side is placed a revers-



THOMSON-HOUSTON ELECTRIC LOCOMOTIVE FOR COAL-MINES.

than could possibly be accomplished by any other method. In fact, it is safe to say that in the near future electricity will displace all other forms of motive power in mining operations where the conditions are at all favorable.

In this connection, it may be mentioned that the Thomson-Houston Electric Company has just completed a mining locomotive for the Hillside Coal Company, Scranton, Penn., which is shown in the accompanying illustration. The machine embodies new features in motor-construction and in general design, and under practical test has shown that it is particularly adapted to the nature of the work required of it. The locomotive is made for

ing-switch, which can be operated in the same way from either end.

One of the distinctive features is the trolley-arm, which will operate with equal facility in either direction; and its method of construction permits a great variation in the height of the conductor. This is a very important and valuable feature, as in mining-work the conductor is rarely maintained for any length at a constant height. The Thomson-Houston Electric Company has already made in mining operations many applications of its electrical apparatus, which has been found to possess the same characteristics of excellence shown in its well-known lighting systems.

EVOLUTION OF MUSIC FROM DANCE TO SYMPHONY.¹

A BLUE egg may become a robin. The latent life sequestered by marble walls may be warmed into activity, and gather to itself the crumbs from a cottage table, and weave therefrom the tissues of life, — feet to perch among the blossoms, wings to fly among the trees, eyes to revel in the scenes disclosed by sunlight, and vocal organs to sing the song of love to mate.

A tiny seed may become a "big tree;" for, warmed into life, it sends its rootlets into the nourishing earth and its branches into the vivifying air, and gathers materials with which to build a *Sequoia*, that stands for centuries as a glory in the forest of the sierra.

The rill born of a summer shower carries the sand from the hill-side and gives it to the brook, and the brook bears it on to the river, and the river transports it to the sea, and the impregnated tide finds a nest beneath the waves and in it lays the egg of an island. Then this boss on the floor of the ocean has the power to gather about it more sands as they come from the distant hills, and still more sands. Every summer shower gives it more, and every storm adds to the sands that are thus buried beneath the sea, until at last an island is hatched, as it lifts its head above the waves.

Robins grow to be robins by minute increments; trees grow to be trees by minute increments; islands grow to be islands by minute increments. There is an aphorism current in the world that like begets its like: it is but half the truth. Whatever is, changes, and no repetition comes through all the years of time: some minute change must ever intervene. Among living things one generation follows another, always with some change; and change on change in sequent reproduction, as the stream of life flows on, results at last in transformation. This slow but sure metamorphosis is called evolution, and the scientific world is engaged in the formulation of its laws.

The laws of animal and vegetal progress, otherwise called biotic evolution, do not apply to mankind in civilization. Biotic evolution is progress in bodily function: human evolution is progress in culture. The one is dependent on the laws of vitality; the other, dependent on the laws of psychology. The first great law of biotic evolution is denominated "the survival of the fittest in the struggle for existence." This law does not directly apply to man in his progress in culture. The bad are not killed off by any natural process in order that the good may survive and propagate their kind. Human progress is by human endeavor, by conscious and designed effort for improvement in condition.

The second great law in biotic evolution is denominated "adaptation to environment." But man is not adapted to environment: he adapts the environment to himself by creating that which he desires. For example: no natural protection to his body is developed by which he is adapted to a boreal climate; but he adapts that climate to himself, modifies it in its effect upon himself by building a house and creating a home climate at the fireside, and when outside of his home he protects himself with clothing, and creates a personal climate, and laughs at the winds that drift the snow. Man is not adapted to environment; but he adapts his arts to environment, and creates new conditions to please himself.

The third great law of biotic evolution is denominated "progress in heterogeneity." With time, animals become more and more diverse in structure and function. Kinds or species multiply. But this law is reversed with men in civilization, for they become more and more homogeneous. The tendency is not to differentiate into species, some with horns and hoofs, some with tusks and claws, and some with arms, and some with wings. The tendency is not towards specific differentiation, but towards specific homogeneity.

There is, however, another kind of differentiation that develops by culture, which may be denominated "qualitative differentiation." Human beings do not develop along divergent lines, but along parallel lines, and they differ mainly in the degree in which they have made progress. Human evolution develops not different kinds of

men, but different qualities of men." The apple-tree under human culture does not develop in one line to bear peaches, another to bear plums, and another to bear pine-apples: but the fruit of one tree is sour, and that of another is sweet; one is dwarfed, gnarled, and bitter, another is large, rosetate, and luscious. Human progress is such culture. It develops different qualities and degrees of the same thing. There are apple-trees that bear nothing but sorry fruits. There are tribes of the world that are all savages. The trees of higher culture bear fruits of diverse qualities. The well-developed pippin, the diseased pippin, and the shrivelled knot of bitterness grow on the same tree. So in lands of high culture men are good and bad, wise and unwise, but they do not thus become specifically different.

The fourth great law of biotic evolution is denominated "progress in integration." The differentiating parts also become more and more interdependent. The organ which can best subserve its purpose is less efficient in performing an unwonted function: it therefore becomes dependent upon other organs, and the interdependence of all the parts of the same organism increases with evolution. Society is an organism. The people organized as a body politic, and constituting a nation, become interdependent, and each one is interested in the common welfare. In the growth of society through the organization of kindred into clans, and of clans into tribes, and ultimately of tribes into nations, great progress in integration is made, and it receives its highest development when despotism is organized. If we study the progress of society through these stages only, we are led to conclude that biotic evolution and human culture follow the same laws, for the integration of mankind in despotic nations is measured by the perfection of despotic governments. The highest integration is secured with hereditary rulers, privileged classes, and enslaved common people.

The progress of mankind from despotism to liberty has been one vast system of warfare against integration, until in perfect liberty under free institutions this integration is destroyed, and the biotic law is repealed in its application to mankind. The development of liberty is the overthrow of the fourth law of animal evolution.

Liberty means freedom to the individual, and is secured by establishing interdependence of industries: thus man transfers despotism from himself to his inventions.

No cruel law of destruction belongs to mankind. No brutal adaptation to environments occurs in the course of human culture. No differentiation into antagonistic species is found. And liberty destroys despotic integration.

The laws of biotic evolution do not apply to mankind. There are men in the world so overwhelmed with the grandeur and truth of biotic evolution that they actually believe that man is but a two-legged beast, whose progress in the world is governed by the same laws as the progress of the serpent or the wolf; and so science is put to shame.

Since the doctrines of evolution have been established, the basis of systematic classification has been changed. Artificial categories have given place to natural categories in such a manner that the classes are believed to represent genetic relations. The search for natural categories began anterior to the establishment of the laws of biotic evolution, and the new philosophy would be unrecognized but for the work which systematic biology has already done. Natural classifications and the laws of hereditary descent develop together, and are interdependently established. Still it remains that genetic biology, or the science of the laws of the progress of life, imposes conditions upon systematic biology; for a natural classification must reveal the fundamental epochs and phases of evolution.

As human progress is not upon divergent lines, but upon the same line to the goal of a higher life, men must be classified, not by biotic kinds, but by degrees of culture; and the three great culture stages, not three great kinds of men, be it understood, have been called savagery, barbarism, and civilization, to which a fourth may well be added, that of modern civilization, — the stage of enlightenment.

That which makes man more than the beast is culture. Culture is human evolution; not the development of man as an animal, but the evolution of the human attributes of man. Culture

¹ Address by Major J.W. Powell, the retiring president of the American Association for the Advancement of Science, delivered at the meeting in Toronto in August.

is the product of human endeavor. This is the burden of my argument.

In man's progress from savagery to enlightenment, he has transferred the laws of beast evolution from himself to his inventions, and, relieved of the load, he has soared away to the goal of his destiny on the wings of higher laws.

The evolution of music has been presented as an illustration of this fact. Man as a poet has not developed by the survival of the fittest. There has been no natural system of laws by which the bad musician has been killed, and the good musician permitted to live and propagate his kind. There has been no system of natural selection to kill poor singers and cheap fiddlers.

There is no adaptation of musicians to environment. There are no aquatic musicians; there are no aerial musicians; there are no tropical musicians; there are no boreal musicians — as those terms are used in biology. The prima donna that sings in Rome may sing in St. Petersburg. The artist on the violin may enrapture the people in Toronto, in Washington, or in Mexico, and an orchestra may play on the land and on the sea.

Again, there has been no progress in the differentiation of musicians. There is no musical species. There is no distinct race of prima donnas. There is no endogenous clan of organists. Musical folk spring up among the people everywhere. Of two children of the same parents, the one will be musical, and the other will not be. A sister will play the violin with beauty, and a brother may love nothing better than an accordion.

Every nation and tribe on the face of the earth has developed its own musicians; and when a great artist springs up in any land, he travels the world, and delights all the people of civilization. Ole Bull, like Orpheus, would make the stony hearts of all men dance; and Jenny Lind could sing a song of sorrow to weeping multitudes in any city of Christendom, and, if the angels loved not her music, small be the meed of praise for angels.

And, lastly, there is no integration of musicians. They are not organized into one body politic. They do not inhabit one little nook of the world. They are not gathered by themselves on one side of the sea. The king of players is metaphoric king, the queen of singers is metaphoric queen.

But though these laws of evolution do not apply to musicians, they do apply to music itself. Man has transferred them from himself to his musical inventions. Ever there has been a survival of the fittest. The music of savagery is lost in barbarism. The songs of barbarism are lost in civilization, and modern music is replacing the music of our fathers. So the old grows into the new by the survival of the fittest; not by natural selection, but by human selection, for men choose to keep the music they love the best.

There has been progress by differentiation in music. Gradually music has developed into distinct parts; and with the invention of musical instruments, musical compositions have been produced adapted to each. There is the music of the organ, the piano, the flute, the violin, and instruments too many to tell, and thus the world is filled with varied music.

Music has been adapted to environment. There is music for the dance and for the battle; music for the wedding and the funeral; music for the theatre and the temple; and there is music about every thing, — the land, the sea, and the air, the valley and the mountain, the flower and the forest, the fountain and the river, the worm and the serpent, the zephyr and the tempest. There is music for all peoples, in all climes, in all conditions. The varieties of music parallel every human thought.

There is integration of music. When a band plays organized music for the military parade, many instruments combine to play their parts in harmony. There is organized music for the temple, where the choir and the instruments combine to make music for prayer and praise. But the highest development of musical integration is found in the orchestra, where the parts of the symphony are played in sweet unison, in grand harmony and sublime sequence, guided by the magic *baton* of the leader.

Music is the invention of mankind; not of one man, but of all men, — of composers, performers, and hearers. Music has come down the stream of time; and as the rivers grow from source to sea, so music grows from primal time to vast eternity.

In the same manner we may take up any one of the elements of human culture, and develop the laws of its evolution, and find that all culture comes by human endeavor. All arts, all institutions, all languages, all opinions, have grown in obedience to the laws of evolution as set forth; and in the exercise of all these human activities man himself has been developed: so the laws of biotic evolution apply not to mankind. Beast is beast, man is man.

I have affirmed that the laws of biotic evolution do not apply to human culture. To make this clear, concrete demonstration is necessary. On this occasion one of the æsthetic arts will be used for this purpose. The evolution of music will be portrayed and its laws developed, and it will be followed briefly through the four stages of culture, — savagery, barbarism, civilization, and enlightenment.

The classic categories of biology should represent genesis by differentiation, but it has been shown that man cannot thus be classified. Man by his genius has transferred the application of the four great laws of biotic evolution from himself to his inventions. Human inventions evolve by human selection; and there is a survival of the fittest, an adaptation to environment, a progress in differentiation, and a progress in integration. Human inventions, therefore, should be classified in such a manner as to exhibit their genesis by differentiation.

If we classify the fine arts on these principles, we must place them in four groups, as we find them arising from four germs. It is true that their development has been more or less interdependent, yet they have four origins, and have developed along four lines, both in form and motive.

Fetich carving was the germ of sculpture. Stone, bone, shell, wood, and various other materials, were used by the sculptor in which to carve the forms of his beast gods. Carving begun in this rude way developed at last along two lines, one leading to idolatry, and the other to sculpture.

Picture-writing was the germ of painting. Early man daubed rude pictures on bark and other materials, and etched them on stone. The alphabetic arts also sprang from this source, as writing, printing, and telegraphing.

Mythology was the germ of drama. Early man believed the animals to be the creators and movers of his universe, and the stories of the doings of beasts constituted the first drama. Later romance sprang from the same source; and from romance, biography and history. Along another line from the same germ sprang science.

The dance was the germ of music and poetry. Poetry derived its form from the dance, and its earliest motive from mythology. The evolution of music will be set forth more fully.

Sculpture represents material forms in solid matter, as wood, clay, stone, ivory, and metal.

Painting represents forms and scenes of nature and human life in color, as light, shade, and hue, through the aid of form perspective, distance perspective, and aerial perspective.

Drama represents scenes in the life of human and mythic heroes by personation or mimicry combined with literary presentation.

Romance represents biography and history in fictitious tales.

Music represents ideas in sound by rhythm, melody, harmony, and symphony.

Poetry represents psychic pictures by metaphor, through the aid of rhythmic literature, sometimes using rhyme and alliteration.

The arts have thus been described by defining their forms; but each has something more as a reason for its being an æsthetic art, — a purpose to fulfil. The motive of all the æsthetic arts is to reach the intellect through symbols, and thus kindle the emotions. All art is therefore symbolic and emotional.

Let us turn to the evolution of music.

This is the burthen of my song, this is the theme that runs through my melody: that music, in harmony with all of the processes of becoming in nature and art, becomes by minute increments, — by growth. How, then, did music grow?

It has been assumed by writers that music has its origin and development in the innate appreciation of the human mind for the rhythms, melodies, harmonies, and symphonies of nature; that it

is the spontaneous outburst of the human soul in response to the music of the physical and animal world. The sighing of the winds, the murmur of the rills, the roaring of the cataracts, the dash of the waves on the shore, the singing of the forests, the melodies of birds, — all these and many more have been considered as the teachers of music to man. The objective study of music among the lower tribes of mankind and among the various peoples of the world in different stages of culture, and of the history of music itself as developed by our own race, leads to a different conclusion.

Kids gambol among the rocks as if filled with joy; colts run about the pastures as if mad with ecstasy; cooing babes pommel vacuity and kick at void with hands and feet as pink and soft as petals of the rose, and seem delighted with the gift of new-born life; lads and lasses play in the park with shouts and laughter, as if existence was forever a May-day of sport.

There is pleasure in activity. The laboratory of life evolves a surplus of motion the expenditure of which gives rise to joyous emotions expressed in rollicking, boisterous play.

In youth and health and vigor there is in the exercise of the muscles and the motions of the limbs a joy which may be heightened as many become associated in the same activities, — brothers, sisters, cousins, sweethearts, wives, husbands, and parents. Let them unite in sportive activities, and the very ecstasy of motion is produced. When such physical activities are systemized, the dance is organized. When a group of pleasure-seekers organize their activities in such a manner that the motion of every one is in harmony with the motion of every other one, the merry dance is an art and a social institution, and every one's joy is multiplied by every other one's joy. Then rhythm of motion becomes rhythm of emotion.

Man early learned that it was easier to control movements of dance by sound than by sight, and so he marked the rhythm of the dance by sounds of the voice or by sounds of the drum.

Blue-eyed children play with the brown-eyed, and brown-eyed children play with the black-eyed, and they all join hands and play "ring-around-a-rosy;" and out of this childish sport, by minute increments, musical rhythm becomes.

The first dancers were the men who lived in the forests, around the sheltered bays of the sea, on shores where quiet lakes mirrored the wild bird's flight, or on banks where the fishes sported in the wavelets of the brook.

The Eden of these sylvan men was large. It was walled with ice, so that men could not wander away to the north pole or to the south pole; but between these frozen regions the temperate and torrid lands were open. Before they learned to fashion stone knives, before they learned to use stone tomahawks, before they learned to use bone awls, before they learned to wear shell beads, before they learned to build shelters of boughs and bark and stone, — while yet naked animals, — men were found in every quarter of the globe. There were men on every shore, and there were men on the banks of every river. Sylvan men and women, boys and girls of the forest, dusky babes of the wood, were scattered throughout the whole habitable earth before the rudest human arts were invented, probably before organized languages were formed, and probably before institutions were organized. How do we know this is true? Is it the story of a romancer who finds the origin of the glacial drift in the lashing of a comet's tail? No, this conclusion is reached through the labors of an army of patient, earnest, keen-visioned investigators. They have found the birthplace of art not alone in one land, but in all lands. The vestiges of the crudest arts are found everywhere, and men began the career of artisans everywhere. It is found that men were already distributed throughout the world when they first began to use the simplest tools. Something more of interest is found. It is discovered that the time when the first art-culture began was long ago, — very long ago; not long when compared with the geologic history of the earth, but very long when compared with the book recorded history of man. Archaeologists have found vestiges of the beginnings of human art in geologic formations, and they have found them in all lands. So the "Garden of Eden" was all the world, and the sons of Adam were a host.

As time passed on from that ancient epoch when men had

landed on every shore, they slowly, very slowly, improved in their arts: for later and still later geologic formations contain vestiges of higher and still higher arts, until at last men could make pottery and weave garments and cultivate the soil; and from that time on, we have human industry recorded in books.

Early human history is recorded in the rock-leaved bible of geology; late human history is recorded in paper-leaved books of libraries. Let us take up the story of music as a human art at the time when the late history commences, for that will serve our purposes.

All the sylvan people of the world rejoice in dancing. So far as we know, it was the earliest of the æsthetic arts, for we find it highly developed at the very birth of all other fine arts. This is because its foundation is laid in the physical constitution of man; it is the expression of the joy of animal life. These sylvan men danced by firelight, and forever they varied the rhythm of their dances with short steps and long steps, with steps to the right and steps to the left, with steps forward and steps backward: so dances came to be composed of a succession of varied steps, so rounded as to make a complete number in a figure of motion. A figure of motion, a complement of steps, is repeated over and over again, and the voices of the dancers are trained to chant the rhythm to guide their feet in the dance. To mark the varied steps to each complement or theme of motion, the voice is varied: long notes and short notes are used, and then loud notes and soft notes; and yet there is nothing but rhythm. Then they begin to vary their voices as a guide to the moving feet by changing the vocal pitch, and the simple chant becomes. First, the voice varies only in time; then it varies in time and stress; then it varies in time and stress and pitch, and the chant is almost a melody. So the music of the lowliest men known to modern investigators is but rhythm. It is the universal music. All music in all times is based on rhythm, but some music has more than rhythm. The music of the savage has been improved. The sylvan man developed the first element of music to a high degree.

At this stage the chant of unmeaning syllables undergoes change, for the emotions that are kindled by the dance are expressed in words, — first a few simple expressions of emotion, mere interjections, then exclamatory phrases, then exclamatory sentences, and the egg of poetry is laid.

This embryonic poetry is devoid of rhythm; for the rhythm yet belongs to the voice, not to the literature. The rhythm does not grow out of the words of the chant, but the rhythm of the chant is imposed on the words.

The stage of culture of this sylvan man is called "savagery;" and it is very long; and during all these centuries, and centuries of centuries, tribes of kindred men dance and chant. At the foot of the glaciers they have their homes, and walls of ice echo their chants; by mountain crags they have their homes, and the rocks echo their chants; in the valleys they have their homes, and the savannas are filled with their chants; in tropical forests they have their homes, and "the sounding aisles of the dim woods" ring with their chants.

When sentences are used to express the emotions kindled by the dance, the leader repeats the words and the people chant the refrain; and more and more he gains a freedom in composition, and he varies his chant with new sentences, iterating and reiterating the emotional theme. In this way poetry becomes, and we have dancing-master poets and dance songs. As the dancing-master poet varies his theme of poetry, so he varies his theme of music, and melody becomes. Poetry and melody are twins born of the dancing chant. Thus it is that "ring-around-a-rosy" becomes a song.

At first musical rhythm is an auxiliary of the dance: the rhythm of music and the rhythm of motion are partners. When unmeaning syllables are replaced by emotional words and sentences, music and poetry live together. Sometimes it is dancing and music only; sometimes it is dancing, music, and poetry altogether; sometimes it is music and poetry only.

So the grandchild of the dance and the child of the chant grows, and is emancipated from the control of dancing, and becomes an art associated with poetry. Priests sing as they perform religious rites, women sing as they grind at the mill, children sing at their

sports; and song, as rhythm and melody, exists during all the period denominated "barbarism."

When freedom comes to song, it starts on a new career. No longer chained to Terpsichorean feet, it soars into the realm of ideal emotion. The dance expresses the joy of exuberant life: the song expresses the joy of exuberant emotion. The dance carries the body through the merry maze: the song carries the soul on its way through the universe of thought.

If I would share my measure of joy with another, behold, my measure is still full, and more than full: it overflows. When song comes, men find, that, though the solo is beautiful, the chorus is more beautiful, and rapidly choral music is developed. At the time to which we refer there is no harmony, but only rhythm and melody. Yet the egg of harmony is laid, for in melody sounds follow one another rapidly, and ere one note leaves the ear another joins it. The waning sound mingles with the waxing sound as the embryo of harmony. Thus melody trains the ear to the appreciation of harmony.

There is still another element of harmony in choral melody. The voices of a varied concourse of people are diverse in pitch. The notes of man are low and resonant, like the voices of waves and winds; the notes of women are high and clear, like the voices of birds; while children pipe like bees. In folk-singing, groups of such voices unite, and the elements of harmony are developed. The village life of barbarism when the people form a body of kin and kith promotes this rudimentary harmony; for they meet as one great family, and join in many a festival that must ever lead to music and dancing.

And here another art assists in the development of music. The drama begins in savagery. The savage defies the beast. To him the animals of the world are wonderful.

The eagle lives a life with which he cannot vie. It plays among the clouds, rests on the mountain-tops, and soars down to circle over the waves of the sea. The humming-bird poises over its blossom-cup of nectar like a winged spirit of the rainbow. The deer bounds away through the forest, and leaves the hunter lost in amazement. The squirrel climbs the tree, and plays about among its branches, and springs from limb to limb and tree to tree, and laughs at the sport. The rattlesnake glides without feet over the rocks, and in his mouth the spirit of death is concealed. The trout lives in the water, and flies up the brook as the hawk flies up the mountain. Dolphins play on the waves as children play on the grass. The spider spins a gossamer web; the grub is transformed into a winged beauty; the bee lays away stores of honey; the butterfly sports in the sunshine like a flower unchained from its stem. The air, the earth, and the waters are peopled with marvellous beings.

The folk-lore of the savage is a vast body of oral literature, in which these wonderful animals are the principal actors, and his book of creation is the history of the animal gods. The stories of these animal gods are dramatized; and the priest-doctors of savagery are the actors who play before the people, assuming the parts of beast gods. For this purpose they dress themselves in the skins of beasts, or wear masks that represent the forms and attributes of their deities. In recitations and dialogues, with much acting and mimicry, they represent the scenes of their mythology to the people. When poetry is born, they recast their stories in poetic form, and chant and sing their verses.

Drama plays a great part in savage and barbaric life. In the tales of the drama the philosophy of the people is embodied. It contains their history of creation. The human mind is ever interested in the origin of things. The desire to know is the fundamental impulse of the intellect. The wisest and best of all peoples, even among the tribes of sylvan men, devote their highest intellectual powers to the enigmas of creation; and as opinions are formed, they seek to teach them to others. Thus it is in savagery and barbarism that philosophy is embodied in drama, and taught to the people. In primitive society the drama is the school of religion; for there its precepts are taught, and its lessons are reflected in the theatrical mirror of life. The drama is deeply embedded in early culture, and is intimately associated with the intellectual growth of the race.

When the drama borrows aid from music, music itself is greatly

invigorated. With the new impulse it rapidly develops, and this is the manner of its growth:—

When the chorus is sung by skilled performers, the unskilled join in parts, adding a kind of refrain to the music, not by following the undulations of the melody in unison with the principal singers of the chorus, but by chanting on a note in harmony therewith; and thus harmony becomes.

To suit the conditions of the actors in the drama, harmonious parts are developed until one, two, or more accessory chants are produced; then these harmonious parts are developed from accessory chants to accessory melodies, more simple than the principal melody, which still retains the name.

In the music thus developed by our race there are usually four parts,—soprano, contralto, tenore, and basso,—and these are adjusted to four classes of voices.

Rhythm grows into melody, and melody grows into harmony: yet music is young, and music must grow, for it blossoms with the promise of becoming divine. Music is to become symphony. Harmony is a combination of co-existent melodies; but symphony in its broadest sense is a combination of sequent harmonies. At the song stage of music, men begin to recite stories, simple dramas, and intersperse their narratives with stanzas of song; then the narratives are chanted, and songs and chants are combined, chants and songs alternating. At this stage a body of sacred music is developed. From hymns grow anthems, and Bible passages are rendered in the solemnity of the chant and the majesty of the hymn, for chants and hymns alternate; and anthems by minute increments become oratorios, where Bible history is taught in a succession of chants and hymns, changing along the course of the oratorio to express the varied emotions kindled by the sacred story. The mythic drama of the Pagan world is represented by the oratorio of the Christian world.

The profane dramas that are recited and sung come to be chanted and sung with instrumental accompaniments. And then are produced the cantatas, or poetic stories set to music; and fugues, or musical dialogues, are composed; and nocturnes, serenade music laden with tender love. Then the cantata is developed into the opera as the drama is wholly set to music and the parts presented by *dramatis personæ*.

Men must laugh sometimes, for tragedy must be set in comedy, as precious stones are oftentimes set in filigree; and so the madrigal is developed, which is an elaborate musical composition of many parts, designed for the expression of tender and hilarious joy in alternating movements: it is the comedy of music. And then comes the sonata, designed for solo instruments,—a musical composition usually of three or more successive parts, each of which has a unity of its own, yet all so related as to form one varied and consistent whole. From the sonata, music passes to the symphony, which is a musical composition of successive parts having slightly varied but intimately related movements, treated in such a manner, by varying the time and stress and pitch, as to produce the greatest contrasts. With the anthem and oratorio, the cantata and the opera, the fugue and the madrigal, the sonata and the symphony, music has reached its highest stage in civilization.

The theme is the evolution of music, not the evolution of musical instruments; but something must be said of instruments, for they play an important part in the evolution of music itself. Were I to enter upon this theme fully, the task would be great. Then I should have to tell of thumpers of many kinds, by which the rhythm of the dance is controlled; I should have to tell of rattles, by which the dance is enlivened; and I should have to tell of whistles, by which the dance is made merry with screams. Then I should have to tell how thumpers became drums, and how rattles became tambourines, and whistles became flutes; and I should have to tell how twanged flexible strings became violins, and how twanged rigid strings became pianos, and how bark whistles became horns, and how pipes became organs.

The invention of musical instruments begins with the sylvan man, who uses them to mark the rhythm of the dance. Throughout savagery and barbarism only time-marking instruments are invented. Not till civilization came to the people of the shores of the Mediterranean were instruments of melody produced; but

when they appeared, a new world of music burst upon the delighted ears of civilized man. Beaten instruments, reed instruments, wind instruments, and stringed instruments give power and variety, and the capacity for musical production is marvellously increased. Men can sing solos, sing in chorus, and sing in parts within the compass of the human voice; but with instruments they can play in unison with like instruments, and in harmony with unlike instruments, and with a compass far exceeding that of the voice. Then music is enriched by increasing the compass, it is enriched by increasing the volume, but more than all it is enriched by increasing the variety of its kinds. At this stage music is sweet, music is grand—but music must become sublime.

Instruments of music are but instruments of melody until science comes, when it is learned that sound is a mode of motion, and that low sounds are slow vibrations, and high sounds quick vibrations. Then the knowledge comes by which man invents instruments of harmony,—co-existent harmony and sequent harmony. Thus science is the last great agency in the evolution of music, for it produces instruments by which symphonies become possible, and music has reached the sublime.

As the blue egg becomes a robin, as the seed becomes a *Sesquovia*, as the sands of the rill become an island, so "ring-around-a-rosy" becomes a symphony.

Primarily feelings arise from biotic pains and pleasures. It is one of the wonderful transformations of nature that the pain of a blow should slowly, through the years of human culture, develop into the sorrow for sin; that the pleasure of a feast should evolve by the metamorphosis of minute changes into the love of justice. How feelings develop into emotions, and emotions into sentiments, and sentiments into aesthetics, is a long and beautiful story which cannot here be told. But the world is full of transformations. The metamorphoses of evolution have been the mysteries of time. In the solution of these mysteries, men have been engaged through untold years,—peering through their purlind primitive ignorance for more light, reasoning with guesses, philosophizing with myths, and believing in errors, but gaining a little truth here and a little there, until by minute increments science has been developed. The evolution of science is itself the mystery of mysteries, the metamorphosis of metamorphoses, for the germ of science is mythology.

With the development of intellect, the emotional nature of man by which he loves and hates has been evolved, and the æsthetic pleasures have arisen under the law of mental association. By association with the joys of life, music has been endowed with its power of producing emotion. This association must be explained.

I have now spoken of the growth of music as a combination of sounds in succession and in harmony, as it is made by the human voice, and have alluded to the origin of the instruments by which parlor, orchestral, and temple music is produced; but nothing has been said of the means by which music is endowed with its power to produce emotion. I have told of the body of music, but have said nothing of its soul. Music is freighted with joy and sadness, with hope and fear, with courage and cowardice, with glory and shame; it is freighted with all emotion; and how does the form of sound become informed with feeling?

When primitive man—poor, naked, houseless, savage man—lived in the Eden walled by ice, and was scattered throughout the garden of the world, his capacities for pleasure were yet little developed. Still he joyed much in his rude way. When the wind blew cold, he warmed himself by the camp-fire; and when the night was dark, he illumined his home with fire-light; and about the fire he danced, and in the dance he had resource of joy. When the fisherman came home laden with a bounteous catch, he made merry by the fire-light dance; when the hunter brought in many pheasants or many antelopes, then, with kith and kin, he made merry by the fire-light dance; when the rich nuts fell from the trees in bounty, he made merry by the fire-light dance; when the wind blew chill, he drove the cold away by the camp-fire dance, and when the night was about him he rejoiced in dancing. So the nights of that region where the stars of the Great Bear are overhead, and the nights of that region where the stars of Orion are overhead, and the nights of that region where the Southern Cross

is overhead, in all the habitable lands of the round earth—the nights were spent in dancing, and the rhythm of the dance and chant became the language of these rude savage emotions.

But disease and wounds and pain and death were the heritage of this early man. Whence these evils came he knew not; why they came he could not tell. How they were to be driven away was the enigma of all savage thought. Through an illogical philosophy, the origin of which is a long and strange story, he came to believe that diseases were living beings; that toothache is the pain wrought by the gnawing mythic worms; that the cough is caused by mythic insects; that headache is caused by invisible mythic ants; and that all diseases and all pains are produced by these mythic agencies. And he tried to drive them away by shrill shrieks, by mad howling, and by horrid imprecation. Then he sought to gain the aid of the friendly spirits of the world,—the good mythic beings. To him the rhythm of the dance and the chant was the language of joy. So he sought to woo these friendly spirits by using this language of joy; and, when wearied with his own efforts at driving away the maleficent spirits, he turned to the dance and the chant, and with them called for the beneficent spirits. In this manner the sylvan man came gradually to believe in the direct efficacy of dance and music as a medicinal agency. Dance and music are the quinine and calomel of the savage,—the "water-cure," the "faith-cure," the "blue-glass cure," the "mind-cure," the "Christian-science cure," the "youth-restoring elixir," the panacea for all human ills.

When the poor diseased people recovered, the joy of recovery became associated with music. The welcome to health and companionship which the poor invalid received was given in dance and music.

Sometimes storms came and destroyed their rude houses; sometimes drought came and destroyed their harvests; sometimes fierce winds came and congealed their life-fluids; sometimes mad lightning came, and, shivering the trees, ended their lives. And so by flood and wind and lightning, and many other agencies, they believed themselves to be persecuted by the spirits of the animal gods who must be appeased; and what would please the god so much as music and dancing? And so they danced to their gods, and beat their drums to their gods, and played their whistles to their gods, and blew their horns to their gods, until the winds stilled, and the storms abated, and the lightnings went out, and the thunders hushed, and the floods ran away to the sea; and then they rejoiced with feasting and dancing and music.

Before the sylvan man had learned to plant fields, and build storehouses, and provide for future days, he believed that every thing was the gift of his animal gods. The earliest provision that mankind made for the future was to lay up a store of their good will. And how could he gain their good will but by dancing and music? So at new moons and at new seasons he held festivals in honor of his gods, and gave them dancing and music.

When, in a later culture, man gathered the fruits of the forest and mead as a store for the winter day, and planted fields and gathered grains, he made thanksgiving to his gods in dancing and music.

The rallying cry to war was dancing and music. There is an instrument used by savages in many lands that consists of a simple tablet of wood, a hand's breadth in length and a finger's breadth in width, to which a short string is attached by one end, while the other is fixed to a stick like a cane. The performer, holding the stick in his hand, whips the tablet of wood through the air in such a manner that it makes a sound, sometimes quick but low, like the whiz of a bullet on the battle-field; sometimes shrill and loud, like the shriek of a cannon-ball thrown into a bombarded city. With these instruments a group of naked savage warriors, intent on plunder, rapine, and the midnight murder of men, women, and children, gather about the camp-fire in the weird dance, and leap and howl and whip their bull-roarers, until they work themselves into a state of fury.

It was in this manner that the music was freighted with emotion by the sylvan man when it was only rhythm, and when it was chained to the dance.

Some music expressed in rhythm and melody has had a long life among all the barbaric and civilized peoples of the world. Min-

strels have carried it about; men have sung their songs in field and forest; women have sung their songs at the oven and the loom; boys have sung their songs while driving the herds to pasture, and girls while milking cows; and there are songs for all times and all conditions and all people. Song has ever remained as folk-music, the delight of the people.

There are songs celebrating all passions, — all joys and all sorrows, all hopes and all fears, all loves and all hates. All the emotions of the human soul are coined into song. Song is the reservoir into which all human feelings are poured, and it is the fountain from which all human feelings may be drawn. And this is true not only in our language, but in all languages.

When harmony was given to music through its association with the drama, musical compositions were no longer confined to simple songs for the field, the fireside, and the chapel, but great pieces were composed for the temple and theatre, and music was made to express the emotions of religion and romance, as in the oratorio, cantata, and opera. This music bore on its wings the hope of heaven and the fear of hell. It told of the joy of the angels before the throne of God, and of the torments of demons in the presence of the Devil. The profane music of this period related biographies and histories filled with love and revenge, virtue and crime, courage and cowardice, repose and tragedy. Music in this stage is freighted with the feelings that are kindled and expressed by laughter and crying, by prattle and wrangling, by caresses and blows, by kisses and frowns, by praise and reproof, by plenty and poverty, by strength and weakness, by health and disease, by birth and death, by festivals and funerals, by carnivals and battles, by peace and war, by victory and defeat, by justice and injustice.

And now we must speak of the symphonic stage of music, when science has given it a multitude of sweet instruments.

The art of music was not born of the music of Nature: it was born of the pains and pleasures, the joys and sorrows, of mankind.

The appreciation of the beauties of nature is of slow growth; and it is only in civilization, and with the most cultured people of civilization, that these beauties are sources of joy; and it is only in the latest music that the highest intellectual pleasures are expressed. The beauties of the earth, the sea, and the air and the sublime spectacle of the heavens, are gradually being wrought into the emotional nature of mankind; and the new music is informed with the strains that are played by Old Ocean against the shores of every land. It is filled with the anthem-music of the forest, and the songs of the birds that chorus the round earth with the rising sun.

In its late history new attributes have been added from the contemplation of nature. These are feelings kindled by the higher intellectual activities. The human reason has acquired a knowledge of the universe, and derived exalted emotions therefrom. The boundless sea now tells its story. From arctic and antarctic lands navies of icebergs forever sail, to be defeated and overwhelmed by the hot winds of the tropics. The lands with happy valleys and majestic mountains rise from the sea, built by the waves and fashioned by fire and storm. Over all rests the ambient air, moving gently in breezes, rushing madly in winds, and hurling its storms against the hills and mountains of the sea and the hills and mountains of the land.

The land, the sea, and the air are the home of a world of life, which man studies with ever-increasing interest and pleasure. The solid earth is composed of crystalline forms, and exhibits chemical activities which ever challenge admiration. Sound and heat, and light and electricity, and vitality and mentality, present modes of motion the contemplation of which fills the mind with delight. Looking above the earth, the worlds of the universe are presented to view, and their wonders fill the soul. So music has come to be the language of the emotions kindled by the glories of the universe.

Thus is seen the growth of music in four stages, — music as rhythm, music as melody, music as harmony, and music as symphony. Rhythm was born of the dance, melody was born of poet-

ry, harmony was born of drama, symphony was born of science. The motive of rhythmic music was biotic exaltation, the motive of melody was social exaltation, the motive of harmony was religious exaltation, the motive of symphony is æsthetic exaltation. It is thus seen that music develops from the emotional nature of man, as philosophy has its spring in the intellectual nature. The earliest emotions arose from the biotic constitution, — simple pleasure or pain, as felt in the body and expressed in rhythm: they were mere feelings. Then feelings were idealized, and became emotions, and were expressed in melody; then the emotions were idealized, and became sentiments, and were expressed in harmony; then the sentiments were idealized, and became intellectual conceptions of the beautiful, the true, and the good, and these were expressed in symphony.

Is there a new music for the future? The science of music answers, "Yes." We know that music has been chained to "form," and imprisoned in the Bastille of musical intervals, and guarded by the henchmen of mathematical dogmas. But a few great musical composers, like Wagner, have broken the chains, and burst the bars, and killed the jailers, and they sing their liberty in strains of transcendent music.

When it is desired to cultivate skill in musical performance, it is necessary to cultivate the art in the individual in the same order in which it is cultivated in the race; and he must first master rhythm, then melody, then harmony, then symphony. Then the love for music must be acquired in the same order. No one can love a symphony or an opera who does not first love song. If you would love the higher music, you must love the songs of the people; and to affirm that you love a symphony, or an opera, or a cantata, but that you do not love a song, is like avowing that you love a garden but do not love a rose, that you love a bouquet but care not for a lily: for a symphony is indeed but a bouquet of melodies, and an opera is a garden of many flowers.

Happy is the home that is filled with song, where boys and girls sing the melodies of the people, and where they make these melodies more musical with the violin, the piano, or the flute; for to music is consigned the purest joy.

NOTES AND NEWS.

IN addition to the election of Dr. Weir Mitchell as president of the next Congress of American Physicians and Surgeons, to be held in September, 1891, which we have already noticed, Dr. W. H. Carmalt of New Haven was elected secretary; Dr. J. S. Billings of Washington, treasurer; Dr. William Pepper of Philadelphia, chairman of the executive committee; and Dr. S. C. Busey of Washington, chairman of the local committee of arrangements. Dr. C. H. Mastin of Mobile is reported to have declined the presidency, on the ground that no member of the executive committee ought to be elected to the presidency.

—The fifty-eighth annual industrial exhibition of the American Institute of this city is now in progress at the Institute building, on Third Avenue, between Sixty-third and Sixty-fourth Streets. The building is well filled with tastefully arranged exhibits, covering a wide range of industries, several in which manufacturing processes are shown being especially attractive and interesting. The electrical exhibits are not as numerous as might be expected, there being only three electric-light companies and a few manufacturers of electrical instruments represented.

—In view of the reports which have recently been published respecting the Johns Hopkins University, President Gilman authorizes the statement that the university will begin its next year on the 1st of October with unimpaired efficiency. Neither the salary of the president nor those of the professors have been cut down, and several new appointments have been made. The indications during the summer have pointed to the usual number of students, and the courses of instruction will be given as announced in the programme. As to the finances of the university, it is no secret that the income derived from the Baltimore and Ohio Railroad was cut off some time ago; but the accumulated income of former years, the income from investments outside of the railroad, the income from tuition (which amounted last year to nearly \$40,000), are available. Besides all this, a number of generous persons have

subscribed the sum of \$108,000, to be expended as an emergency fund during the next three years. In addition, a new building, given by Mr. Eugene Levering of Baltimore, is now going up. A lectureship in literature has been endowed by a gift of \$20,000. By the death of John W. McCoy the university inherits at once his choice library of 8,000 volumes, and is the residuary legatee of his estate. The exact amount to be received from this source cannot yet be ascertained, but the most prudent estimates place it above \$100,000, exclusive of the library. This gift is free from conditions. It is safe to say that within six months the Johns Hopkins University has received from these various sources nearly \$300,000, and other gifts are expected. The national character of the institution is a strong reason why its work should receive important aid from a distance. It will thus be seen that no consideration need be given to alarming rumors, as the present efficiency of the university is assured for the next three years.

— By the will of Mr. John W. McCoy, who died in Baltimore Aug. 20, 1889, the Johns Hopkins University is made the residuary legatee of his estate. His large and valuable library is also left to the university. His art collection is bequeathed to the Peabody Institute. A fuller statement as to this valuable gift will be subsequently made.

— President Hall of Clark University, Worcester, Mass., in an official statement, thus defines the functions of docent in the university: "The highest annual appointment is that of docent. This rank and title is primarily intended as an honor to be awarded to those worthy of more permanent and lucrative positions, as professors or assistant professors in colleges. It may be bestowed without examination upon a few men who have advanced beyond the requirements of a doctorate, and who satisfy the authorities of the university by a thesis, a public address, or in any other way, of both their scientific attainments and their teaching ability, and, if necessary, may be accompanied by a salary. Docents may be provided with individual rooms; and special apparatus may be purchased for their research if desired and approved. They may also be equipped and sent on scientific expeditions. While they will be expected during some part of the year to deliver a limited number of lectures on some special chapter of their department, their time will usually be reserved for study and research in a way best adapted to qualify them still more fully for academic advancement. It is believed that by the existence of such a select body of men of guaranteed scientific training, ability, and approved power to teach, the difficulties under which college trustees sometimes succumb in selecting suitable men for the professors may be diminished, and that otherwise this new academic grade will aid in raising standards of scholarship in colleges, and encouraging scientific research." The work of the university has begun. The professors and instructors in the departments of mathematics, physics, chemistry, biology, and psychology met their students Monday, Oct. 7. The following lectures were delivered: by Dr. Bolza, in mathematics, Oct. 8; by Dr. Cook, in psychology, Oct. 7; by Dr. Sanford, in psychology, Oct. 8. Dr. Donaldson gave an introductory lecture on Oct. 9 in the neurological laboratory.

— In the *Michigan Engineers' Annual*, which is the report of the proceedings of the Michigan Engineering Society, of January, 1889, Professor M. E. Cooley, M.E., of Ann Arbor, gives the following experience on the value of covering steam-pipes: "The benefits of covering steam-pipes to prevent radiation are strikingly illustrated by the following example: The Thomson-Houston electric-light plant in Ann Arbor has about 60 feet of 7-inch pipe, connecting the boiler with the engines, and two large steam-drums above the boilers. In March, 1887, the steam at the far end of this pipe was tested to determine the amount of entrained water, the pipes and drums at the time being uncovered. An average of nine experiments gave 31.01 per cent of moisture. In June of the same year, after the pipes were covered with magnesia sectional coverings, the quality of the steam was again tested, the average of five experiments giving 3.61 per cent moisture. The tests were made by the same men, from the same connections, and in the same manner. The pipes and steam-drums in March were subjected to a draught, which, of course, aided the condensation. Enough water passed into the cylinders to retard the engines, producing a disagreeable

noise. In June the weather was warmer, and the pipes and steam-drums were well protected. The quality of steam at the boilers was tested in June, and showed about 3 per cent of moisture. Assuming that 100 indicated horse-power were being developed at the time, and that each horse-power required 30 pounds of steam per hour, we would need 3,000 pounds of steam. If the steam is assumed to have 25 per cent entrained water, due to condensation in the pipes and connections, then 4,000 pounds steam will need to be produced in the boilers, or 1,000 pounds more than necessary. To produce this steam will require about 125 pounds of good coal per hour, or 1,000 pounds per day of eight hours. One-half ton per day, at \$3 per ton, for 300 days, equals \$450, which, at 6 per cent, pays the interest on \$7,500. The actual cost of the covering, put on complete, probably did not exceed \$150.

— The deepest bore-hole in the world, claimed at different times for a number of places, is, according to latest accounts, at Schladebach, a small German village near Leipzig. It measures 1,748.4 metres, or about 5,735 feet. The time expended in boring to this depth amounted to six years, at a cost of \$52,500. A peculiar experience encountered in connection with this and other deep holes in different parts of Germany is, according to *Umland's Wochenschrift*, that the observed temperatures, while steadily increasing with the depths, show a smaller ratio of increase in the lower strata.

— In a recent issue of the *Centralblatt der Bauverwaltung*, attention is directed to the fact, observed in some of the streets of Frankfort-on-the-Main, Germany, that the asphalt pavement in the immediate neighborhood of large gas mains is rapidly destroyed by escaping gas, deep cracks being formed. This has been found to be particularly marked at places where the underlying layer of beton was imperfect, due to interruption of the work over night while laying. If this is true, it furnishes an additional reason for preventing that escape of gas from the mains in New York City which has already given so much trouble by explosions in subways and sewers.

— How many of the engineering works of the nineteenth century will there be in existence in the year 6000? Very few, it is feared, and still less those that will continue in the far-off age to serve a useful purpose. Yet there is at least one great undertaking conceived and executed by an engineer, which, during the space of four thousand years, has never ceased its office, on which the life of a fertile province absolutely depends to-day. We refer to the Bahr Joussuf, — the canal of Joseph, — built, according to tradition, by the son of Jacob, and which constitutes not the least of the many blessings he conferred on Egypt during the years of his prosperous rule. This canal took its rise, as given in *Engineering*, from the Nile at Asiu, and ran nearly parallel with it for nearly two hundred and fifty miles, creeping along under the western cliffs of the Nile valley, with many a bend and winding, until at length it gained an eminence, — as compared with the river-bed, which enabled it to turn westward through a narrow pass, and enter a district which was otherwise shut off from the fertilizing floods on which all vegetation in Egypt depends. The northern end stood seventeen feet higher than low Nile, while at the southern end it was at an equal elevation with the river. Through this cut ran a perennial stream, which watered a province named the Fayoum, endowing it with fertility and supporting a large population. In the time of the annual flood a great part of the canal was under water, and then the river's current would rush in a more direct course into the pass, carrying with it the rich silt which takes the place of manure, and keeps the soil in a state of constant productiveness. And this, with the exception of the tradition that Joseph built it, can be verified to-day, and it is not mere supposition or rumor. Until eight years ago, it was firmly believed that the design has always been limited to an irrigation scheme larger, no doubt, than that now in operation, as shown by the traces of abandoned canals and by the slow aggregation of waste-water which had accumulated in the Birket el Querun, but still essentially the same in character. Many accounts have been written by Greek and Roman historians, such as Herodotus, Strabo, Mutianus, and Pliny, and repeated in monkish legends or portrayed on the maps of the middle ages, which agreed with the folk-lore of the district.

These tales explained that the canal dug by the ancient Israelites served to carry the surplus water of the Nile into an extensive lake lying south of the Fayoum, and so large that it not only modified the climate, tempering the arid winds of the desert, and converting them into the balmy airs which nourished the vines and the olives into a fulness and fragrance unknown in any part of the country, but also added to the food-supply of the land such immense quantities of fish that the royal prerogative of the right of piscary at the great weir was valued at \$250,000 annually. This lake was said to be four hundred and fifty miles round, and to be navigated by a fleet of vessels, while the whole circumference was the scene of industry and prosperity.

— A company is now putting down a shaft into Grand Avenue Cave, four miles from Mammoth Cave, for the purpose of bringing up the air and putting it into the rooms of a large hotel which they propose to build, both as a pleasure-resort and sanitarium. They have been able to get no information on the subject, and ask for such in the "Want" column in this number.

— The Shore Line Railway bridge at New London, the largest swing-span drawbridge in the world, is now in position. It was built parallel to the shore along the fender pier, so as not to obstruct navigation, and was swung into place half an hour before sunset Saturday, Sept. 28. It is of solid steel, weighs nearly 2,500,000 pounds, and its connecting parts, when the bridge was swung into position, shot into the mortises of the bridge proper with absolute precision. This was a great relief for the anxious engineers. Some of the highest engineering skill ever employed in bridge-building has been used in the construction of this bridge, the situation involving peculiar difficulties. In some places, says *The Iron Age*, 56 feet of water and 80 feet of mud were found where the piers must be set. There great timber curbs were constructed, and sunk to the total depth of 137 feet. After scooping out the interior mud, the curbs were driven full of piles. These, cut off at a level midway in the curbs, were bound solidly together by filling the spaces with concrete. On this rock-like basis the masonry of the pier was built up. The centre pier is an immense structure 71 feet square. It is flanked on either side by spans of 310 feet, and there are two other spans at either side of the river of 150 feet each. The unusual length of draw was required by the United States Government, that there should be no obstruction to the passage of the naval fleet to the Thames naval station farther up the river. This great bridge, 1,422 feet long, crosses the Pequot River (imitatively named by the first settlers the Thames, while they quite as foolishly named Pequot New London) from a point at the terminus of the Yale-Harvard regatta course at Winthrop's Point, at the upper part of the town.

— According to *Nature*, the International Oriental Congress, which was held this year during the first and second weeks of last month in Stockholm and Christiania, was well attended, and was especially noticeable for the enlightened and warm interest taken in the proceedings by the King. Representatives of Oriental learning from the chief countries were his Majesty's personal guests, the members of the congress present were on several occasions specially entertained by him, and in other marked ways the King showed his desire to honor science and learning in the persons of the assembled Oriental scholars. *The Times* is the only one of the English daily papers in which the proceedings have been followed regularly; and in the last letter on the subject, its correspondent, who has been far from a prophet of smooth things in reference to all the proceedings, says that "this eighth International Oriental Congress was favored above all its predecessors by the right royal splendor with which the ruler of the two countries entertained his guests, by the warm interest which the citizens took in the foreign *savants*, by the care and kindly forethought with which all the arrangements for our comfort had been planned and were carried out, and last (not least) by the grand and lovely natural features of the places which the members visited. Perhaps at future congresses care will be taken that there be less of empty Oriental parade, by which no palpable literary object can be gained, and that greater facilities be given for placing without delay within the reach of members an abstract of the proceedings

in each section. However, in the face of such boundless hospitality and such personal sacrifices on the part of our hosts, it would be ungracious were we to take exception to what are, after all, but small matters of detail." A large number of papers of great philological and general interest were read, as will be readily gathered from the following list of the sections, with their respective presidents and vice-presidents:—Section I. Modern Semitic: presidents, Baron Kremer of Vienna, M. Schefer of Paris, M. de Goeje of Leyden. Section II. Ancient Semitic: president, M. Fehr of Stockholm; vice-presidents, M. Chivolson of St. Petersburg, M. Oppert of Paris. Section III.: presidents, M. Max Müller of Oxford, M. Weber of Berlin, M. Spiegel of Erlangen. Section IV.: president, Brugsch Pacha; vice presidents, M. Lieblein, M. Reinsch. Section V.: president, M. Schlegel of Leyden; vice-president, M. Cordier of Paris. Section VI.: president, M. Kern of Leyden; vice-president, Mr. R. N. Cust of London.

— The carrier-pigeon has just been turned to a curious use in Russia, according to the *Novoe Vremya*. It is to convey negatives of photographs taken in a balloon. The first experiment was made from the cupola of the Cathedral of Isaac, and the subject photographed was the Winter Palace. The plates were packed in envelopes impenetrable to the light, and then tied to the feet of the pigeons, who safely and quickly carried them to the station at Volkovo.

— From the general results of the Swiss census of Dec. 1, 1888, which have already been worked out, it seems that the total population is 2,934,055, against 2,846,102 in 1880. The German-speaking element increased from 2,030,792 in 1880 to 2,092,562, which, taking into account the normal growth of the population, was no relative increase, the proportion in both cases being precisely 71.3 per cent of the whole. The French, on the other hand, increased from 608,007 to 637,940, which was also a relative increase of 21.4 to 21.7 per cent; while the Italian declined actually as well as relatively, the numbers being 161,923 in 1880, and 156,602 in 1888, or 5.7 and 5.3 per cent respectively. The decline of the Italians in the cantons of Uri and Schwyz is explained by the return home of a large number of Italian workmen engaged in the St. Gothard Railway; but it is not so easy to explain why there is a large decrease in the Germans in the cantons of Berne and Neuchâtel, while the French have increased. In general the French increase in Switzerland seems to be at the expense of the Germans, while the German element recovers its place at the expense of the Italian.

— Among recent appointments of Johns Hopkins men, we note the following: Edward A. Bechtel (A.B., 1888), professor of Greek in Mount Morris College, Illinois; Edward W. Bemis (Ph.D., 1885), adjunct professor of history and economics in Vanderbilt University; B. Meade Bolton (assistant, 1887-88), director of the Department of Bacteriology in the Hoagland Laboratory, Brooklyn, N.Y.; David T. Day (Ph.D., 1884), expert and special agent in charge of the subject of mines and mining for the eleventh census; John C. Fields (Ph.D., 1887), professor of mathematics, Allegheny College, Pennsylvania; Andrew Fossum (Ph.D., 1887), classical instructor, Hill School, Pottstown, Penn.; J. Edward Harry (Ph.D., 1889), professor of Greek and German in Georgetown College, Kentucky; George L. Hendrickson (A.B., 1887), professor of Latin in Colorado College; George N. C. Henschen (A.B., 1889), instructor in natural sciences in the Reading (Penn.) High School; William H. Howell (Ph.D., 1884, and associate professor), lecturer on physiology in the University of Michigan; Frank G. Hubbard (Ph.D., 1887), instructor in English in the University of California; Cary T. Hutchinson (Ph.D., 1889), docent in physics in Clark University; James T. Lees (Ph.D., 1889), principal of the Latin School, and instructor in Latin and Greek in the University of Nebraska; Henry Sewall (Ph.D., 1879, and recently professor in the University of Michigan), professor of physiology in the College of Physicians and Surgeons, Baltimore; Moses S. Slaughter (fellow, 1885-86), professor of Latin in Iowa College; Professor Albion W. Small (Ph.D., 1889), president of Colby University, Maine; William E. Story (associate and associate professor, 1876-89), professor of mathematics in Clark University; James S. Trueman (fellow, 1888-89), professor of Greek and Latin in Allegheny College, Pennsylvania.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The "Exchange" column is likewise open.

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MR. SETH LOW, ex-mayor of Brooklyn, has been elected president of Columbia College, to fill the vacancy caused by the death of Dr. F. A. P. Barnard. President Low is an alumnus of the college of which he has just been made the head. He is a native of Brooklyn, and as mayor of that city attained a national fame. The general verdict is that the trustees have done well in selecting a man who has always shown himself equal to the positions of trust in which he has been placed, who is in the very prime of life, being about forty years old, and who has the due scholarly training for his new work.

THE WORLD'S-FAIR FINANCE COMMITTEE met Oct. 8, and received the report of their executive committee. The report of the executive committee was discussed, but not acted upon. After careful examination of the whole subject, the committee report that in their opinion no complete financial scheme can be determined upon until it is approximately known what is the aggregate amount of money to be raised; and this will be largely an open question until the site, plan, and scope of the exhibition are finally agreed upon. It is of first importance that Congress should give to the exhibition a national and an international character by appropriate legal enactment, which should, at the same time, determine its location in this the principal port of entry and metropolis of the country. It is also essential that the exhibition should receive encour-

agement and assistance from the State and city of New York; and the suitableness and liberality of this assistance must be an important factor in any financial plan which may be adopted, for if direct money contributions are voted, or lands are set apart for the use of the exhibition which belong to or may be acquired by the city, and upon which it may lawfully erect buildings, a very much less sum will be needed than if the committee must raise all the money, or if private property must be leased or purchased. Meanwhile, to show the sincerity and willingness of the citizens of New York, they recommend that steps be taken to raise a preliminary fund of \$5,000,000, for which stock should be issued, when authorized by congressional or legislative enactment.

The meeting of the world's-fair committee on site on the same day was largely attended. The chief business was the consideration of a report from the sub-committee on buildings, consisting of Messrs. Towne, Chandler, and Hunt, who were appointed specifically to ascertain in regard to the value of property within the boundaries of the proposed site. In substance the report said that the site should be ample for the construction of five buildings, to cover in the aggregate 65 acres, and 200 smaller buildings, to be scattered over an area not to exceed 250 acres. In regard to the area of the main site, the committee reported that the exposition could be held at Riverside and Morningside Parks and on adjacent private lands, of which there might be needed only 120 acres, but that it could be better accommodated in 200 acres, making the total area of the site from 200 to 270 acres. From all the inquiries that the committee had been able to make, the price of property in that section of the city was about \$100,000 per acre, involving an outlay of \$12,000,000 or \$20,000,000, according to the choice of 120 or 200 acres. When the various amendments had been voted on, the resolution, which was passed unanimously, read as follows: "That the proposed site, which includes Riverside and Morningside Parks, shall be held to comprise such portions of Central Park north of Ninety-seventh Street as are physically available and may be found absolutely necessary for the purposes of the exposition, and also to include adjacent lands fronting on the north and east of Central Park, is in all respects the best; that therefore all efforts should be concentrated upon the acquisition of the needed area in this locality."

MENTAL SCIENCE.

New Experiments upon the Time-Relations of Mental Processes.

WITH the law once admitted that all mental states are definitely related to and conditioned upon physical ones, it would readily follow that mental processes, or at least the physical changes that accompany them, take a definite amount of time for their normal performance. Furthermore, these times can be regarded as an index of the complexity of the act in question; and a comparison of the times taken up by various mental processes will furnish a basis for their classification, and may afford desirable glimpses of the nature of the processes themselves. This is the cardinal thought that has urged investigators to carefully measure those simple acts that lie at the basis of psychic life with all the accuracy that the use of refined and complicated apparatus could furnish. A great many interesting results were obtained, and many theories refuted. Recently the fact has come into prominence that the attitude of the subject, the direction of his attention, exercises a profound influence upon the results, and many observations have been repeated with this fact in mind. Among these the work of Dr. Münsterberg ("Beiträge zur Experimentellen Psychologie," Heft 1, 1889), of the University of Freiburg, merits detailed notice.

As re-actions were to be made by each of the five fingers of the right hand, many preliminary experiments were made with each to eliminate the difference in alertness of the fingers. The fingers pressed down upon the keys of a keyboard, and as soon as a sound (usually a word) was heard the re-action was made by raising the appropriate finger. In this simplest process of executing a move-

ment as soon as an expected sensation has been received, Lange had found a great and constant difference according as the attention was fixed upon the sensation, the expected sound, or upon the movement of re-action. In the first case the subject distinctly waits for the sensation, appreciates it, and then proceeds to move the finger: it is a "sensory" re-action. In the second case the impression is taken in almost automatically, and the desire is to have the finger move the moment any impression is felt: it is a "motor" re-action. The sensory is always longer than the motor re-action. Lange found in three observers sensory times of .230, .223, and .224 of a second; and motor times of .123, .125, and .137 of a second,—an average difference of one-tenth of a second.

I. Münsterberg's sensory time is .162, his motor .20, of a second,—a much smaller difference of only .042 of a second. It is to be noted that the motor times of all the observers agree remarkably well, while their sensory times show individual variations. The explanation of these facts will be attempted after the results of certain other experiments have been given.

II. The next complication consisted in calling out in an arbitrary order "one," "two," "three," "four," or "five," to which the thumb, forefinger, middle finger, ring-finger, and little finger were to respond respectively. This is more complicated, and involves the association of "one" with a movement of the thumb; and so on. As before, one may fix the attention upon the expected sound or upon the movement. The sensory time for the entire process was .383 of a second; the motor, .289 of a second,—a difference of .094 of a second. When making a sensory re-action, the sound is always appreciated; and errors, i.e., raising the wrong finger, never occur. In motor re-actions they occasionally occur, the error invariably consisting in raising a neighboring finger.

III. Here the re-action was the same; but, instead of the words "one," "two," "three," "four," "five," the Latin declension—*lupus, lupi, lupo, lupum, lupæ*—was associated with the five fingers, the process being the same as before, but the association more artificial. The result was, for sensory re-actions, .465 of a second; for motor, .355 of a second,—a difference of .110 of a second. Only a single false re-action was made.

IV. The movements of the five fingers were associated respectively with the five members of the three following declensions of German pronouns: *ich, meiner, mir, mich, wir; du, deiner, dir, dich, ihr; er, des, dem, den, die*. This is more complex not only by the change between three series, but by the relatively minute and irregular distinctions between the words. The sensory time was .688 of a second; the motor, .430 of a second,—a difference of .258 of a second. Here errors occurred in the motor re-actions ten per cent of the time, showing the increased facility of confusion. It was noticed, too, that the second finger was often erroneously raised in answer to *du*, apparently on account of its position in the familiar series *ich, du, er*.

V. Here the elements of the process are changed. If a noun is called, the thumb is to be raised; if an adjective, the forefinger; if a pronoun, the middle finger; if a number, the ring-finger; if a verb, the little finger. This very artificial relation was first thoroughly learned by going over the list, raising each finger as the class to which it corresponded was mentioned. All the words were monosyllables, and new words were being constantly used, no word occurring twice. The sensory time was .712 of a second; the motor, .432 of a second,—a difference of .280 of a second. Here errors are very frequent (thirty per cent), but are confined to the motor re-actions.

VI. This series was just like the former except that the categories were "a city," "a river," "an animal," "a plant," "an element;" such as "London," "Rhine," "dog," "rose," "gold." The sensory time was .893 of a second; the motor, .432,—a difference of .461 of a second. Errors occurred in twelve per cent of the motor re-actions.

VII. Here the categories were still more difficult; viz., "an author," "a musician," "a naturalist," "a philosopher," "a statesman or general." Only in a very few prominent cases is this decision easy. The average time was, for sensory re-actions, 1.122 seconds; for motor, .437 of a second,—a difference of .685 of a second. Errors occurred in twenty-five per cent of the (motor) re-actions.

It is to be noted that the cases I., II., and III. involve associations of a finger-movement with but one word: it is an "anticipated" association. In the other cases a more or less wide range of words is to be re-acted upon by the same movement: it is a "free" association. It will have been noticed, too, at what a rapid rate the difference between sensory and motor times increases as the processes become more complex, this difference being sixteen times as great in VII. as in I.

The explanation of the shortening of the re-action time by the motor form of re-action is comparatively simple in Case I. We need only assume, quite naturally, that the fixation of the attention upon the movement really gets ready the innervation (as it were, lights the match beforehand), and is thus immediately ready to make the movement (to set afire the train of powder). But in the following cases not only does this explanation become doubtful (for, inasmuch as it is not known which finger is to be moved, only a general, unspecialized innervation to move a finger can be anticipated), but it can only account for .042 of a second of difference, while the real difference progressively rises to sixteen times that amount. We can be quite sure, then, that the shortening takes place in the purely mental process of recognizing a given word as an instance of a more or less general class, and of appreciating that this class is to be represented by a certain movement. While in the four last cases the sensory times rose from .688 to .712, to .893, to 1.112 seconds, the motor time practically remained unchanged,—.430, .432, .432, and .437 of a second. The increase in the sensory time indicates that the processes are becoming mentally more complex. It is more difficult to recognize that a given word (heard only once during the experiments) is a certain part of speech than to recognize a word as one of the same three, *ich, du, der, or meiner, deiner, des*, and so on; still more difficult to recognize a concept as belonging to one of five well-known general categories; and most difficult to place a man in one of five special, somewhat closely related professions. But why should these differences disappear by simply fixing the attention upon the movement to be executed? Indeed, according to a current theory, of which Wundt is the acknowledged champion, and which Dr. Münsterberg fiercely combats, turning the attention towards an act shortens the time of its accomplishment; fixing the attention upon the mental, sensory part of the process should shorten the time. This apperception theory, that conceives the mind as a point in which only a single act has room at a given moment, and through which accordingly the several elements of a complicated process must pass *seriatim*, gives no satisfactory explanation. Dr. Münsterberg regards the true explanation to lie in the fact that in the motor re-actions the several parts of the mental process overlap in time. In the motor re-action we have before us, as it were, five possible movements, each (aided, perhaps, by unconscious tentative movements) ready to be made, and five lines of association along one of which the impulse is coming. The moment the word is sounded, it is referred to the "third-finger-moving category," or whichever it may be,—the intermediate acts of recognizing, let us say, that the word was "frog," that a frog is an animal (and not one of the other four classes), and that when an animal's name is called we must raise the third finger; which acts are gone through consciously and successively, in the sensory re-action being performed almost simultaneously and automatically, or at least subconsciously. This, in Cases IV., V., VI., and VII., would be about the same process, the tracts of association (cortical fibre-connections to concretize the conception) being about equally much used in each case, since their entire use was what brought about by the experiments themselves. We see, too, why it is natural that in the sensory cases errors did not arise, but that in the motor re-action an impulse could readily be switched into a neighboring association-tract. Dr. Münsterberg regards the motor form of re-action as the one more closely corresponding to natural, every-day processes; the sensory re-action being a mere artificial, experimental result. When we act and speak, the movement results before we have consciously appreciated the excitation, analyzed it, and referred it to certain categories. It seems to be referred to certain definitely established trains of thought, the reasons for doing so never consciously appearing.

While this explanation is not entirely adequate, it has the advan-

tage of giving a very real interest to the facts, of being in harmony with current psychophysical and neurological conceptions, and of suggesting further experimental inquiry by the results of which it can be substantiated or refuted.

A point unnoticed in the original essay may be here appended. If we compare the gradual increase in the motor times from I. to VII., we find the greatest difference (.169 of a second) in passing from I. to II.; that is, when, instead of re-acting by one certain motion, we re-act according to circumstances by any one of five, — an evident increase of motor complexity. Next, in passing from II. to III., we find a smaller increase of .066 of a second easily explainable by reflecting that we have already had practice in considering the fingers as "one," "two," "three," "four," "five;" and so the connections are easier, while the associations with *lupus*, etc., are new. In passing from III. to IV. we have an additional motor complexity in the fact that each of the association tracts is subdivided into three sub-tracts, and the expectation of the intended movement is accordingly less definite. The time increases by .075 of a second. When these tracts become divisible into an indefinite number of strands, it does not seem to complicate matters, and from here on the motor times are the same. A similar comparison of the increase of sensory times and of the percentage of error will be equally instructive.

An account of further experiments by Dr. Münsterberg will be given in a future number of *Science*.

HEALTH MATTERS.

THE EFFECTS OF ALCOHOL UPON LONGEVITY. — The British Medical Association appointed a commission to inquire and ascertain the average age of three classes of drinkers; to wit, total abstainers from alcoholic beverages, moderate drinkers, and sots. The commission reported its observations upon 4,234 deaths, divided into five categories: 1. Total abstainers; 2. Habitual, temperate drinkers, — those who consume a moderate amount of alcoholic liquors; 3. Careless drinkers, — those who do not mean to get drunk, but are simply imprudent drinkers; 4. Free and habitual drinkers; 5. Decidedly intemperate drinkers, — sots. According to this classification, the average age reached by each of these categories is as follows: first class, 51 years 22 days; second, 63 years 13 days; third, 59 years 67 days; fourth, 57 years 59 days; fifth, 53 years 3 days. From this the curious fact is brought out that the teetotalers are the shortest lived, the sots having but a slight advantage over them in the average duration of life. The moderate drinkers reach the most advanced age.

THE FOOD TREATMENT FOR INSOMNIA. — Dr. Eggleston says, in the *Journal of the American Medical Association*, that most students and women who are troubled with insomnia are dyspeptic, and he has found it easy to successfully treat such cases without medicine. They are instructed to eat before going to bed, having put aside work entirely at least an hour before. If they are not hungry, they should simply be instructed to eat; and if they are hungry, they should eat whatever they want. A glass of milk and a biscuit is sometimes all that can be taken at first, or a mashed potato buttered. In a short time the night appetite will grow, and the appetite will then need no particular directions. If possible, the night meal should be taken in another room than the sleeping-apartment, and for men in the city it will be found advantageous to go out to a restaurant. The idea of going out for something to eat, and having to wait a short time for it, will excite the appetite. Before eating, however, a bath should be taken, preferably cold or cool, which should be given with a sponge or stiff brush, and the body thoroughly rubbed off with a coarse towel afterward. The bath need not be more than five minutes in duration. After the bathing and rubbing, or after eating, a moderate amount of exercise should be taken. For this a few minutes with Indian clubs or dumb-bells is sufficient. Further than this, the patient should go to bed at the same hour every night, and arise at the same hour every morning. There is a popular superstition that grown people should not eat immediately before going to sleep; that it will give them indigestion or nightmare, or both. Dr. Eggleston cannot see why adults should be so very different in this respect from babies. It may be true that digestion is carried on slowly during sleep, and

that the digestive function is less active, but here one need not be in a hurry for the completion of the operation. The average person should be in bed seven or eight hours, which is time enough for the digestion of almost any thing edible. In our American life, he thinks, the digestion carried on through sleep probably has the better chance for thoroughness.

PARASITES OF THE BLOOD. — A Russian scientific observer some years since discovered in the blood of birds animate bodies of the nature of parasites, to which he has given the name of *Polimitus*, presenting a striking resemblance to the organisms described by M. Laveran as existing in the blood of persons attacked by malarial fever. Subsequent researches have shown that the presence of microbial parasites of animal origin in the blood is much more common than had been suspected, more especially in cold-blooded animals. Of warm-blooded animals, carnivora are more liable to be invaded by these intruders than others; but it is comforting to learn, that, for the most part, their presence does not appear to entail any particular inconvenience. According to *The Medical Press*, only four or five out of three hundred birds examined died in consequence of lesions caused by the parasites, and the pathological appearances were then identical with those observed in the subjects of malarial fever.

EXECUTION BY ELECTRICITY. — At a recent meeting of the Paris Academy of Sciences a communication from Mr. Edison was read respecting the use of electricity as a means of inflicting capital punishment. He is of opinion that an alternative current will cause death without pain, but he adduces no experimental evidence in support of that contention. The matter was referred to the medical section of the Academy, which is to have the assistance of M. Marcel Desprez, the electrician, in drawing up a report on the subject.

BOOK-REVIEWS.

Strength: How to get Strong and keep Strong, with Chapters on Rowing and Swimming, Fat, Age, and the Waist. By RICHARD A. PROCTOR. London and New York, Longmans, Green, & Co. 12°. 75 cents.

HERE is a somewhat lengthy title, and one recalling those of a hundred years ago, when in the titlepage were generally revealed the author's tenets, be they in religion or the sciences. Mr. Proctor defines the strength to which he refers as that which it is well that all actively employed members of the human family should have. The average man or woman is so engrossed in his struggle for existence, that he has no time and energy to give to keeping his body in good working order in all its parts. It may be that it works well enough under ordinary circumstances, but after a few years of inattention any effort at unusual exertion reveals a softened muscle here, or a stiff joint there, that had not been suspected. How by a due but not excessive amount of exercise to find these weakening parts, and to bring them back to healthful vigor, is one of the author's objects.

But in the chapters on reducing fat, on nature's waist and fashion, on learning to swim, and on other cognate subjects, are to be found some good advice, and some suggestions likely to prove fruitful of discussion.

The Reconstruction of Europe. By HAROLD MURDOCK. New York, Houghton, Mifflin, & Co. 12°. \$2.

THIS work is an account of leading political events in Europe from the establishment of Louis Napoleon's empire in 1850 to the close of the Franco-German war in 1871. The introduction by John Fiske gives a general survey of the great political movements of the century, and Mr. Murdock then takes up his theme at the downfall of the French republic of 1848, and the defeat of the other revolutionary attempts of that time. Attention is given almost exclusively to international affairs, and both diplomatic and military manoeuvres are described at length. The work is well written, though sometimes with little too keen an eye to dramatic effect, and with less philosophical insight than might have been wished. Too much space is given to unimportant military details to the exclusion of political events of much greater consequence, a fault that is specially noticeable in the earlier chapters. Moreover, we do

not see the propriety of including the Crimean war in the subjects treated; for, though it occurred after the time at which Mr. Murdock begins his narrative, it had nothing to do with the reconstruction of Europe, and its connection with the later events described is very remote. Of course, the greater part of the volume is devoted to the unification of Italy and Germany, and the author shows pretty clearly why the revolutionists of 1848 failed to reach these ends, and why and how they were afterwards attained. The diplomacy of Cavour and Bismarck is well described, while the obtuseness of the French Emperor and his ministers and marshals is strikingly shown. Some of the great battles of the epoch, especially that of Sadowa and the engagements around Metz, are very clearly delineated, and those who are fond of military history will find many interesting chapters in Mr. Murdock's book. He closes without alluding to the Russo-Turkish war of 1878, doubtless because the work of reconstruction in that quarter is not yet completed, and no one can tell how it will end. On the whole, and in spite of some drawbacks, Mr. Murdock has written an interesting work, and one that will be specially useful to those persons who wish to keep informed of the general course of European affairs without going into all the details.

AMONG THE PUBLISHERS.

ARNOLD & Co., Philadelphia, publish this week Mrs. S. T. Rorer's book on "Home Candy-Making."

— Among the scientific notes in the *Johns Hopkins University Circulars* for September are "Contributions to the Mineralogy of Maryland," by George H. Williams; "Note on some Minerals from the Chrome-Pits of Montgomery County, Md.," by A. C. Gill; "A Study of the Oyster-Beds of Long Island Sound with Reference to the Ravages of Starfish," by C. F. Hodge; and "Association in Substitution and Rotation," by Professor Morton W. Easton of the University of Pennsylvania.

— *The Publishers' Weekly* notes the promotion of one of the most popular and promising members of the trade. Mr. Edward W. Bok last week resigned his position as manager of the advertising department of Charles Scribner's Sons, to assume the editorship of *The Ladies' Home Journal* of Philadelphia, under most favorable arrangements. Mr. Bok has been with the Scribners for five years, and in graduating to the editorial chair becomes, perhaps, the youngest chief editor in the country. He is twenty-five years of age. In this connection, the following extract from the *New York Star* possesses special interest at this time: "Only those on the 'inside' of New York literary and journalistic circles know any thing about 'The Bok Syndicate Press,' a bureau from which emanate many of the best and most striking literary articles by famous authors found in the modern newspaper. It is owned and managed by two brothers, Edward W. and William J. Bok. The combined ages of these two young publishers do not make the figure fifty, and yet within their control rests one of the most remarkable literary influences of to-day. They control the literary work of some forty-five of the most famous men and women of the day, which they supply to newspapers simultaneously all over this country and in Canada and England. Edward Bok holds a responsible position in one of the big New York publishing-houses, and his name is withheld from the enterprise. William devotes all his time to the work, and under his name the business is conducted. While Edward makes all the contracts with authors, William stands at the helm and carries out the ideas of his younger brother. A better matched couple of brothers it would be difficult to find. Edward has a wonderfully extensive acquaintance among famous people. He is well read, has good literary judgment, and knows precisely what the people want. William is of untiring energy, and a doubtful literary venture becomes a success in his hands. The brothers are very popular in society, and one is almost sure to meet them at any prominent literary or social event. Both are good talkers, have pleasant manners, and what the one lacks the other supplies. They have built up their business from nothing. Henry Ward Beecher started Edward by making him his literary manager, and in this way the bureau began. Now almost every author of note writes for the two brothers. They have no difficulty in securing writers, for they pay promptly and

manage excellently. Their principal writers include Grace Greenwood, Wilkie Collins, Marion Harland, Lew Wallace, Ella Wheeler, Will Carleton, Max O'Rell, and a score of others. They work quietly, the general public hears but little of them, yet it is doubtful whether any two young men in New York have so bright a future before them."

— Brentano's will publish shortly a collection of papers on technical and historical subjects under the title of "Military Miscellanies," by Gen. J. B. Fry, U.S.A.

— Roberts Brothers have just ready "Louisa M. Alcott: her Life, Letters, and Journals," edited by Ednah D. Cheney, illustrated with portraits and a view of the Alcott house in Concord.

— Houghton, Mifflin, & Co. published on the 5th "A Summer Journey to Alaska," by Maturin M. Ballou, who describes in a most interesting manner not only the resources and features of the country and people of Alaska, but also the wonders of the Yellowstone Park and the marvellous country along the Canadian Pacific Railway; "The Reconstruction of Europe," a sketch of the diplomatic and military history of continental Europe, from the rise to the fall of the second empire, by Harold Murdock, with an introduction by John Fiske; also the first two volumes of the scientific papers of Asa Gray, selected by Charles Sprague Sargent, comprising reviews of works on botany and related subjects, 1834-87, and essays and biographical sketches, 1841-86. They publish this week the pretty two-volume edition of the "Autocrat of the Breakfast-Table." It is promised in beautiful type, tasteful binding, and with steel-engraved titlepages. Miss Lucia T. Ames's novel, "Memoirs of a Millionaire," comes very opportunely, when the public is engaged as never before in thinking on social questions; and her story, which suggests some excellent uses for wealth, is likely to find eager readers. Rev. Julius H. Ward's little book, "The Church in Modern Society," is an attempt to show what influence the Church is entitled to exert, why it fails now to exert it, and how it may regain its lost prerogative. The new edition of the *Atlantic* index, affording ready access to the varied riches of the sixty-two volumes of the *Atlantic Monthly*, will be welcome to many.

— Count E. De V. Vermont, author of "America Heraldica," and a publisher at 744 Broadway, this city, is no relation to the man arrested under the name of W. C. Tenner, *alias* Terrail de Vermont, for having forged various checks in New York, Canada, etc.

— The friends of *Psyche*, a journal of entomology published by the Cambridge Entomological Club, have made an appeal to entomologists for support. The limited funds of the club are not sufficient to publish the journal with the present subscription list without falling into arrears, so that the journal has been a heavy drain upon its local supporters, though several friends at a distance have generously assisted. A slight increase of the subscription list would render it nearly self-supporting, which is all the club asks, and it is believed that the special circumstances of the present time, indicated in the form of a subscription, will find a response from those interested in its welfare. Sample copies will be sent to any one desiring to call the attention of others to its character. A friend of the Cambridge Entomological Club having assured the publication of *Psyche* to the end of 1893 on condition that fifty *new* subscriptions to the present volume (at five dollars the volume) are received before Nov. 1, 1889, Mr. George Dimmock of Cambridge has subscribed for five copies; Mr. Samuel H. Scudder of Cambridge, for five; Mr. Roland Hayward of Boston, for two; and Mr. Holmes Hinckley of Cambridge, for one copy. Subscriptions and payments may be made to Samuel Henshaw, treasurer, Cambridge, Mass.

— "The Butterflies of the Eastern United States and Canada, with Special Reference to New England," describes in detail all the butterflies known to occur in North America east of the Mississippi, excepting such as are found only in the unsettled parts of Canada or south of Kentucky and Virginia. It was originally issued in twelve monthly parts, each containing 8 plates (colored and plain) and about 150 pages of text. The first part was published Nov. 1, 1888; the last will be published Oct. 1, 1889. As now completed, it contains 17 plates of butterflies, 6 of eggs, 11 of

caterpillars, 2 of the nests of caterpillars, 3 of chrysalids, 2 of parasites, 33 of structural details in all stages of life, 19 maps and groups of maps to illustrate the geographical distribution of butterflies, and 3 portraits of early naturalists of this country,—in all, about 2,000 figures on 96 plates, of which 41 are colored. The text contains 2,000 pages, including an introduction of 104 pages, and an appendix of 150 pages, which contains descriptions of such species concerned as have not been found within the limits of New England, and also descriptions of all known parasites of North American butterflies, by Messrs. Howard and Williston. Special attention is paid in this work to the distribution, habits, and life-histories of our butterflies; and careful descriptions are given of every stage of life, not only for the species, but for the genera and

higher groups wherever the data are attainable. Analytical tables applicable to every stage (a feature never before attempted in a work of this kind) are introduced wherever possible. Seventy-six essays scattered through the work discuss such special questions as arise in studying butterflies, and in themselves form a complete treatise on the life of these insects. The work makes three volumes: the first contains the introduction and the family *Nymphalidae*; the second, the remaining families of butterflies; the third, the appendix, plates, and a full index. Explanations of the plates are placed beside them. The price, bound in three volumes, half levant, gilt top, is \$75. It will be ready for delivery, bound, Oct. 1, 1889. Communications concerning it should be addressed to Samuel H. Scudder, Cambridge, Mass.

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—The London correspondent of *The New York Times* says, "The *New Review* has been such a remarkable success that it will henceforth contain ten additional pages. Its freshness, ability, and scope have made even the *Fortnightly* and the *Contemporary* seem dull by comparison, and this month in the table of contents it easily leads all its older and costlier rivals. A little two-page paper by Cardinal Manning on the strike is one of the wisest and most valuable deliverances on the subject I have ever seen, and John Burns's longer article is extremely forcible."

—In the *New England Magazine* for October many of the articles are devoted to subjects relating to education. Mr. Albert P. Marble, the retiring president of the National Educational Association, contributes an article on the history and prospects of the association; W. A. Mowry, the editor of *Education*, writes on Dr. Harris and the Bureau of Education; there is a brief article on history, by A. E. Winship, the editor of the *New England Journal of Education*; and there is a long and fully illustrated article on the educational institutions of Nashville. Nashville receives further notice in a general article on the history and new life of the city, by Hon. A. S. Colyar. This article also is illustrated, and is timely, as the recent meeting of the National Educational Association in this "Athens of the South" has drawn to it the attention of thousands of the teachers of the country. It is the first of a series of articles, in which the *New England Magazine* proposes to present the enterprising cities of the New South to Northern readers. Dr. Holmes, whose eightieth birthday has just been celebrated, receives attention in this number of the magazine. The frontispiece is a portrait of Dr. Holmes, from a recent photograph. There is an illustrated article, "Dr. Holmes at Fourscore," by George Willis Cooke; an article on "Dr. Holmes's Pilgrim Poems;" and interesting facts about the poet among the editorial notes. Professor Hosmer's story, "The Haunted Bell," is continued, and there are some short stories, one by Mrs. Celia P. Woolley, the author of "Love and Theology." Mr. Mead's study of the question, "Did John Hampden come to New England?" is finished, the whole evidence on this puzzling point being laid on the table. Another historical article is by Professor Charles H. Levermore, "Pilgrim and Knickerbocker in the Connecticut Valley." Mr. Hale has a gossipy paper entitled "Tarry at Home Travel," not easy to describe, but delightful to read. There is a brief article on John Boyle O'Reilly; and a long and thorough one by William Clarke of London on Parnell, which will attract much attention. It is accompanied by a portrait of Parnell, from a recent photograph. The articles on O'Reilly and Dr. Harris also have portraits.

—Messrs. Houghton, Mifflin, & Co. have published a small volume by Mary E. Burt, an Illinois teacher, entitled "Literary Landmarks." The authoress is impressed with the importance of giving children a taste for better reading than much that they now indulge in, and more knowledge of the literary history of the world. She lays the most stress on works of imagination, though she does not neglect scientific and historical books, and others that convey information. She gives some account of her experience in teaching the history of literature by means of specimen works, — a study which she has found more interesting to school-children than is commonly supposed. The book contains some charts to illustrate the literary history of the world, one of which is quite elaborate, and would, we should think, be useful to other teachers. Miss Burt is perhaps a little too positive in expressing her views, and the list of books that she recommends for young people is too full for ordinary use; but we welcome her attempt and all attempts to raise the standard of juvenile reading.

— "Evolution of Morals," by Lewis G. Janes, and "Proofs of Evolution," by Nelson C. Parshall, are the contents of Nos. 11 and 12 of the *Modern Science Essayist*.

LETTERS TO THE EDITOR.

Lightning-Strokes.

THE attempt of *Science* to obtain information regarding lightning-strokes and their damage is very praiseworthy, and it is to be hoped that it will result in a clearer understanding of the danger

from these strokes to unprotected houses. I have heard intelligent men say that a lightning-rod attracted the lightning, and was more dangerous than none. This is unquestionably an entirely erroneous supposition, in case the lightning-rod has a good ground, for its whole duty is to cause electricity of increased tension to pass off silently and insensibly, rather than to gain a sufficient potential to give a disruptive discharge. The following is a brief account of a few strokes that have come to my attention, in which damage resulted, in the past four years.

On Aug. 23, 1885, a church with a high steeple, and protected by an iron lightning-rod, was struck in a severe storm. The stroke stopped the tower clock, but without serious injury. The electricity came down the rod to within fifteen feet of the ground, when it dashed across twenty feet of air space, to a faucet connected with the city water-pipes, and disappeared without further injury. It slightly dazed a man who was within a few feet of the line from the rod to the faucet. A singular point is, that this same church was struck in precisely the same way several years before; and on that occasion, as the stroke entered the water-pipe, it broke the marble front of the sink, and threw it on the floor. It is very plain that the whole difficulty in this case was an insufficient ground. After the last catastrophe the rod was changed to copper, but it is plain that the only method of avoiding danger is by improving the ground.

In this same storm, lightning struck a house about three-quarters of a mile from the church. This house had no rod. The main part had a hip roof, and was shingled; while a lower southern extension had a tin roof, from the south-west corner of which a tin eaves-spout ran down to about ten inches above the earth. The lightning struck the south-west corner of the extension, and divided, a part going down to the end of the spout, and then into the house, where it knocked off the plastering. The other part crossed to the north-east corner, passed down between the weather-boarding and plastering, and finally dug a furrow in the ground, and disappeared in a pool of water about fifteen feet from the house. The latter part of the stroke drove off, as by an explosion, the plastering on the inside and the weather-boarding on the outside. There was no trace of scorching on the boards. A woman and her two sons in the house were dazed and partly stunned.

A year or two later a modern house was struck on one of the principal avenues of the city. It had no lightning-rod; but, from a tower having a slate roof, a gilded ornament projected to about three feet. The whole house excepting this tower was roofed with tin. The stroke passed down the inside of the tower, knocking off the plastering, stunning one of the inmates, and doing other slight damage. This house has had the same ornament erected, and no rod put in place to protect from a similar stroke.

The last stroke that has been called to my attention occurred this summer. A gilded wooden cross about four feet in height, on the tower of a beautiful stone church which had no protection from lightning, was struck. Various ornaments on the tower were shattered, and the tower itself was damaged. The whole damage was two hundred or three hundred dollars. The gilded cross has again been erected without a lightning-rod to invite another visitation by Providence.

It seems to me the architects of modern buildings are largely responsible for this state of affairs. It is probable that in a large city with numerous tin roofs the danger from lightning on ordinary roofs is very slight; but certainly in isolated spots, and all projecting metallic or gilded points, there is a constant hazard from lightning unless protected by a rod well grounded.

H. A. HAZEN.

Washington, D.C., Oct. 7.

A Queer Maple-Tree.

A HARD-MAPLE tree in the yard of S. G. Scott at Plainwell, Mich., is an object of great curiosity. It has been shedding its foliage through September, but new leaves are again appearing, and after the fall frosts the tree again drops its leaves. This it has done regularly for several seasons. It differs only in respect of shedding its foliage twice a year, from other maples standing within a few feet of it.

M. G. MANTING.

Holland, Mich., Oct. 4.

INDUSTRIAL NOTES.

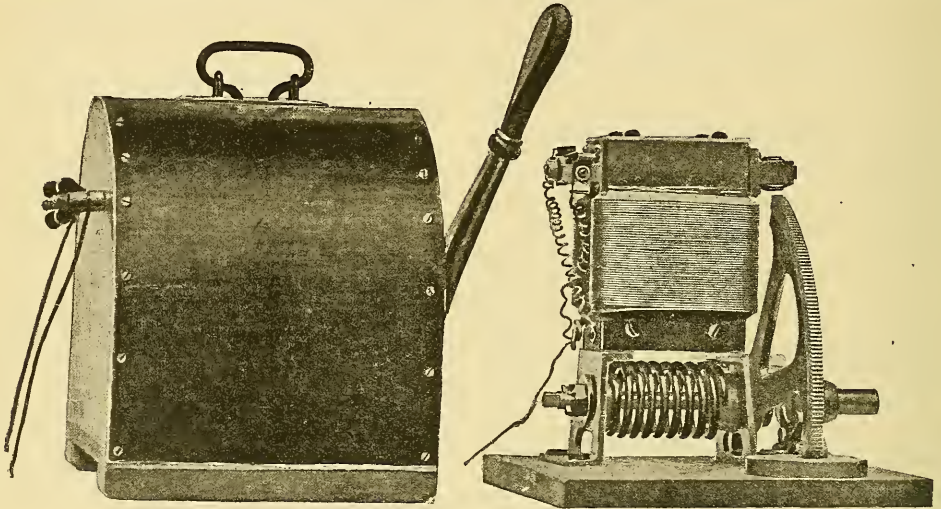
Electric Blasting Battery.

THE small dynamo-electric machine shown in the accompanying illustrations is intended for use in exploding blasts in mining and similar operations. It is called the "Crescent" battery, and is manufactured by the Ingersoll-Sergeant Rock Drill Company of this city. It is said to be the only electric blasting-machine which discharges a uniform current of electricity at every operation, no matter who may use it. Its action does not depend upon the skill of the operator, and, what is very important, there are no parts liable to break or get out of order.

The following is a description of the machine: A strong steel-wire spring is fixed to a shaft which carries a racked segment. The operator, when he presses the lever over, simply tightens the spring, and at a certain fixed point the lever is automatically released from its contact with the shaft, and the recoil of the spring gives a rapid and uniform movement to the armature, which generates the current. A nut is provided for giving greater or less ten-

motor is used, and it does its work without a hitch. It is a small arrangement, and is stowed away under the seat in the stern, where it is entirely out of the way. Two hundred and forty revolutions per minute are made by the screw, which gives the boat a speed of about five miles an hour. The boat being a very wide one, this is a very good result. There is no puffing little engine, as in a steam-yacht, heating up the little craft to an uncomfortable degree, requiring the constant attention of the engineer in shovelling coal and watching the steam-gauge, and rendering the boat top-heavy by the weight of the boiler. The batteries are directly over the keel, taking up no room which is needed, as their wood-casing makes good seats; and, as they weigh nearly five hundred pounds, they make excellent ballast.

The master of the craft moves a little lever, which starts the motor, and then, seating himself directly over it, he has nothing further to do but steer the boat. The batteries take about eight hours to discharge, and the motor will run that length of time without a particle of attention. The motor makes no jar in the boat, as an engine always does on a small boat, and the only noise



ELECTRIC BLASTING BATTERY.

sion to the spring, thus adjusting the capacity of the battery. The spring never breaks.

Those who are familiar with electric blasting will not fail to appreciate the great importance of a uniform discharge. Missfires and serious accidents are often due directly to a lack of uniform strength in the battery-current: one hole will fire while another in the same circuit will miss. With the Crescent, it is claimed that one can estimate with certainty that a certain number of holes will go off at each operation.

An Electric Boat on the Housatonic.

A BOAT propelled by electricity was first launched Sept. 20 by George G. Grower, electrician and chemist, of Ansonia, Conn.; and about 4 P.M., Monday, Sept. 23, a party, consisting of Mr. Grower, Frank A. Kirkham, and Fred Wehrle, of Ansonia, and a reporter, stepped into the boat and pushed off.

There is nothing unusual in the appearance of the boat, except a long, box-like structure extending the length of the boat over the keel. When the party was seated, and Mr. Grower pressed a little lever, the boat started up the river at a good rate of speed, although stemming a strong current, as the tide was running out.

The boat is an ordinary-sized row-boat, fourteen feet in length, and four feet wide. The structure in the centre contains the storage-battery, of fifty cells, which furnishes the power. A Perret

motor is used, and it does its work without a hitch. It is a small arrangement, and is stowed away under the seat in the stern, where it is entirely out of the way. Two hundred and forty revolutions per minute are made by the screw, which gives the boat a speed of about five miles an hour. The boat being a very wide one, this is a very good result. There is no puffing little engine, as in a steam-yacht, heating up the little craft to an uncomfortable degree, requiring the constant attention of the engineer in shovelling coal and watching the steam-gauge, and rendering the boat top-heavy by the weight of the boiler. The batteries are directly over the keel, taking up no room which is needed, as their wood-casing makes good seats; and, as they weigh nearly five hundred pounds, they make excellent ballast.

The master of the craft moves a little lever, which starts the motor, and then, seating himself directly over it, he has nothing further to do but steer the boat. The batteries take about eight hours to discharge, and the motor will run that length of time without a particle of attention. The motor makes no jar in the boat, as an engine always does on a small boat, and the only noise

that can be heard is a slight one from the gear, the little vessel gliding along as smoothly as an ocean steamer. Electric lights could easily be arranged, the power of the batteries being calculated for the purpose. Many persons watched the craft from the shore, and they had good reason to be puzzled. The picture of a number of persons in a boat, no one being occupied except the pilot, with no oars, sails, or even a smoke-stack visible, and with the boat rushing through the water, would naturally excite the curiosity of the uninitiated.

The trip made Monday was the third one, and on no occasion has there been the slightest hitch or cause for discouragement. The Perret motor, which is used, is a light one, weighing but ninety pounds, but is of one horse-power, and is of 100 volts electro-motive force. It is very simply managed, all four of the party Monday taking a turn as "engineer," with equal success. It can be reversed quickly, and stopped instantly. It is built so that in starting the power is applied gradually to the motor, thus obviating the danger of burning out the armature.

Mr. Grower is now introducing the Perret motors into factories, where power is lost by the large quantity of shafting required. Several of the motors scattered through a factory do away with a lot of the shafting, and save a large proportion of the power which is otherwise lost.

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I have forty varieties of birds' eggs, side blown, first class, in sets, with full data, which I will exchange for books, scientific journals, shells, and curios. Write me, stating what you have to offer.—Dr. W. S. Strode, Bernadotte, Fulton County, Ill.

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Shells and curiosities for marine shells, curiosities or minerals address W. F. Lerch, No. 308 East Fourth St., Davenport, Iowa.

I want to correspond and exchange with a collector of beetles in Texas or Florida.—Wm. D. Richardson, P.O. Box 223, Fredericksburg, Virginia.

100 botanical specimens and analyses for exchange. Send list of those desired and those which can be furnished, and receive a similar list in return. Also cabinet specimens and curiosities for the same. Scientific correspondence solicited.—E. E. Bogue, Orwell, Ashta, County, O.

I will sell to chapters or individual members of the Agassiz Association, 25 fine specimens of fossil plants from the Dakota group (cretaceous), correctly named, for \$2.50. Send post-office order to Charles H. Sternberg (author "Young Fossil-Hunters"), 1033 Kentucky Street, Lawrence, Kan.

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The undersigned wishes to make arrangements for the exchange of *Lepidoptera* of eastern Pennsylvania for those from other localities. All my specimens are named and in good condition.—Charles S. Westcott, 613 North 17th Street, Philadelphia, Penn.

California onyx, for minerals and coins not in my collection.—W. C. Thompson, 612 East 141st Street, New York, N.Y.

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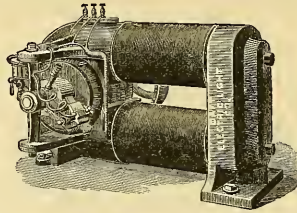
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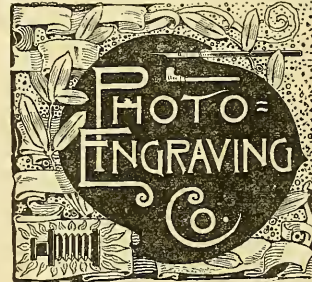
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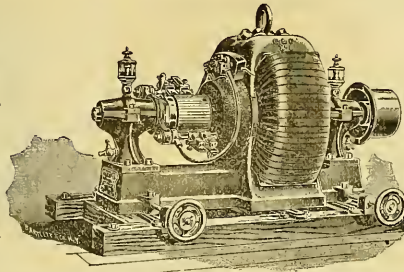


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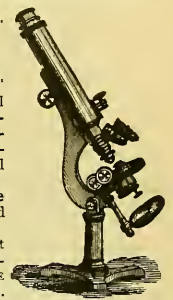
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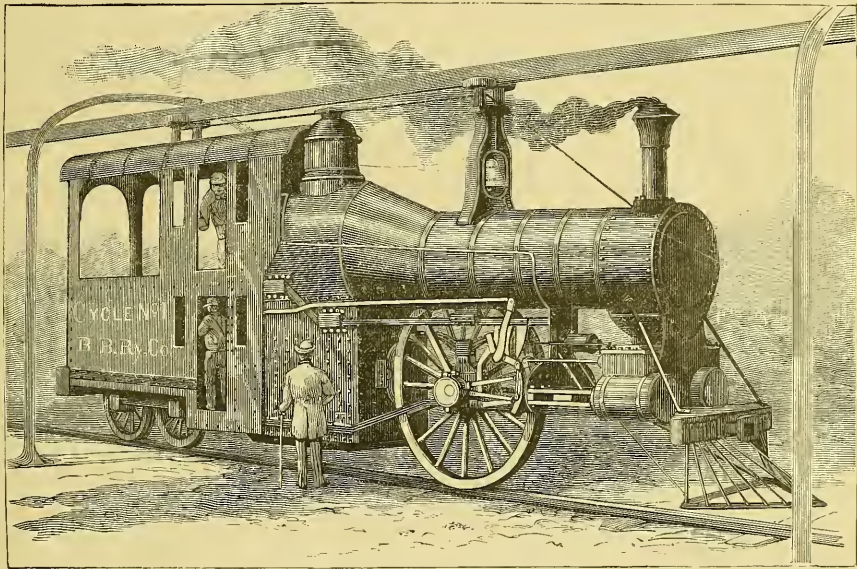
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THE BOYNTON BICYCLE RAILROAD.

A TRIAL trip of the Boynton bicycle locomotive and cars was made on the company's experimental track, between Bay Ridge and Coney Island, on Monday last. A portion of the old Sea Beach Railroad track was remodelled for the purpose by the erection of uprights supporting the guard-rail shown above the loco-

reached, however, as near as could be computed on a short track, was at the rate of twenty miles an hour. The road had a rise of 98 feet in 4,300 feet of length, and was nearly all curves, and consequently was well adapted for testing every point of the new system except speed. The motion of the train was remarkably smooth, and free from jolts.



BOYNTON BICYCLE LOCOMOTIVE.

otive in the illustrations. By the placing of a guard-rail of this kind above each rail, an ordinary single-track road may be converted into a double-track road for the Boynton system, the locomotives and cars being so narrow that trains will pass each other under such circumstances without danger of coming into contact.

* The locomotive weighs twenty two tons, and its total height is 15 feet 6 inches. It has a single driving-wheel of 7 feet 9 inches diameter, with double flanges, to ride on a single rail. The cab is two stories high, the upper story being occupied by the engineer, and the lower by the fireman. The engine has two cylinders, 12 by 14 inches each, and is operated with a boiler-pressure of 150

On Monday's trial-trip the train consisted of Cycle Engine No. 1,



BICYCLE LOCOMOTIVE AND PASSENGER-CAR.

and one car of eighteen compartments. The car was fitted to seat one hundred and eight persons, and that number made two trips over the road to Coney Island, and back to Gravesend. It is claimed by the inventor, the Hon. M. E. Boynton, that a speed of one hundred miles an hour can be obtained with this system, although no effort was made to run at a high rate of speed on this occasion, owing to the bad condition of the road-bed. The speed

pounds to the square inch. The passenger-cars are 4 feet wide, 14 feet high, in two stories, 40 feet long, and are designed to weigh five tons each.

Future developments of this system, as to speed, economy of construction, operation, and maintenance, and general adaptability to regular passenger and freight traffic, will be awaited with interest by all concerned in railroad operations.

THE RÔLE OF PTOMAINES IN INFECTIOUS DISEASES.

THE trustees of the Fiske Fund, — Albert Potter, M.D., Chepachet; John W. Mitchell, M.D., Providence; William H. Palmer, M.D., Providence, — with George L. Collins, M.D., Providence, as secretary, at the annual meeting of the Rhode Island Medical Society, held June 13, 1889, announced that they had awarded a premium of two hundred and fifty dollars for the best essay on "The Rôle of Ptomaines in Infectious Diseases," to an essay bearing the motto, "Their poison is like the poison of a serpent." The author was found to be Charles V. Chapin, M.D., of Providence, R.I.

From Dr. Chapin's historical sketch we learn that the word "ptomaine" (from *πτῶμα*, "a corpse") was first applied by Selmi to basic substances derived from the putrefaction of organic nitrogenous material. The ptomaines are of the same general chemical composition as the vegetable alkaloids of pharmacy, and they are not to be distinguished from them by chemical tests. Individual alkaloids can, of course, be distinguished one from another, but there is no sharp line of demarcation, and no general tests, which seem to distinguish the ptomaines from the alkaloids.

The former term is applied to those alkaloidal substances which are produced by putrefactive decomposition; that is, by the action of micro-organisms. The alkaloids proper are produced by changes going on within the living organism of plants. But they have this in common, that they are both produced by a retrograde metamorphosis of highly organized albuminoid material.

The ptomaines are divided into two classes, according to their chemical composition; the first containing no oxygen and volatile, the second containing oxygen and corresponding to the fixed alkaloids. The internal chemical composition, and the methods by which they are isolated, belong rather to the domain of chemistry than pathology. It is sufficient to say that they are separated from their aqueous extracts by means of ether, chloroform, benzine, or other non-miscible solvents, which are then evaporated, the residue extracted, and the process repeated, and finally the different ptomaines separated and isolated by precipitation with various re-agents suitable for the purpose.

A history of the various experiments and observations which gradually led up to a correct understanding of the chemistry and pathology of these compounds is most important in this connection.

Haller, in the middle of the last century, was the first to experiment in regard to the nature of putrefactive poisons, determining that the aqueous solutions of putrid substances would cause death when injected into the veins of animals. Gaspard, in an article published in 1822, related similar experiments, and noted among the symptoms, vomiting, twitching and convulsions, hiccough, and great thirst. He found the intensity of these symptoms increased with the amount of the dose: in the majority of cases, death occurred within twenty-four hours. He determined by experiment that neither CO_2 , nor H_2S , nor NH_3 could produce such symptoms, but believed that it must be some other chemical substance. Gaspard showed that the blood from an animal thus infected could infect another, and he referred to the similarity of the nature of this infection to that of the specific infectious fevers. Somewhat similar results, which he obtained by the intra-venous injection of pus, he attributed to the products of septic processes, which had begun in the pus.

Magendie found that putrid materials introduced into the alimentary canal were not productive of any such marked symptoms as when introduced into the veins, and he therefore concluded that the mucous membrane acted as a sort of filter to separate the poisonous elements; and he believed that the respiratory mucous membrane had the same function, for he exposed pigs, fowls, rabbits, and dogs to putrid exhalations, and only the latter succumbed, and they only gradually, giving no evidences of acute poisoning.

Leuret repeated the injection experiments of Gaspard and Magendie, and accepted their views of the chemical nature of the septic poison; but he did not succeed in isolating it, or determining its nature.

Virchow also showed that septic infection quickly caused vomiting, diarrhoea, muscular weakness, and convulsive symptoms, with

great heart weakness, and death in a few hours. Beck repeated these experiments, and determined the presence of sulphide of ammonia in the putrid material, and showed that it would also produce a fatal result.

Stich performed similar experiments, and came to the same conclusions as to the chemical nature of the poison. Then followed the experiments of Panum in 1850. He was the first to actually determine the chemical nature of the septic poison by separating it from septic solutions.

Weber v. Hemmer repeated Panum's experiments with substantially the same results, and Thiersch, Stich, and Schwenninger followed in the same path; but none of their work was as thorough and satisfactory as Panum's.

In 1866 Bence Jones and Dupré separated from the decomposing organs of men and animals, especially from the liver, an amorphous substance to which they gave the name "animal chinoidin," from its presenting a fluorescence like quinia when dissolved in dilute sulphuric acid.

In 1868 Bergmann succeeded in isolating a putrid poison, and, in company with Schmedeberg, he separated a poisonous substance from putrid yeast. This substance they obtained by a circuitous process, in the shape of minute crystals of the sulphate. Its watery solution produced in dogs the symptoms of septic poisoning, such as vomiting, diarrhoea with bloody stools, and, on autopsy, there was ecchymosis of the stomach and intestines. In frogs, also, severe symptoms were produced. This poisonous substance was called "sepsin," but was not obtained in sufficient quantity to admit of a determination of its chemical structure.

In 1869 Zuelzer and Sonnenschein separated from macerated bodies a crystalline substance which exhibited all the alkaloidal reactions. Physiologically it seemed to be a narcotic, somewhat like atropine, and resembled the so-called "sausage poison." It produced dilatation of the pupil, muscular paralysis, and acceleration of the cardiac pulsations. The authors obtained this substance by the ether and alcohol process for separating alkaloids, called Otto-Stas's method, and also by diffusion and extraction with glycerine.

Rörsch and Fassbender obtained from a cadaver a non-crystallizable substance resembling digitaline in its properties, but not having its bitter taste.

Schwanert, at about the same time, obtained from a dead body an oil with strong basic properties, and which smelled like propylamine.

Marquardt, and later Hager, obtained a substance to which was given the name "septicin," and which Hager believed was a mixture of amylamine and caprylamine. Lieberman also obtained a similar substance from the stomach of a person who had been poisoned by arsenic. The physiological action of none of these was determined.

Krebs-Brandes obtained a conine-like substance, and found that .007 of a gram injected into a frog killed it instantly, and .044 of a gram had the same effect on a pigeon in a few minutes.

Brouardel and Boutmy found in a decomposed goose a substance which gave re-actions, like conine, and which produced toxic symptoms.

According to Husemann, there are a large number of cadaveric alkaloids which resemble conine.

Wolckenhaar separated an amorphous base, which resembled nicotine, but had no toxic properties.

Moriggia and Battistini found in the watery extract of dead bodies a poison somewhat like curara; which, however, gradually lost its toxic properties the more it was purified.

Selmi, in Italy, while engaged as a medico-legal expert, became convinced that alkaloidal substances were formed in the human body after death by the putrefactive processes there taking place. From 1870 till the day of his death, Selmi devoted himself to the study of these substances; and he determined the occurrence of several alkaloids similar to morphine, conine, atropine, and delphine, and other vegetable alkaloids, but he did not succeed in separating any of them with sufficient purity to permit of chemical determination. Selmi, however, did much to encourage and advance the study of these substances, and definitely determined that they were produced by the action of microbes on proteid tissue. Among the other Italians who were encouraged to pursue this line

of study by Selmi's work may be mentioned Brugnatelli, Zenoni, and Cortez, who found an alkaloid resembling strychnine in decaying corn-meal. At the same time, Gautier, in France, was attacking the problem, and independently arrived at the same results, — that alkaloids are produced by the decomposition of albuminous substances.

The first to actually separate and determine the chemical composition of an animal alkaloid was Nencki, in 1876. He obtained from decomposing gelatine needle-shaped crystals of a salt to which he gave the name "collidin," and which he determined had the formula $C_8H_{11}N$.

During the last five or six years the study of ptomaines has received much attention on both sides of the Atlantic; but no one has done so much to develop methods of procedure, and put our chemical knowledge of these substances on a firm scientific basis, as Brieger. Of the ptomaines whose composition has been determined, Brieger analyzed nineteen, while Gautier and Etard come next with three.

The infectious diseases, at least those which are caused by micro-organisms (and those are the only ones we are now considering), may be classed in two divisions.

First, we have those in which the organism invades the blood and propagates there, and by so doing produces profound alterations in that medium. Among such diseases may be mentioned anthrax, malaria, relapsing fever, and certain forms of septicæmia.

The second class includes those diseases in which the micro-organism does not develop in the blood, but only reproduces itself in limited foci. Thus in typhoid-fever the specific organism grows only in glandular structures in the walls of the intestines, and in the mesenteric glands and the spleen; in cholera the growth is confined chiefly to the lumen of the intestines, though the walls of the gut are sometimes invaded; in abscesses and suppurating wounds the pus-forming organisms are confined to the abscess, or the tissues of the wound, and are not found in the blood; and in sapræmia the organisms of putrefaction in most cases do not involve the living tissue at all, but find their pabulum in blood-clots, exudations, and spots of necrosis.

It has been an interesting and important problem to discover how micro-organisms actually produce the symptoms in these different affections. It has been variously attributed to the "mechanical irritation" of the microbes, to their occlusion of minute vessels, to their consumption of certain elements in the blood or tissues necessary to the physiological integrity of the host, and, lastly, to the production of poisonous materials which re-act upon the tissues.

While there are some theoretical and experimental reasons for believing that micro-organisms may occasionally act in all of these ways, the evidence has of late been accumulating, as Dr. Chapin has attempted to show, that the last-named method is by far the most common and important. Even if there were no experimental evidence, we should hardly be able to explain the constitutional symptoms of the second class of infectious diseases in which the organisms are strictly localized, except on the hypothesis of the production of soluble substances which are taken up in the circulation.

But we know that there is much besides mere hypothesis which would lead us to attach great importance to the rôle of the chemical products of bacterial life in the production of the symptoms of the infectious diseases. In certain forms of septic disease the demonstration is complete that the entire circle of symptoms is immediately caused by the action of such substances. The experiments of Bergmann, Hemmer, Weber, and, first and most important of all, Panum, show that chemical substances, which can be isolated, produce precisely the same set of symptoms that are caused by the injection of untreated putrid material containing living organisms; and recently, since the perfection of bacteriological methods, Roux, Chamberland, and Arloing have shown that cultures of septic organisms produce substantially the same results, whether the organisms are present or have been removed by heating or filtration. And not only this, but Roux and Chamberland have obtained the same substances from the tissues of animals suffering with the diseases concerning which the experiments were made.

In the formation of pus it has been demonstrated, that, in some cases at least, it is the ptomaine produced by the organism which induces the migration of the leucocytes.

It is in regard to tetanus, however, that we have the most accurate knowledge in regard to the mechanism of the production of the symptoms. That this disease is caused by a bacillus, which develops in wounds, and does not migrate into the blood-vessels, is beyond question. From artificial cultures of this organism, and also from the tissues of a human subject suffering from the disease, a ptomaine has been obtained which produces in animals the identical symptoms of the disease; and, furthermore, it has been obtained in such purity that its chemical formula has been accurately determined.

Typhoid-fever and cholera do not normally occur in the lower animals, though the administration of their specific organisms under certain conditions is followed by a set of symptoms called "experimental typhoid fever," and "experimental cholera." The experiments of Sirotnin, and Beumer and Peiper, for typhoid-fever, and of Gamaleia and Löwenthal for cholera, have shown that all the essential features of these diseases are dependent upon the soluble substances contained in cultures of the organisms.

The experiments that have been made with anthrax, hog-cholera, fowl-cholera, and erysipelas, while indicating to some degree the importance of the rôle played by soluble substances in these diseases, have not given very complete or satisfactory results.

As the subject of the essay is "The Rôle of Ptomaines in Infectious Diseases," the action of other substances has only been briefly alluded to; but it must be remembered that a very large number of substances besides those belonging to this particular chemical group are elaborated by the growth of micro-organisms. We have every reason to believe that the most important are, indeed, of an alkaloidal nature: for the sepsin of Panum, and the tetanine of Brieger, produce all the symptoms of septic poisoning and of tetanus; and cadaverine is, in and of itself, capable of producing true suppuration.

Nevertheless it is probable that such substances as sulphuretted hydrogen, ammoniac sulphide, phenol, etc., all elaborated by bacterial life, have some influence upon the body. Moreover, the experiments of De Christmas, Arloing, Rietsch, and Wooldridge, afford very strong evidence that ferments of a proteid nature play a very important part in the production of infectious diseases. The ptomaines, like the vegetable alkaloids and the leucomaines, all chemical allies, have a markedly selective action on the nervous system; and we may assume with a fair degree of probability that many of the nervous phenomena, the delirium, stupor, tremblings, and paralysis of the infectious diseases are due to these substances. The action of typhotoxine, found in the cultures of the typhoid bacillus by Brieger, and the ptomaine isolated by Hoffa from anthrax cultures, are indications of this.

One of the most common and important phenomena of the infectious diseases is fever. That fever may be produced by ptomaines is shown by Panum's experiments with sepsin, and Hoffa's with the anthrax ptomaine.

That the fever of the infectious diseases is frequently due to these substances is very probable; but that it may be due to other materials or causes is also probable, and, in fact, quite certain. Angerer and Edelberg have shown that fever can be caused by the injection of blood and of fibrine ferment; and Schmiedeberg obtained like results with another proteid substance.

Wood, Reichert, and Hare, Otto, Bergmann, and others have shown that pepsin, trypsin, and pancreatin are all capable of producing a rise in temperature; so that it is highly probable that proteid substances, as well as those of an alkaloidal nature, have much to do with the production of febrile symptoms in the infectious fevers.

The experiments of Arloing and De Christmas would also show that some pyretic substances are not readily diffusible, and are probably of the nature of ferments.

Another rôle of the ptomaines and other soluble substances is the preparation of tissues and fluids for the growth of microbes. There is in the living body a constant tendency towards the destruction of all micro-organisms. This tendency varies greatly from time to time, and can doubtless be greatly affected by the ac-

tion of ptomaines. Thus, in the case of the pus-forming organisms, it has been shown that they can much more readily attack the living tissues when the latter are inflamed; and it has also been shown that the ptomaines, some of them at least, do thus prepare the tissues for the microbes by exciting inflammation. In a broad area of suppuration the ptomaines diffuse into the tissues out beyond the sphere of direct bacterial action, and the organisms follow closely in the wake of the inflammatory area thus formed. This was observed to be the course of events, in the keratitis excited by Leber with cadaverine.

Typhoid, cholera, and many other organisms, are destroyed when injected directly into the blood; but in later stages of these, as of most infectious diseases, the organisms are found often in large numbers in the circulating fluid. It is very possible that the changes in the blood which permit of the growth of the organisms are due in part to the action of ptomaines on the blood itself; but it is also probable that they are due to changes in general nutrition, affecting the organs by means of which the blood is formed. This, however, is a branch of the subject on which we have only just begun to speculate, and on which little work has been done.

On the other hand, we have considerable positive knowledge in regard to an opposite action of ptomaines; namely, the rendering of tissues refractory to the action of microbes. It has long been known that the growth of micro-organisms in artificial culture-media, in very many instances, soon produces such changes that the media are no longer capable of supporting bacterial life. Various explanations have been offered of this phenomenon; but it is now definitely settled, particularly by the experiments of Garré and Freudenreich, that it is in most instances due to the production of substances which exert a hostile influence upon the vegetation of the organisms. This explanation is of very great importance, both practical and theoretical, in relation to immunity, particularly acquired immunity, in animals. Various theories have from time to time been advanced to account for this phenomenon.

1. The theory was advanced by Pasteur and Klebs that the immunity was due to the consumption by the organisms of certain ingredients of the tissues which were necessary for the growth of the organisms, and which were not afterwards replaced. This "exhaustion hypothesis" has now been generally abandoned as not in accord with observed facts.

2. The theory of Metchnikoff is, that the invading organisms are devoured by the leucocytes, which, by this exercise of their functions, acquire an increased power in this direction which can be effectually exercised on a subsequent occasion.

3. Lastly, it has been suspected, that, during the first attack of an infectious disease, soluble substances are elaborated which exert such a physiological action on the tissues that the latter are enabled to resist the inroads of the organisms; and that this refractory condition remains a longer or shorter time, until it is lost through the regular metabolic changes of the animal body. This is the "retention hypothesis," and is favored by most of the evidence which has been accumulating during the last few years.

The immunity which is thus produced has varying degrees of permanency. In malarial and relapsing fevers where there is a distinct remission, it is probable that the organisms produce a substance which is a poison to themselves as well as their host, and that its presence in the blood destroys or drives out the organisms in that fluid, while those that are in the spleen and other lymphatic glands remain unaffected. This constitutes the remission, which only lasts a short time, until the objectionable substances disappear or until the corpuscular elements which have been made refractory have been replaced by others newly formed. In such instances the refractory condition is very brief. In other cases, as in anthrax, studied by Roux and Chamberland, or the experimental cholera of Löwenthal, the immunity may last a few days or weeks. In still other cases it may continue indefinitely, as in measles and small-pox.

The success of so many experimenters in obtaining immunity in animals by the administration of chemical substances opens up the most hopeful field of therapeutic research.

Much was expected from prophylactic inoculations with attenuated but living virus; but the difficulty of keeping the virus of the proper degree of virulence, and the danger that arises from the fact

that every inoculation establishes a focus from which the disease may spread in severe form, have prevented these expectations from being fully realized. But if immunity can be secured by the use of chemical substances, the action of which can be measured and regulated, and which can be prepared outside of the body, we shall obtain an invaluable means of controlling the infectious diseases.

Every experiment which throws any light on this important subject is worthy of close attention, and, if verified, is a step towards the solution of the great problem of the prevention of disease.

RUSSIAN LITERATURE.

IN *The Publishers' Weekly* for Oct. 12 is printed a statistical report, compiled from official sources, of the number of books published and printed in the Russian Empire (excepting Finland) during 1888. The number of titles recorded amounted to 7,427; the total number of copies printed, 21,103,272. Of these, 5,318 books were in the Russian language, 716 in Polish, 343 in Hebrew, 311 in German, 217 in Lettic, and 178 in Esthonian. The following is a classified list, in tabulated form, showing the number of titles and the editions printed of books in the Russian language:—

	Works.	Copies printed.
Works of reference.....	629	3,877,092
Educational:		
Religious.....	521	3,691,838
General.....	720	3,334,122
Medical.....	848	1,923,618
History.....	445	446,083
Jurisprudence.....	256	288,022
Agriculture.....	176	248,202
Military science.....	173	214,819
Literature.....	159	211,944
Juveniles.....	155	178,623
Geography and travels.....	150	545,662
Popular literature.....	144	141,066
Political economy.....	142	821,800
Technology.....	115	65,344
Natural history.....	101	84,088
Pedagogics.....	93	109,240
Art.....	60	64,818
Philosophy.....	52	43,417
Mathematics.....	46	62,966
Mathematics.....	45	32,150
Mathematics.....	43	34,417
Politics, etc.....	33	31,070
Miscellaneous.....	312	913,495
	5,318	17,395,050

Among the books of reference there are catalogued 155 Russian almanacs, of which 1,537,649 copies were printed. Besides these, there were also 205 almanacs in other than the Russian language. St. Petersburg and Moscow, of course, lead in the production of literature. Then follow Warsaw, Odessa, Riga, Kasan, Kiev, Tiflis, Wilna, Dorpat, Charkow, Reval, Mitau, etc. The total number of periodicals was 667, of which 493 were printed in the Russian language, 76 in Polish, 49 in German, 13 in Esthonian, 8 in Lettic, 7 in French, etc. The most of these are printed in St. Petersburg. The statistics showing the proportion of inhabitants to the daily journals issued are most remarkable. It appears, that, taking European and Asiatic Russia together, there is but one journal to 484,590 inhabitants. The proportions taken in the cities, for instance, show, in Reval, one daily journal to 8,550 inhabitants; in Riga, one to 13,490; in Tiflis, one to 14,860; in St. Petersburg, one to 28,970; and in Moscow, one to 75,350. This gives one a tolerably clear idea of the intellectual development of the masses.

M. Pawlenkow gives the following facts concerning the prices some of the prominent Russian authors realized for their work. Shortly before his death, Turgueniew sold the rights in all his published works, "for all time," to Glasunow, for 90,000 rubles (over \$69,300). The publishing-house of Salajewy offered to the novelist Shtshedrin for his writings 60,000 rubles, but the transaction was not consummated. Gogol received 60,000 rubles; Pushkin, 35,000 rubles; Schukowskij, 5,000 rubles; Krylow (for his fables), 14,000 rubles; Nekrassow, 15,000 rubles; Gontsharow, 35,000 rubles; Ostrowskij, 10,000 rubles (for one edition); Grigorowitsh, 5,000 rubles; Aksakow, 3,000 rubles (for one edition); Mey, 1,000 rubles. The popular author, Gleb Uspenskij, sold his works to Pawlenkow and Ssbirjakow for 25,000 rubles. Pawlenkow printed

a cheap edition of these books, and sold 10,000 copies within one year. Popular text-books seem to have the largest sales; and Polubojarinow, the publisher, paid to the author of a series of arithmetics, Mr. Jewtushewskij, the sum of 50,000 rubles. From the foregoing it will appear that the notion that Russian literature is made up solely or largely of those writers whose works have thus far been translated into English — Turguenief, Tolstoi, Dostoyevsky, and Gogol — is fallacious. As a writer in the *Christian Union* recently pointed out, it would be as just to England and America to translate Dickens, Hawthorne, and Haggard into some foreign tongue, and represent them as English literature, as it is to Russian literature to be judged by the writings of the authors now known to us through English translations. "Nothing could be more unfounded or contrary to the fact than the impression which is abroad that we have in these translations a fair presentment of Russian literature. In reality, we who only read English — and even those of us who know French and German — have gained no more of that literature than the faintest glimpse. With very few exceptions, the books that have been Englished are all novels; they are all novels of the modern period, but they do not do the smallest justice to the novelists of that period. We rave about Turguenief and Tolstoi, but what of Gontcharov, Pisemsky, and Pomyalóvsky, and half a dozen others equally or unequally noteworthy, about whom never a word is said? And then what have the Russian poets, the Russian essayists, the Russian historians, the Russian scientists, done, that we should be kept in the most Cimmerian darkness as to them and their works? By what strange caprice of translator or publisher or public is it that to Anglo-Saxon readers Pushkin, Lérmontov, Griboýédov, Kylov, Bielinsky, Káramsin, Bestuzhev-Ryúmin, Solóviev, Písarev, Dobrolyúbov, and so many others, remain practically unknown? All the more is there reason to wonder at and deplore this neglect when it is remembered that in ignoring writers like these we are taking special pains, as it were, to hold unliquidated our manifest duty to a great race."

ELECTRICAL NEWS.

NEW INSULATING MATERIAL. — A recent German patent for a new insulating material for electric conductors specifies the use of paper which has been thoroughly soaked in an ammoniacal copper solution. The pasty mass is then pressed against the conducting wires to be covered by means of rollers, and the whole is finally submitted to strong pressure. When dry, the covered wire is passed through a bath of boiling linseed-oil, being left in it until the covering is saturated. This makes it elastic and impermeable to moisture. The covering is said to be durable, and efficient as a non-conductor.

LEAD-COVERED CABLES. — It has been accepted as an acknowledged fact that lead-covered cables, when placed under ground in creosoted wooden troughs, undergo a rapid deterioration of the lead sheathing, owing to the metal being converted into a carbonate; but closer research tends to show that this destruction need not necessarily take place. Close observation of creosoted conduits and lead-covered cables, laid at various times since 1884, apparently prove, according to the London *Electrical Review*, that the destructive agent usually present in freshly creosoted wood disappears almost entirely after a few years. A cable was laid upwards of two years ago in a conduit constructed in 1884, and at this date there is but very slight trace of action on its surface, while part of the same cable laid in an 1888 conduit shows considerable scale of carbonate of lead after one year's exposure. Parts of the same cable placed in other conduits about a year after their construction show but little damage. One cable laid in 1885 is only slightly affected, and it is not anticipated that any further deterioration will take place. Some experiments to test the effect of time and ventilation on creosoted wood were carried out by placing cables covered with an alloy of tin and lead in boxes made of creosoted wood, one box made of wood creosoted more than two years back, and another more recently impregnated. These boxes were sealed up, and opened after a lapse of three months. The samples in the old wood box were barely touched, while the samples in the newer one were thickly covered on the sides and top

with what is chemically known as phenolate. Either phenol, a volatile gas, or acetic acid in combination with carbonic-acid gas, will attack lead and reduce it to a carbonate. If no acetic acid is present in the wood, and the phenol be evaporated by some means or another, there should be no more damage done to lead cables in creosoted troughs than if they were run in conduits of other materials; but means should be taken to freely ventilate the troughs, not only to protect the cables, but also to guard against accumulations of explosive gas. Under these conditions, plain lead sheathing would prove as efficient as that made of the tin alloy, the durability of which latter covering can hardly be accepted as assured.

LIGHTNING ON WAR-VESSELS. — Apart from the modern vessels being protected by their construction, or by special provisions for the purpose, the London *Electrical Review* asserts that lightning does not play as destructive a part as it did forty or fifty years ago, as even those ships unprovided with conductors have suffered less damage than a smaller number of ships experienced formerly; not that modern vessels are exempt, but they seem to be struck in a manner which causes fewer fatal accidents, and in some cases even the effects of a lightning-flash have borne so little trace of their origin that they have been credited to the wilful act of some one on board.

HEALTH MATTERS.

The Pathological Bearings of Heredity.

ANIMALS, including man, have arrived at their present state of development by the combined but rival forces of heredity and evolution, the latter term including the effects of surrounding environment. Evolution without heredity, as Ribot observes, would render every change transitory; and every modification, whether beneficial or not, would disappear with the individual. The results of heredity without evolution, on the other hand, would give us the monotonous conservation of the same types fixed once and for all. With heredity and evolution we have life and variation. Evolution produces physiological and psychological modifications, habit fixes these in the individual, and heredity fixes them in the race. These aphorisms, says *The Medical Press*, apply as well to diseased conditions as to health, and, in endeavoring to unravel the mysterious bearings of heredity upon disease, we have to bear in mind the conflicting influence of stability with this tendency to variation. The operation of hereditary tendencies is perpetually disturbed by innumerable circumstances unappreciable by our means of observation, but capable nevertheless of producing varieties infinite alike in extent and degree.

It is well known that sensitiveness, whether to general or special impressions, varies extremely in different individuals. An operation which involves pain amounting to agony to one person will be borne by another with comparative indifference; and the tissues of one person will re-act to stimuli to such an extent as to cause violent inflammation, while those of another prove quite passive under similar circumstances. It is this varying irritability which explains the fact that no two cases are exactly alike of the same disease. These differences are distinctly transmissible from parent to offspring; and, when the inherited quality is a tendency on the part of certain tissues to re-act more readily than normal to morbid influences, we say that a person has a diathesis. What we term, for the want of a better word, idiosyncrasy, is in reality a diathesis or part of a diathesis, — a peculiar susceptibility of the individual to re-act unduly, either in excess or otherwise, to certain stimuli. Idiosyncrasies may be transmitted, as they very frequently are; but they are in any case congenital. These peculiarities of tissue and function often remain latent until some morbid process emphasizes the fact that a particular proclivity exists in the individual. This point cannot be better illustrated than by quoting the well-known story, that, of several hunters who were thrown at the same time into the same stream of water, no two were affected alike. In one an attack of rheumatism marks the tendency of joint-tissues to take on a certain process of inflammation, in another an attack of inflammation of the lungs points out the pulmonary apparatus as the organ least endowed with powers of resistance, while a third

simply gets a cold in the head. As for the horses, they very probably escape scot free in the absence of any special or general variation in the tissue tendencies.

While we recognize clearly enough that certain diseases are largely influenced by inherited tendencies, there are others, and these the majority, in which the influence of heredity is more or less indistinct; but it is as certain as any thing of the nature of a deduction can be that the conduct of a particular organism, in the face of morbid influences, is determined largely by inherited qualities of tissue, even when the susceptibility is difficult or impossible to make out. The problem before us is to discover and elucidate the natural laws which govern and regulate the transmission of mental and physical qualities, or, in the words of Mr. Lewis, "the paths along which forces travel to their particular results." We are already in possession of a large number of facts and observations bearing upon the "how," though the "why" still remains, and is likely to remain, unfathomable. These relative individual differences of bone tissue-cell, organ, membrane, and vessels, which are admitted by all competent authorities, really form the foundation of all sound views in pathology; and the more they are recognized and appreciated, the more will the art of medicine acquire scientific exactitude and increased usefulness to humanity. In the words of Sir James Paget, better treatment will follow better diagnosis, and better diagnosis will certainly follow a more exact pathology.

PEA-SOUP AS A SUBSTITUTE FOR BEEF-TEA. — Dr. Ris of Klotten, Switzerland, says *The British Medical Journal* of Sept. 28, emphatically recommends pea-soup as an excellent substitute for beef-tea for invalids, convalescents, and more especially for patients suffering from cancer of the stomach, or *diabetes mellitus*. Take peas, water, and sufficient amount of some vegetables suitable for soup, and one-half per cent of carbonate of soda, and boil the whole until the peas are completely disintegrated; then let the soup stand until sedimentation is complete, and decant the fairly clear, thin fluid above the deposit. The product is stated to resemble a good meat-soup in its taste, to be at least equally digestible, and at the same time to surpass the very best meat-soup in nutritive value. The latter statement may appear surprising, but the author reminds us that peas (as well as beans or lentils, either of which may be used instead of peas) contain a considerable portion of legumen; that is, a vegetable albumen which is easily soluble in a faintly alkaline water, is not coagulated by heat, is easily absorbed, and equal to the albumen of eggs in its nutritiousness.

MALARIAL FEVER IN EASTERN MASSACHUSETTS. — The results of a study on this subject by Charles H. Cook, M.D., of Natick, are, (1) that the disease seems thus far to have been limited to the cities and towns along the Charles and Sudbury Rivers and the branch of the Blackstone; (2) that it seems to have travelled to the east rather than to the west, that is, in the direction of the prevailing winds rather than against them; (3) that it seems to have developed and increased in seasons below the average temperature equally well as in those above; (4) that some of the marked outbreaks occurred in cold and wet periods, as well as in hot and dry seasons; and (5) that an "essential," as given by at least one authority, — namely, that there must be an average temperature of at least 58° F. for twenty-four hours to develop the disease, — does not hold good in this analysis; neither does another "essential" of an average temperature of at least 65° F. for twenty-four hours to produce an epidemic.

TRANSPLANTING OF A CHICKEN'S CORNEA. — Dr. Gravenigo, of the University of Padua, is said to have successfully performed an operation which hitherto has been vainly tried by various experimenters, both in France and elsewhere. The operation consists in the grafting of a chicken's cornea into the human eye. In the successful case reported by Gravenigo the graft is said to have united quickly, and formed a cornea which was very transparent, shining, and convex.

THE SANDWICH ISLAND LEPER COLONY. — The leper colony on the Sandwich Islands contained a hundred persons in 1884. At present the number is smaller, and most of them are men. The government, according to recent reports, contributes one hundred

thousand dollars a year toward the expenses of the colony, and three years ago the king personally inspected it. The average duration of the disease is eleven years, and the mortality fifty eight per thousand. The local physician, Dr. Hoffman, is a victim of the disease.

THE FOODS OF DIFFERENT PEOPLES. — Many nations, many dishes! Some articles that are esteemed as delicacies by certain nations are regarded with disgust by others. According to the *Pacific Record*, the Turk is seized with violent trembling at the very idea of eating oysters. The American Indians look upon an invasion of grasshoppers as a mark of especial favor from the Great Spirit, and make the best of such a time to lay up a store of provisions for the future. Buckland states that among certain people a mixture of fish nearly putrefied and soapstuds is preferred to the best butter. In Canton and other Chinese cities rats are sold at ten cents a dozen, and a hind-quarter of dog is more expensive than mutton or beef. Some of the East Indians eat serpents dried in the oven, but despise the flesh of rabbits. Lizard-eggs are a delicacy in the islands of the Pacific, and many people besides the aborigines of the Argentine Republic esteem the flesh of the skunk. Ants are eaten by many peoples, and in Siam a curry of ants' eggs often tickles the palates of the wealthy. The silk-worm is eaten with relish by the Chinese, and a dessert of roast snails is considered a fitting termination of a feast in New Caledonia.

THE DREAD OF DEATH. — Sir Lyon Playfair, in a letter to Junius Henri Browne, author of a paper with the above title, says, "Having represented a large constituency (the University of Edinburgh) for seventeen years as a member of Parliament, I naturally came in contact with the most eminent medical men in England. I have put the question to most of them, 'Did you, in your extensive practice, ever know a patient who was afraid to die?' With two exceptions they answered, 'No.' One of these exceptions was Sir Benjamin Brodie, who said he had seen one case. The other was Sir Robert Christian, who had seen one case, that of a girl of bad character who had a sudden accident. I have known three friends who were partially devoured by wild beasts under apparently hopeless circumstances of escape. The first was Livingstone, the Great African traveller, who was knocked on his back by a lion, which began to munch his arm. He assured me that he felt no fear or pain, and that his only feeling was one of intense curiosity as to which part of the body the lion would take next. The next was Rustem Pacha, now Turkish ambassador in London. A bear attacked him, and tore off part of his hand, and part of his arm and shoulder. He also assured me that he had neither pain nor fear, but that he felt excessively angry because the bear gnawed with so much satisfaction in munching him. The third case is that of Sir Edward Bradford, an Indian officer now occupying a high position in the Indian office. He was seized in a solitary place by a tiger, which held him firmly behind the shoulders with one paw, and then deliberately devoured the whole of his arm, beginning at the end and ending at the shoulder. He was positive that he had no sensation of fear, and thinks that he felt a little pain when the fangs went through his hand, but is certain that he felt none during the munching of his arm."

CHOLERA IN ASIATIC TURKEY. — Bagdad and Bussorah have been visited by an epidemic of cholera. The disease was first noticed in obscure inland spots, whence it spread to the port of Bussorah, near the head of the Gulf of Persia.

TOBACCO AND INSANITY. — The essay recently read before the San Francisco Medical Society by Dr. Shiels, on tobacco and its effects, was one deserving of exceptional credit, as well for the thoroughness of his investigations as for the general fairness of his conclusions. The doctor addressed a series of questions to the members of a leading New York medical society individually, and upon their answers his deductions are mainly based. The general trend of the decisions of this medical tribunal is that smoking in excess is bad, which few will be found to dispute. The question, "Have you ever seen a case where the brain was permanently affected by the use of tobacco?" elicited a symphonious chorus of noes all along the line, disturbed only by the solitary demurrer of

an ex-asylum superintendent, who claimed five cases of insanity due to the weed. Dr. Shiels believes there must have been some error of diagnosis here, and beyond a doubt the large majority of asylum physicians would, if canvassed, sustain him in his scepticism. It is only in a remote and subsidiary sense that the tobacco habit can be considered a factor in the production of insanity. Its opponents urge that it promotes nervousness. This depends on the individual and the amount indulged in. They also claim that it weakens moral fibre, impairs nutrition, fritters away a man's time, and induces a host of other evils. But it is not upon the brain that the penalties of its immoderate use are visited: the organs more likely to suffer are the heart, stomach, and throat.

THE ETIOLOGY OF GOITRE. — Dr. Th. Kocher of Berne, Switzerland, first of all determined accurately in what parts of his own canton goitre was common. On comparing the water of these regions with that of goitre-free neighborhoods, says the London *Lancet*, he finds that the one striking difference is that where goitre is abundant the water contains a considerable quantity of organic or organized material, and he concludes that it is this factor which determines the prevalence of goitre in any district. He finds that in certain goitrous parts particular families who have access to special water-supplies in which there is not this quantity of organic matter remain free from goitre, although breathing the same air, living on the same soil, engaging in the same occupations, and eating the same food, as their very goitrous neighbors. On comparing the chemical composition of goitrous and non-goitrous water in the Berne canton, the only other difference he found was that the quantity of sulphate of lime was less in the goitrous; but, as it is well known that goitre is often found in those who drink water richly laden with this salt, this difference cannot explain the great pathological fact. Dr. Tovel has found that the water in goitre-free parts contains a very minute quantity of micro-organisms; and it has further been shown that if goitrous water is injected into rabbits the thyroid gland is very prone to swell, although in dogs the injections have no effect. Kocher's investigations do not certainly completely clear up this difficult subject, but they throw some light upon it, and as such are to be heartily welcomed.

NOTES AND NEWS.

THE corner-stone of the new building of the New York Academy of Medicine, in West 43d Street, near Fifth Avenue, was laid with appropriate ceremonies on the afternoon of Oct. 2.

— The Brussels correspondent of the London *Times* points out that the number of foreign students at the German technical high schools is steadily increasing, especially at Berlin, where last year there were thirteen English students preparing for the professions of mechanical and mining engineers, architects, and chemists.

— The Durban correspondent of the London *Times* telegraphs that the Cape Government has decided to adopt Professor Seeley's proposal for a geological survey under his charge. He believes that other eruptive diamond-bearing tracts like Kimberley exist elsewhere.

— In a paper recently published in the "Transactions of the St. Louis Academy of Science," Nipher has shown that the average rate of rainfall on the State of Missouri during the ten years ending Dec. 31, 1887, was 196,000 cubic feet per second. During the same interval, the average river-discharge of the Mississippi River at St. Louis was 191,000 cubic feet per second.

— Speaking lately at the meeting of the British Association, Sir Lowthian Bell said, "If technical education means, as is sometimes alleged, a system by which, along with scientific instruction, manual dexterity in the use of tools, or a practical knowledge of various manufacturing processes, has to be acquired, I confess I am not sanguine as to the results. Certain I am, that if foreign workmen are more skilful in their trade, which as a rule I doubt, and which in the iron trade I deny, this superiority is not due to scientific training in the manner proposed; for in this they possess, so far as I have seen, no advantage over our own workmen. My objection to the whole system is the impossibility of any thing approaching a general application being practicable. I have not a

word to say against the rudiments of science being taught wherever this is possible. The knowledge so obtained may often give the future workman a more intelligent interest in the employment than he at present possesses; but I think they who expect much good to attend such a thin veneer of chemistry or physics do not take sufficient account of the extent of the knowledge already possessed by more highly educated men, who are now directing the great workshops of the world. It is by extending and enlarging this that substantial aid has to be afforded to industry and science, and not by teaching a mere smattering in our primary or any other schools."

— At St. Petersburg, on Sept. 7, several Pulkova astronomers and geodesists took advantage of the ascent of a balloon belonging to the Technical Society to test the accuracy of barometrical measurements. According to *Nature*, the aeronauts, who reached a height of 1,800 metres, took with them, besides chronometers and various meteorological instruments, a barometer, a barograph, and an aneroid; and they obtained, in addition to the curve of the barograph, the various heights at which the balloon stood during its ascent and descent for twenty-eight different moments. The heights obtained from these measurements will be compared with those found by geodetical angular measurements, which were made at five different places as far distant from one another as Cronstadt, the St. Petersburg University, Kolpino, and Pargolovo; that is, at distances of more than thirty miles between the extreme stations. The geodetical measurements thus secured are now being calculated.

— A botanical garden has been established in the Alps of Valais at an elevation of more than 5,600 feet above the level of the sea. It is situated on a cone-shaped knoll, which is about 200 feet high, and composed of a number of natural terraces, planted with *Pinus cembra* and larch, and faces north, east, and west. On the summit is a plateau facing the south, on which will be a little *châlet*, containing the library and herbarium of the garden. The Association for the Protection of Plants has bought the land, and converted it into an alpine garden for plants from all the alpine regions of the globe. Representatives of the floras of the Himalayas, of the American mountains, of New Zealand, of the Antarctic regions, of the Caucasus, of Siberia, of the Pyrenees, the Alps, the Carpathians, and the Ural, will be separated, and each cultivated in a special division. Naturally, M. H. Correvon was named director of this new trial-garden, in which he had already planted several thousand mountain plants. This garden is at so high an elevation that interesting observations can be made concerning the floras of all the alpine regions of the globe, on the relations of plants with insects, their acclimatization, variability, etc. Already consignments of plants have been sent to M. Correvon; and a German botanist who is travelling in the East, and is continuing the work of Boissier (M. Bornmüller), has promised some interesting specimens. Other parcels are expected from Canada, Greenland, and New Zealand. The *Gardeners' Chronicle*, from which we take these facts, invites all who are in suitable latitudes to send to M. Correvon seeds or bulbs from the northern regions in which they are travelling, for the garden of Bourg St. Pierre, which will necessarily serve later on for the temporary reception of plants from high altitudes which cannot be acclimatized directly with us, but require to be subjected to an intermediate temperature first. In this way, M. Correvon is going to try to acclimatize the celebrated but fragile *Calyso borealis*, which he hopes to introduce into cultivation by accustoming it to this intermediate position.

— The Ceylon papers announce the death of an elephant named Sella, which had served the Public Works Department for over sixty-five years. Originally, we learn from *Nature*, Sella belonged to the last of the Kings of Kandy, Sri Wickrema Raja Singha, and was one of about one hundred elephants which passed to the British Government in 1815, when the Kandyan dynasty was overthrown and the whole island passed under British rule. It was supposed at that time that Sella was fifteen years of age, but this was uncertain. In 1880 it was decided that all the elephants belonging to the Public Works Department should be sold, and Sella fell to a well-known resident of Colombo, Mr. de Soysa. The animal aided in several *keddah* operations for the capture and taming

of wild elephants, but became totally blind about three years ago. He continued, however, to work at the plough until within a short time of his death. After death, the tusks were removed, and measured five feet in length. Sella himself was eight feet high.

— Of the various orders of the fungi, the *Uredineæ*, or what are commonly known as the rust parasites, are of present interest to the scientist, in that, in their as yet comparatively unknown life-history, development, and relations to other life, many facts lie still unearthed, and to the agriculturist and horticulturist because the destructive capabilities of these pests are becoming more and more a matter of financial importance. Upon passing through fields of ripening wheat or other of the small grains, one may often be not a little surprised to find that his clothes have become quite thickly besprinkled by a yellowish-brown dust which has fallen from the plants. This is an aggregation of the spores of one of the special forms of what the farmer designates as rust. Whether he regards it as a distinct thing in itself, or as simply a diseased condition of the plant-tissues arising from the evil effects of bad drainage, want of proper light, or what not, none feels to a greater extent than he its destructive effects upon the yield of the crop. The rusts of the agriculturists, however, are but representatives of a great order, embracing more than twelve hundred species, of which it is the province of a paper on "The Heteroëcismal Pucciniæ," by Henry L. Bolley of Lafayette, Ind. (published in the *American Microscopical Journal*, vol. x.), to give an outline of the structural development and life-history of a few species.

— Charles R. Williams, in a letter to *The Evening Post*, writes, "Apropos of the frequent discovery in the Far West of fossils of horses with toes, has it ever been recalled that Julius Cæsar had such a horse? Suetonius, in his 'Life of Cæsar,' sixty-first section, says, 'Cæsar made use of a remarkable horse, with feet almost human, and hoofs divided in the manner of toes' (*Utebatur equo insigni, pedibus prope humanis et in modum digitorum ungulis fissis*). The whole passage is interesting. The horse, it appears, was foaled in Cæsar's stud. The soothsayers at once proclaimed that it betokened for its master the dominion of the world, whereupon Cæsar had it reared with the utmost care, and was the first to mount it. Indeed, it would never suffer anybody else upon its back. Later he sat up an image of the horse in front of the Temple of Venus Genetrix. Was not this an instance of what evolutionists call 'reversion'?"

— The vexed question of obtaining some recognition of physical as well as intellectual powers in competitions for the public service was well put before the British Association by Mr. Francis Galton, in his paper, "On the Advisability of Assigning Marks for Bodily Efficiency in the Examinations of Candidates for the Public Service." The curious and hardly accountable disregard of bodily efficiency in those examinations through which youths are selected to fill posts in which exceptional bodily gifts happen to be peculiarly desirable, must, he said, strike the attention of anthropologists with especial force. The reform now asked for is to give additional marks to those youths who, being fit for service, are at the same time exceptionally well fit so far as bodily efficiency is concerned. There has been a vast amount of lax assertion in reference to this matter, some saying that high intellect is often associated with stunted and weakly frame, and others pointing to instances in which high mental and high physical powers have been connected; but it is only very recently that we have secured a firm and sufficiently large basis of facts. These are the various measures of Cambridge students made during the last two or three years, and discussed by Dr. Venn, F.R.S., in an excellent memoir recently published in the *Journal of the Anthropological Institute*. "The number of those who were measured is 1,095, and they were divided into three classes: (1) high-honor men; (2) low-honor men; and (3) poll men, that is to say, those who did not compete for honors, but took an ordinary pass degree. The result was that the physical efficiency of the three classes proved to be almost exactly the same, except that there appeared to be a slight deficiency in eyesight among the high-honor men. Otherwise they were alike throughout, — alike in their average bodily efficiency, and alike in the frequency with which different degrees of bodily efficiency were distributed among them. Therefore the fact that a man had suc-

ceeded in a literary examination does not give the slightest clew to the character of his physical powers; and an opinion that the present literary examinations are indirect tests of bodily efficiency must be considered erroneous. The intellectual differences are usually small between the candidates who are placed, through the present literary examinations, near to the dividing line between success and failure. But their physical differences are, as we have just seen, as great as among an equal number of the other candidates taken at random. It seems, then, to be most reasonable, whenever two candidates are almost on a par intellectually, though one is far superior physically, that the latter should be preferred. This is practically all I propose."

— The Emperor of Brazil has announced by telegram to the Paris Academy of Sciences an observation of globular lightning on Sept. 16.

— In the laboratory of the State Mining Bureau in San Francisco, according to the *Engineering and Mining Journal*, a discovery was made recently which is highly prized. In working a specimen of sulphide or blende ore sent from a mine in Shasta County, Cal., a small piece of native metallic zinc was secured. This is the first piece of the character named ever known to have been secured in this country. Late works on metallurgy note the existence in the mines of Victoria, Australia, of the only native metallic zinc known. The Mining Bureau will endeavor to secure other specimens from Shasta County.

— In the well-known method employed by Regnault for determining the density or specific gravity of air, oxygen, nitrogen, hydrogen, and carbonic acid, we deal primarily with tares, of which the weights to be determined are the differences. The glass balloon which holds the gas is tared by a similar balloon of exactly the same volume, and of nearly equal weight, suspended from the opposite pan of the balance. The small difference of weight required to establish perfect equilibrium is alone measured with standard brass or platinum weights. Whatever may be the form of the subsequent calculation, the primary object is to obtain the tare of the empty balloon when absolutely vacuous. This known, the differences between such tare and the tare of the balloon filled with various aeriform substances, gives the weights of equal volumes of these substances under the temperatures and pressures at which the balloon was filled. The volume of the counterpoise is exactly adjusted to that of the balloon by the aid of a small subsidiary glass bulb; and by sealing up more or less mercury in this bulb it is easy to make the difference of weight such that the standard weights required to complete the equilibrium will measure the differences of tare to be determined, and no more. In the method of Regnault the tare of the empty balloon, or what was equivalent to it, was found by exhausting the balloon with an air-pump and weighing it after measuring the tension of the residual gas while the glass was surrounded by ice. But it has been shown by Aganennone and Lord Rayleigh that the results thus obtained are vitiated to a small extent by the circumstance that when the balloon is exhausted the pressure of the atmosphere determines a slight shrinkage of the external volume, which naturally disturbs the exactness of the compensation between the buoyancy of the air on the balloon and on its counterpoise. Although this shrinkage can be readily measured, as was done by Dr. T. W. Richards under Professor J. P. Cooke's direction, and still more recently by Professor Crafts, who experimented on the balloon used by Regnault, which fortunately has been preserved, it seemed desirable to develop a method by which this correction could be avoided; for, even if the new method should lead to no more accurate results than before obtained, it might serve to confirm the validity of the correction in question, and at least would give additional data towards establishing the value of important physical constants. The new method Professor Cooke has devised for the purpose consists in first taring the balloon when filled with carbonic-acid gas, and then drawing the gas through absorption tubes and determining its weight, as in the well-known method of organic analysis. This weight known, the tare of the empty balloon is obviously the difference between the first tare and the weight in question. The practical problem here presented is, however, far more difficult than that of organic analysis. In the last we expect to determine

the weight of only a few decigrams of carbonic acid within a few tenths of a milligram, while in the problem now before us we must weigh at least nine or ten grams of carbonic acid, not simply to a proportional, but to an equal, degree of accuracy. Professor Cooke only succeeded in securing such accuracy after many trials and a careful study of all the conditions involved; and the primary object in a paper published in the "Proceedings of the American Academy" (vol. xxiv.) is to describe the precautions which are essential to the success of the new experimental method. Incidentally it will appear that the results confirm in a most striking manner the high value of the specific gravity of hydrogen found by Lord Rayleigh, and the low value of the atomic weight of oxygen found by Professor Cooke at the Harvard Chemical Laboratory.

— Mr. A. J. Field, in a letter to the editor of *Knowledge*, on the question whether the female viper swallows its young for their protection, says, "Unfortunately the common adder (or viper) when in captivity is usually a very sullen reptile, and I am afraid that it would give the naturalist but little opportunity for observing its maternal affection, even if a female with young should be obtained without injuriously disturbing or killing the mother. I have kept adders several times, and now have two healthy pairs; but, although I once succeeded in taming a male adder, I have never succeeded in making a female forget that it was a prisoner. Among vipers, the females are certainly more sulky and bad-tempered than the males; so that the question will always remain an open one if we must wait until we see the young swallowed by their mothers in captivity. My illustration showing the adder with its fangs erect (referred to by Pen-y-Pan) is quite correct. Two fangs are erected when the adder prepares to strike, no more. The other teeth are merely in readiness should one or both the fangs be lost. The largest adder I have seen was three feet four inches in length." In reply to this letter, the editor of *Knowledge* writes as follows: "Dr. William Duncan, in a recently published paper on the 'fer-de-lance,' one of the *Crotalide*, or pit vipers, of the West Indian Islands, says that the female fer-de-lance devours her young in very wholesale fashion. This dangerous serpent is very prolific, and sometimes brings forth as many as two hundred young at a birth, seldom less than one hundred. Dr. Duncan says the female fer-de-lance, when about to bring forth her young, generally selects a fairly open or cleared space, a mountain footpath being a favorite spot. Along this she crawls slowly, dropping her young one by one on the way. As soon as the last has been brought forth, the faint and hungry mother turns and devours the first of her brood that meets her sight, and continues this unnatural course until satiated with her repast, or she finds no more of her offspring to glut her rapacity. Naturally many of them, three-fourths at least, escape, and these the strongest, — a clear case of the survival of the fittest. This has been observed by several planters in St. Lucia, and has been mentioned to me independently by Mr. E. S. Gordon, Mr. A. R. Maruchau, and Mr. Marius Devaux, and others of the colony."

— The opinion expressed by *Engineering* the other day, that the oil-deposits of Burmah really were enormous, in spite of the pessimist report of Dr. Noetling, the paleontologist appointed by the Indian Government to examine the petroleum-fields of Yenangyoung, has been justified by events. The Indian press has attacked the report so vigorously in support of Mr. Marvin's views, that Dr. Noetling has been compelled to explain matters in the columns of the *Pioneer*. According to this, since he made his actual survey his opinion has totally changed, and he now agrees that the petroleum-deposits are of the immense character insisted on by the author of the "Coming Oil Age." "Since I wrote my report," states Dr. Noetling, "the oil-bearing strata have been traced over a large area, only a very small part of which has hitherto been exploited, and that in a most unscientific way. I, in my report, calculated, that, under a reasonable system of working, one square mile could produce not less than 1,440,000 litres per diem. This estimate may be a little too high; but admitting only half of the estimated production, say 500,000 litres per diem per square mile of the Burmah oil fields, the production would be something enormous, as the oil-bearing strata are now known to extend, roughly speaking, over an area of not less than 100 square miles, — a fact

which was not known to me at the time I wrote my report." Here there is convincing testimony that the area of the Burmese oil-fields is very large; and the assumption is fair, that, if suitable engineering methods of exploitation be introduced, the industry can be put on a footing that will compete with, and perhaps in course of time even beat, the American oil-trade.

— At the recent meeting of the British Association, a paper by Mr. J. Spiller, on "An Experiment on Color-Blindness," was read. Mr. Spiller has had so much experience in comparing coal-tar colors and testing for color-blindness, that he thought there could be no question as to his own sight being normal. He made himself color-blind on purpose by taking, on Aug. 29, a dose of a grain and a half of santanine, the acting principle of the flowers of *Artemisia santonina*. Within less than five minutes afterwards the white tablecloth appeared of a delicate pale bluish tint, and every thing else as if regarded by spectacles of that color; ultramarine looked normal; violet and pink were good; green turned slate-color. The spectrum was visible, unbroken, but with hardly any variations. There was nothing particular in the green, which appeared fine and normal; and he could not discover the neutral gray band in the green, for which he was particularly searching. Mr. Spiller warned his audience against any repetition of this experiment, which, after all, did not reduce him to ordinary color-blindness, and the results are extremely disagreeable.

— "A Bibliography of Geodesy," by J. Howard Gore, B.S., Ph.D., has been issued as Appendix No. 16 of the report for 1887, of the United States Coast and Geodetic Survey. Although the restricted popular demand for a work peculiarly designed for the uses of the student and scientist rarely induces its author or compiler to forego its preparation, it is nevertheless likely to be a matter of serious consideration in connection with the question of publication by private enterprise. It is especially the case, that, beyond the gratification of his own scientific tastes and the undemonstrative approbation of the worthy few who appreciate the value of appliances which lessen the labor of learning, the compiler of so complete and exhaustive a bibliography of geodesy as that of Professor Gore can have had little to inspire his zeal and sustain his prolonged labor in an undertaking which at the outset involved the thorough exploration, in person, of thirty-four of the principal libraries of America and Europe, the exploration of the minor libraries by proxy, and, in addition, a searching inquiry by correspondence with all the geodesists or mathematicians of both continents. That Professor Gore has not lacked, during the preparation of his work, such inspiration as was derivable from the approbation of the competent, is attested by the generous overtures from various institutions, among them being the International Geodetic Association at Berlin, offering to undertake the publication of his book, — a most gratifying recognition of his fitness for the work, and of its anticipated value. The reason for the preparation of this work was the need of it felt by the compiler. He began in 1885 a history of geodesy, but before proceeding far it was found very difficult at any time to be sure that the literature regarding the operations of a given period had been exhausted. It was at once deemed best to collect titles as well as the works themselves. The excellent library facilities in the various technical departments in Washington emphasized the feasibility of such an undertaking. The number of titles collected for this purpose only, so far exceeded the special lists as given in the various bibliographies of mathematics, that many persons suggested an extension of the original plan, so as to make the compilation useful to others. In response to this proposition, the various libraries in Washington were carefully searched, and during two trips to Europe nearly every library facility there has been exhausted. In order to procure titles of such recent works of living authors as might escape notice, owing to delay in obtaining a place in the library catalogues, a circular letter was sent to every mathematician whose address could be obtained. Each circular had appended to it the titles of all of the known works of the recipient, with a request that omissions be supplied. This alone was the labor of several months, but was fully repaid in the gratifying assurances from many that nothing could be added, as well as in the few additional titles which tend towards making this work complete.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The "Exchange" column is likewise open.

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THERE IS LITTLE to chronicle this week of the progress in the plan for a world's fair in this city in 1892. The executive committee, composed of members of the various committees who have had the work in charge, and the sinking-fund commissioners, met on Monday and organized. Among the messages received was one from Joseph Pulitzer, subscribing \$50,000 outright, and offering to be one of twenty-five to subscribe \$100,000 each. The work of getting the property-owners within the limits of the proposed site to give the use of their land on any terms can be said to make practically no progress, as was to be expected. Meanwhile the Chicago committee, who want to see the fair in that city, urge in every way the claims of that city. They will have it, that, as Chicago is nearer the centre of population in this country, it will be more accessible for Americans, who will be those most largely represented as visitors and exhibitors. Then, again, the question of site is not a troublesome one for Chicago. It cannot be said that New York has down much yet to secure the fair, and it is certain that Chicago is making a good deal of noise; so that, unless there are some tangible results to show in New York, the popular verdict may soon be in favor of the Western city.

REPORT OF THE COMMITTEE OF THE NEW YORK STATE MEDICAL SOCIETY ON THE CAUSES AND PREVENTION OF BLINDNESS.

TWO years ago a committee was appointed by this society to investigate the question of blindness due to contagious ophthalmia in this State and in the United States, and to recommend means for its prevention. The importance and extent of the subject were so great, that at the meeting one year ago it was only possible to report progress, and ask that more time be given for the work. This was rendered necessary also by the fact that our lamented colleague, Dr. Agnew, was unable to render the valuable assistance upon which we had counted; and only recently has his place on the committee been satisfactorily filled. Even now it seems advisable to give a synopsis of the more important features of the subject, instead of attempting to go into many details which are not only of interest to the ophthalmologist, but also of importance from a sanitary point of view. The reasons for this investigation concerning the increase of blindness will become apparent if a statement is first made of the statistical facts. In presenting these it will be necessary to repeat to a certain extent the statements made in a paper by the chairman of this committee, which was published in the "Transactions of the American Ophthalmological Society" in 1887. As far as we are aware, however, these statistics have not been stated in a similar manner anywhere else. When we compare the report of the United States census of 1870, with the report of 1880, we find the population of the United States in 1870 was 38,558,371, and the number of blind then was 20,320; whereas the population in 1880 was 50,155,783, and the number of blind was 48,929; in other words, while the population of the entire country had increased 30.09 per cent, the number of blind had increased 140.78 per cent.

It is worth while, in passing, to call attention to the distribution of the blind throughout the country, and in doing so to quote the figures in the paper already mentioned. If the United States be divided into three parts, according to latitude,—the first or southerly range of States including those which lie below the 35th parallel, the second range between the 35th and 40th, and the third above that,—we find there is a constant increase in the ratio as we pass from the north toward the south. Thus there are, in the northerly range of States, 7.9 blind in each 10,000; in the middle range of States, 9.42 blind in each 10,000; in the southern range of States, 10.81 blind in each 10,000.

There is another classification of the States which is also of some interest. If they be divided according to longitude into three groups, each of which includes about fifteen degrees, we find the proportion of blindness decreases as we go from east to west. According to this division, the first group of States would lie between the Atlantic Ocean and the Mississippi River, extending to about the 15th degree of longitude west from Washington; the second would be from the Mississippi to the Rocky Mountains, or from the 15th to the 30th degree; while the third would include the strip from the Rocky Mountains to the Pacific Ocean, or from the 30th degree of longitude west. Here we find, in the easterly range of States, 10.34 blind to each 10,000; in the middle range of States, 7.90 blind to each 10,000; in the western range of States, 5.68 blind to each 10,000.

So much for the statistics relating to the United States as to the number of blind, their increase throughout the country as a whole, and their distributions in different parts of it.

Let us next consider the statistics which are available relating to New York State alone. The population in New York State in 1870 was 4,382,759, and in 1880 was 5,082,871, being an increase of 15.9 per cent; whereas the number of blind in New York State in 1870 was 2,213, and in 1880 was 4,981, being an increase of 125.07 per cent.

In a similar manner, if we compare the State census of 1875 with the United States census of 1880, we find the population in 1875 was 4,698,958, and in 1880 was 5,082,871, being an increase of 8.1 per cent; while the number of blind in 1870 was 2,256, and in 1880 was 4,981, being an increase of 111.03 per cent; in other words, the official reports show, that, during the ten years preceding 1880, blindness in the State of New York increased 8.2 times as

rapidly as did the population, and during the last five years of that decade it increased 13.7 times as rapidly.

It may be interesting also to glance at the distribution of blind throughout the State of New York. The tenth United States census gives for the first time the number of these unfortunates in the different counties of each State. These statistics are in process of publication; but, as that portion of the report was not complete when this one was being prepared, application was made to the State Board of Charities, where there is deposited a copy of the official returns relating to the blind. The assistant secretary of the board, Mr. James O. Fanning, has kindly furnished the committee with the number of blind in each county, having ascertained that by adding the lists of more than five thousand names on record. The different counties have been arranged in four groups. The first includes those which contain less than .005 of one per cent; the second, those which contain from .005 to .01 of one per cent; the third, those which contain from .01 of one per cent to 5 per cent; the fourth, those which contain more than .0521 of one per cent.

In view of these rather startling assertions in regard to the increase of blindness, it is natural that we should question the correctness of the data which lead to any such conclusions; in other words, to suspect that the apparently rapid increase was due to the difference in the manner in which the statistics were collected in 1870 as compared with 1880. In the compendium of the "Tenth Census" it is stated by Mr. Wines, who has charge of that department, that the plan was essentially the same; but, in order to satisfy ourselves more thoroughly, a letter was addressed to the secretary of the interior, asking for any additional facts in regard to this point, and we were informed that the same outline was followed in one case as in the other, simply a special blank for the blind being filled out in 1880. Of course, these examinations were by no means as accurate as would be desired from the ophthalmological point of view, for the numerators were often ignorant and careless men; but the fact remains that the errors were probably almost as great in 1870 as in 1880. Moreover, in order to verify the accuracy of some of the figures in the last census, we made application for the returns regarding the city of Buffalo; and while a number of changes of residence were made, and it was difficult to verify the reports in detail, still the information obtained, as far as it went, showed that at least that part of the report was quite as reliable as could be expected.

Let us consider next the causes which tend to make this apparent increase of blindness. In doing so, it is natural that we inquire, first of all, what were the causes which have produced that condition among those who are already blind. To determine this, it seemed advisable to undertake the examination of a considerable number of these unfortunates, and, of course, that could be done most conveniently in asylums, almshouses, where they were collected together. Accordingly a list of questions was prepared, being mainly a copy of that which was used by Hugo Magnus, a specimen of which is here appended; the name of the blind-asylum, location, date of the examination, and name of the examining physician, heading the list. 1. Name of the blind person, residence; name of father or guardian, residence. 2. Sex. 3. Age. 4. Religion. 5. Nationality. 6. For adults, occupation before blindness; for children, occupation of the parents. 7. Color of the hair. 8. Color of the iris, if possible. 9. Degree of blindness: A. Count fingers at $\frac{3}{4}$ of a metre; B. Quantitative perception of light; C. Absolute amaurosis. 10. Cause of the blindness of the right eye. 11. Cause of the blindness of the left eye. 12. Condition of the right eye. 13. Condition of the left eye. 14. Age at which right was lost. 15. Age at which left was lost. 16. Can the blindness be referred to scrofula? 17. Can it be referred to syphilis? 18. Is the blindness the result of any disease of the general system? 19. Are there any other bodily infirmities? (For those who have had small-pox) 20. Was the blindness before vaccination? and 21. Was the vaccination effectual? 22. Did the blindness occur when in a town, or when in the country? 23. Were the parents related to each other? 24. Did the parents have normal vision? 25. Were any of the relatives blind? 26. Were there any other circumstances which might be important in connection with the case?

To the president of each county medical society we then forwarded as many of these blanks as there were blind inmates of his county almshouse, and the request was made that the blanks be filled and returned to the chairman of this committee. Responses were returned in only nineteen instances, although letters with blanks were sent to all. Unfortunately, also, the answers to some of the questions were so indefinite that it was necessary to omit the cases from the classification.

A second set of examinations which the committee have to acknowledge was made by Dr. W. H. Bates of New York, acting under the supervision of Dr. H. D. Noyes. This list includes one hundred and sixty-eight cases seen at the New York State Institution for the Blind in New York. The third list contains the results of an examination of one hundred and twenty-eight inmates of the New York State Institution for the Blind at Batavia. These examinations were made by the chairman, assisted by Dr. Elmer Starr of Buffalo.

In spite of this plan of inquiry, it is difficult to determine exactly some of the causes of the blindness, even when the greatest care was exercised; but it was evident from even the most casual examination that a very large percentage of the cases were due to some form of contagious disease of the eye. It must be admitted that in the case of blind-asylums this representation, however truthful in itself, has a tendency to exaggerate the importance of the contagious disease of the eye as a cause of blindness. We do not find at such an institution those who have become blind by accident to adult life, or by those diseases which are more common in old age. A table of percentages is given by Magnus in his admirable work on blindness, in which he brought together the results of examinations by different investigators, which covered a total of 2,528 cases of blindness. In this table it may be seen at a glance how very great is the influence of those diseases which are distinctly of a contagious kind as compared with any other, over 20 per cent of those of all ages being due to contagion. In the "Annual Report of the Manhattan Eye and Ear Infirmary for the Year 1886" is given a summary of 48,509 cases, of which it was shown that 26 per cent were due to conjunctival diseases, and 25.5 per cent to corneal diseases; but one of those who made this report, when speaking of them, mentions "over 50 per cent as being communicable, or closely related to communicable diseases." In summing up, therefore, this portion of the question as to what are the causes which have produced blindness, it is fair, we think, to reply that contagion exercises by far the most important influence.

There is another aspect of this part of the subject which it is necessary to mention; we have reference to the influence which immigration has upon the increase and spread of contagious diseases of the eye, directly and indirectly. A considerable number of facts might be presented to illustrate this phase of the subject. We need only select as an example the influence exerted by one class of immigrants in relation to spreading one disease of the eye. It is generally conceded that trachoma is essentially contagious, and also is of frequent occurrence among the lower class of the Irish population. Now, the report of the Treasury Department for 1886 shows that from 1871 to 1880 there were nearly half a million of Irish immigrants in this country, — more exactly, 444,589, — and during these years the Irish formed 15.1 per cent of all the immigrants who arrived in the United States. It should be borne in mind that by far the greater part of these immigrants — at least four-fifths of them — land at Castle Garden. In order, therefore, to ascertain what care was exercised in isolating any such contagious cases which might enter there, a letter was addressed to the physician in charge of the State Emigrant Refuge and Hospital at Ward's Island, New York, inquiring as to this point; and his replies, although frankly given, were by no means such as to impress one with the care which the authorities exercise as to the disposition of such cases.

Few persons appreciate how great is the cost to the community of the maintenance of a number of persons in their midst who are not only non-producers, but who must also be fed and clothed. It is possible to make an estimate of the annual cost to the State for the maintenance of the blind. Supposing they were all provided for in an economical manner, such as can be done in large institu-

tions: it is fair to estimate the cost of keeping each one at \$2 per week, or \$104 per year; to which should be added, for clothing, \$28 per year, or a total cost of \$132. These are the figures given in the report of the Perkins Institution, a Massachusetts asylum for the blind, in October, 1874. It must be remembered, however, that these individuals are not producers; they do not earn what they otherwise would; and this amount must be added to the cost. Taking the lowest estimate of a man's wages at \$1.20 for each working day, supposing that not one among them all could become a skilled artisan, and counting the wages of the women at only 40 cents a working day, we find there is a total yearly loss to the community, cost and wages for each man, of \$404, and for each woman of \$256. This, at the very minimum estimate, amounted in New York, in 1880, to \$1,682,136, and over \$25,000,000 in 1888 for the entire United States.

If these statements are of as much importance as they would appear, it behooves us at least to inquire what steps can be taken for lessening the increase of blindness. In a paper like this it is possible only to refer briefly to points which are of primary importance, without attempting detail in any respect. At present, however, if we were to suggest a plan, it would be about as follows:—

First, To popularize with the profession and laity the necessity of some care as to the proper cleansing of the eyes of infants immediately after birth; to impress the importance of this matter upon nurses, hospital attendants, and others; and, if possible, to teach them to apply to every infant's eyes a suitable solution of nitrate of silver, which need never be stronger than two per cent, and of maximum quality.

Second, Enactments should be encouraged similar to that recently passed by the New York State Legislature in regard to the proper isolation and quarantining of children with suspicious diseases of the eyes in all residential schools and in large institutions in which children are brought together. Moreover, similar rules, with proper modifications, should be adopted in prisons, reformatories, and other institutions for adults. Especially does this hold good concerning soldiers in barracks, and sailors on shipboard.

Third, By educating the public. The laity should be cautioned as to the contagious character not only of the so-called granular lids, but especially of those severe forms of inflammation of the eye which result from inoculating it with gonorrhoeal matter. This might be accomplished by posting notices in proper places, officially signed by the Board of Health or other proper officers. Other proper notices posted in stone-quarries, machine-shops, etc., would tend to lessen the proportion of accidents to eyes, so frequent in these places.

Fourth, That steps be taken to prevent the introduction into this country, by immigration, of cases of contagious diseases of the eye.

Fifth, That renewed efforts be made by the profession to collect data relating to bacteria affecting the eye, especially to the action of the gonococcus, the so-called trachoma coccus of Michel, and other forms of either the normal or diseased conjunctiva.

In submitting this report the committee is impressed with the fact that any such presentation of statistics and recommendations is entirely inadequate to give a proper idea of the importance of the subject. In order to condense the statement as much as possible, it has been necessary to omit certain phases of the question entirely. The distribution of blindness in different portions of the State; the relation of certain causes which produce it to altitude, to density of population, and other factors,—have been entirely omitted for the sake of brevity. The bacteriological questions which it involves have been hardly referred to, although considerable data have been accumulated relating to the causes of the disease here, by a personal examination of the same causes as they exist in Egypt, in Finland, and in other countries where blindness is of frequent occurrence. It is hoped, however, that these few facts, though imperfectly presented, may arouse some slight interest in the subject, and, in doing so, tend to lessen the number of those most unfortunate and most pitiable of human beings, the blind.

LUCIEN HOWE
E. V. STODDARD
HENRY D. NOYES } *Committee.*

BOOK-REVIEWS.

The New Eldorado; A Summer Journey to Alaska. By MARTIN M. BALLOU. New York, Houghton, Mifflin, & Co. 12°. \$1.50.

MR. BALLOU, who has travelled extensively in various parts of the globe, here gives us an account of a recent trip across this continent and up the coast of southern Alaska. He is a close and cultivated observer, though not exactly of the scientific order, and his book is intended rather for popular than for learned readers. He tells his story well, except that he is sometimes too anxious to be picturesque, and occasionally falls into rhetorical exclamations that might better have been omitted. On his journey across the continent he tarried nowhere any length of time save in the Yellowstone National Park, where he spent ten days, and to which he devotes several chapters. The scenery that abounds there, however, is not easily described, and his book contains no pictures nor maps to supplement the work of the pen. Arrived on the Pacific coast, Mr. Ballou's party embarked on a steamer and sailed up the coast of Alaska, passing for the most part between the islands and the mainland. The northern parts of the territory were not visited, though the author gives some account of them taken from other authorities. Alaska has generally been supposed unfit for agricultural purposes; but Mr. Ballou assures us that all the southern part will grow any crops that will thrive on the Atlantic coast north of Chesapeake Bay. Still the agricultural resources of the region as a whole are admitted to be small; but its fisheries are well known as of great value, its timber abundant, and its mines of gold, iron, and coal, of special importance. All these resources are described at length by our author, as is also the scenery of the region he passed through. The native inhabitants, however, hardly correspond with the natural features of the country. Mr. Ballou says what good he can of them; but in laziness, filthiness, cruelty, and superstition they are like all barbarians the world over. The Eskimo live in the extreme north, while the natives of the region Mr. Ballou visited are similar to the Indian tribes of our older Territories, though superior in intelligence. Since the government has established a few schools among them, they have shown great eagerness to learn, and the increase of such schools is strongly advocated. Mr. Ballou complains that Congress has not done its duty by Alaska, and gives good reasons for this view, and he also thinks that the scientists have been backward in the work of exploration. On his part, he believes that the future of Alaska is bright with promise, and readers of his book will, to some extent at least, share his views.

Elementary Lessons in Heat. By S.-E. TILLMAN. Philadelphia, Lippincott. 8°. \$1.80.

THE author is professor of chemistry at the United States Military Academy, and prepared these lessons for use at West Point in a short course on heat. The character of the matter presented was determined to some extent by the peculiarities of the course of study at the academy; but the main point sought was to give the information most likely to be needed, and to give it without overloading with details of apparatus and methods of investigation. After a number of chapters on the elementary principles of heat, there follow several on thermodynamics,—not treated mathematically,—and the influences of heat and cold on meteorological phenomena.

Our Cats and all about Them. By HARRISON WEIR. Boston and New York, Houghton, Mifflin, & Co. 12°. \$2.

MR. WEIR is president of the National Cat Club of England; but before he was that, and before the club existed, he was the originator of the cat-show at the Crystal Palace, held in the summer of 1871.

What they talk of at the Cat Club we may believe to be the "points" of their pets, and the latest trick or show of wisdom in door-opening or wandering home of these same pets. This is what the book tells of. It is a gossipy book, full of stories of the doings of cats, sprinkled with descriptions of the innumerable kinds, with an account of their diseases, and ending with several chapters on trained cats, and cats that have learned to fish.

The author confesses to having been won over to a love for cats

from having been their hater, and writes this book that others may see the cat in all its possibilities as a useful, attractive, and affectionate domestic animal.

At the present time, when the power cats possess of finding their way home over supposed to be unknown roads is receiving some discussion, it is interesting to note that at a race of this kind held near Liege, Belgium, in 1860, the winner was a blind cat.

But it is not alone of cats as cats that our author tells us; he gives us also a glossary of terms of which the word "cat" forms a part. In fact, "Our Cats and all about Them" is a title well borne out by the contents, so far as such information as the ordinary reader is likely to seek is concerned.

A Treatise on Ordinary and Partial Differential Equations. By WILLIAM WOOLSEY JOHNSON. New York, Wiley. 8°. \$3.50.

THIS treatise on differential equations is in continuation of the series of mathematical text-books, by the same author, of which have already appeared the differential and integral calculus. Professor Johnson is professor of mathematics at the United States Naval Academy at Annapolis, and it may be that some will trace in the book methods which are said to be characteristic of the United States Army and Navy mathematics; but it must be said that the plan pursued is likely to lead to a clearer understanding by the student. The object is to give a knowledge of the subject, so far as it is likely to have practical application; and in this it is safe to say that Professor Johnson has succeeded.

A Graduated Course of Natural Science, Experimental and Theoretical, for Schools and Colleges. Part I. By BENJAMIN LOEWY. London and New York, Macmillan. 12°. 60 cents.

THOSE who are trying to introduce sane methods of science-teaching into our schools, will find in Mr. Loewy's little book much that is suggestive and of value. Mr. Loewy was at one time the science master in the recently discontinued International College

just out of London, and has had twenty years of experience in teaching physics and chemistry to large classes, both in the lecture-room and in the laboratory. In this first part of his series he confines himself to the physical phenomena which arise on account of the mutual attraction of particles of matter, but he has limited himself to those interactions of matter that his experience shows him to be really intelligible to young beginners. This sketch of the author's purpose may be misleading, as the following summation of some of the chapter-heads will show: "Pressure in Liquids," "Filtration," "Cause of Winds," "Hard and Soft Water," "Action of Animals and Plants on Air," etc.

AMONG THE PUBLISHERS.

THE Longmans will publish shortly two volumes of American short stories,—"Gerald French's Friends," tales of California Irishmen, by George H. Jessop; and "A Family Tree and Other Stories," by Brander Matthews.

—The October number (No. 43) of the Riverside Literature Series (published quarterly during the school year 1889-90 at 15 cents a number, by Houghton, Mifflin, & Co., Boston) contains the "Story of Ulysses among the Phæaciens," from William Cullen Bryant's "Translation of Homer's Odyssey." This selection, which has been described by one of our most famous Greek scholars as the finest and at the same time simplest bit of imaginative writing in all Greek literature, is a complete story in itself. It tells of Ulysses' discovery by Nausicaä, the daughter of King Alcinoüs, his reception by the king, the festivals given in his honor, his song of the Trojan Horse and the Fall of Troy, and his departure for his home in Ithaca, and gives a most excellent picture of the life, manners, and customs of the ancient Greeks. This number of the Riverside Literature Series will be found of especial value for use in schools. It is rarely possible to make a selection from a great poem like the "Odyssey" at once so complete in itself, so fascinating, and so instructive, as is this "Story of the Adventures of Ulysses among the Phæaciens."

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— Charles Scribner's Sons have ready the second volume of the "Cyclopedia of Music and Musicians," which contains, besides many text portraits of musicians and singers and facsimile scores and autographs, full-page etched portraits of Gounod, Handel, Haydn, Lasso, Liszt, Lully, Mendelssohn, Meyerbeer, Mozart, Paine, Palestrina, and Purcell; and a new book by Donald G. Mitchell (Ikt Marvel) entitled "English Lands, Letters, and Kings, from Celt to Tudor."

— Harper & Brothers published on Oct. 11 a volume on the "Constitutional History of the United States," by George Ticknor Curtis. It is a revised edition of Mr. Curtis's earlier work, which, though published thirty years ago, remains to-day the established authority on the history of the formation and adoption of the Constitution. Many years ago Silas Wright, then United States senator from New York, requested George Bancroft to write a life of Martin Van Buren, and furnished a complete collection of papers and letters as materials for the work. From these and other sources Mr. Bancroft compiled a biography which Van Buren, when he saw the manuscript, pronounced to be authentic and true as a record of facts relating to himself. Party feeling ran high at the time, and Mr. Bancroft deemed it best to postpone the publication of the work until the character and career of Van Buren could be judged without prejudice. Nearly coincidentally with the author's eighty-ninth birthday, Messrs. Harper & Brothers published this biography, which is entitled "Martin Van Buren to the End of his Public Career." In his preface Mr. Bancroft says, "In my recent revision of the original manuscript, I have made no change that could affect Van Buren's approval of it as thoroughly correct."

— Messrs. John Wiley & Sons have just issued "A Chart Relative to the Composition, Digestibility, and Nutritive Value of Food," prepared by Professor Henry A. Mott, Ph.D., LL.D. The subjects of the chart are arranged under the following heads: "Relative Value of Foods;" "Digestibility of Foods;" "Most Easily Digested Substances;" "Daily Proportions of Carbon and Nitrogen in the Food of Different Ages per Pound Weight of the Body;" "Substances absorbed and discharged during Twenty-four Hours;" "Amount of Digestive Fluids secreted Daily, and the Proportion of their Chief Constituents;" "A Dinner that will digest within Two Hours;" "Uses of Food in the Body;" "Way in which Nutrients are used in the Body, and supply it with Strength;" "Nitrogen and Carbon required Daily to support Life;" "Alimentary Substances in a Dry State required Daily for the Support of an Ordinary Workingman of Average Height and Weight;" "Standards for Daily Diets;" "Standard for Ordinary Man doing Moderate Muscular Work;" "Warmth and Strength derived from Various Articles of Food and Drink;" "Composition of Various Meats;" "Composition of Meat Extracts;" "Composition of Fish and Shell-Fish;" "Composition of Vegetables;" "Composition of Farinaceous Foods;" "Composition of a Hen's Egg;" "Composition of Cocoa;" "Composition of Coffee;" "Composition of Tea;" "Composition of Various Kinds of Cheese;" "Analyses of Cheese;" "Analysis of Milk;" "Analysis of the Products of the Dairy;" "Analysis of Condensed Milk;" "Analysis of American Wines;" "Approximate Analysis of a Man;" "Fruits arranged in the Order of their Contents of Free Acid expressed as Hydrate of Malic Acid;" "Fruits arranged in the Order of their Contents of Sugar;" "Fruits arranged according to the Proportion between Acid, Sugar, Pectin, Gum, etc.;" "Working Power of the Human Body;" "Thermotic Power and Mechanical Energy of Ten Grains of the Material in its Normal Condition when completely burned in Oxygen and when oxidized into Carbonic Acid;" "Water and Urea in the Animal Body;" "Ingredients and Food-Materials;" "Quantity of Nitrogen and Carbon in 100 parts of Various Alimentary Articles." The price of the chart, mounted on rollers, is \$1.25.

— Ticknor & Co. have just published a limited edition of the late Carl Pfeiffer's work, "American Mansions and Cottages," containing one hundred folio plates in a portfolio. They have also just ready a one-volume edition of Charles Wickes's "Illustrations of Spires and Towers of the Mediæval Churches of England."

— Edward Atkinson has contributed an article on "The Art of Cooking," which will open the November *Popular Science Monthly*. In it he points out what enormous quantities of food and fuel are wasted in ordinary cooking, and describes the "cooker" and "oven" invented by him, which need but a wonderfully small quantity of oil or gas, and cannot spoil the food. Col. Garrick Mallery's address before the American Association for the Advancement of Science, on "Israelite and Indian," will be published in the same number. It shows the remarkable similarity between the mortuary customs and religious beliefs and practices of the two peoples, but Col. Mallery draws a conclusion from this parallel unfavorable to the suggested descent of the Indians from the "lost tribes." "The Decadence of Farming," as shown by the number of farms for sale and the prevalence of farm mortgages, will be explained by Mr. Joel Benton in this number (the writer maintaining that our modes of taxation bear more heavily on the farmers than on any other class); and there will be a copiously illustrated article on "Sensitive Flames and Sound-Shadows," by Professor W. LeConte Stevens, embodying some very curious instances in which sound has been found to behave like light.

— Casey's "Treatise on Spherical Trigonometry," published by Longmans, Green, & Co., London and New York, is intended as a sequel to the author's "Treatise on Plane Trigonometry." The book contains much that is new; the author, as is customary now, having culled rich material from the latest mathematical papers. There is a large number of examples furnished, which are believed to cover the ground completely. Professor Casey is professor of higher mathematics and mathematical physics at the Catholic University of Ireland.

— The Forest and Stream Publishing Company announce for publication "Pawnee Hero Stories and Folk-Tales," by George Bird Grinnell. The book is said to present a faithful delineation of the Indian's character and his daily life.

— Mr. George Curzon, M.P., who made a detailed examination of the Transcaspian country last fall, has written an account of his travels; and his "Russia in Central Asia in 1889" and the "Anglo-Persian Question" will be published soon by Longmans, Green, & Co., both in London and New York. It will contain maps from the latest investigations, some forty illustrations, and a bibliography.

— S. C. Griggs & Co., Chicago, have just issued a translation from the Danish, by Professor Julius C. Olson of the University of Wisconsin, of Peter Lauridsen's work entitled "Vitus Bering, the Discoverer of Bering Strait." They will publish soon a new edition, from new plates, of Dr. J. R. Boise's "First Lessons in Greek," revised, with the advice and approval of the author, by Professor G. Pettengill of Ann Arbor High School.

— Messrs. Ginn & Co. announce for publication "Russell's Chromatic Chart," by E. P. Russell, director of Conservatory of Music, and teacher of music in the State Normal School, Oneonta, N.Y. This chart is designed to teach music-students the habit of thinking the tone as well as reading it, so that the mind may perceive the tone before the voice executes it. It is of great help in teaching the intervals by quick transitions from one key to another. It is of the greatest value in the study and execution of the chromatic scale. The teacher will observe that the chart will, if carefully and intelligently used, help the articulation and enunciation to a remarkable degree. It is believed that the chart is a practical help, of which every wide-awake and progressive teacher will desire to make constant use. The size of the chart is 42 inches by 55 inches. They have also just published the "Common School Song Reader," by W. S. Tilden, teacher of music in the State Normal School, Framingham, Mass., and will issue during the autumn and winter of 1889, "Open, Sesame!" edited by Mrs. B. W. Bellamy and Mrs. M. W. Goodwin, — a collection of prose and verse, comprising more than a thousand selections, carefully edited, and arranged for com-

mitting to memory. It is in no sense an elocutionist's manual, the editors having made the first test of each selection, "Is it worth learning?" and the second, "Is it adapted to recitation?" The book is representative of English literature, and also comprises many translations from foreign sources. Its various departments contain many of the familiar classics, and also many extracts from late literature never before included in such a collection. It is arranged in three volumes, each complete in itself, and specially adapted to the age for which it is intended. Volume I. is designed for children from four to ten years old; Volume II., for those from ten to fourteen; and Volume III., for the oldest students. The purpose of the book is to train the memory, to educate the literary taste, and to supply the student with the long-needed standard collection of poetry and prose for recitation.

—"The Batrachia of North America," by E. D. Cope, issued as Bulletin No. 34 of the National Museum, embraces the results of a study of the characters of the species, with their variations, which has been rendered effective by the full collection contained in the National Museum, and which this work thus illustrates. Besides this descriptive part, there are presented the results of a thorough study of the osteology of the class, based on the material contained in various museums of the United States and Europe. These results are expressed largely in systematic form, in the belief that descriptive zoölogy will never be complete until the structure is exhausted in furnishing definitions. Wherever practicable, reference is made to the relations between the extinct and living forms.

LETTERS TO THE EDITOR.

The Telephone for the Prediction of Thunder-Storms:

IN 1886 the writer had an experimental telephone line on the Yale campus which proved to be of some value in the prediction of

one phase of the weather. As is well known, the approach of an electrical storm produces sounds in the telephone something like the "sound of a distant rocket, or the quenching of a drop of melted metal in water."

One afternoon shortly after the erection of my line, on a seemingly perfectly clear day, I heard the sounds in the telephone. Although at the time there was no sign of an approaching storm, two hours later the clear weather had vanished, and a severe storm swept over the city.

On another occasion, when an excursion had been planned, as the weather was cloudy and rather doubtful, the telephone was consulted, but gave no evidence of electrical disturbance; and the afternoon passed "fair weather."

In several like instances I made use of the instrument with very satisfactory results. Since then I have had no opportunity for continuing my observations, but I think that similar use of the telephone might be of value to individuals or to local communities.

HARVEY B. BASHORE.

West Fairview, Penn., Oct. 14.

Map of Niagara Falls.

ON the 88th sheet of the new "Stieler's Hand Atlas," No. 6 of the United States, is a small map of Niagara Falls, which contains a curious misprint. The course of the river is well shown, colored red on the Canadian and green on the United States side. The horseshoe fall is represented, but the American fall is obliterated. The coloration for the bank extends all round Goat Island; which, however, instead of being an island, is a peninsula. In other words, there is no American fall represented on the map except in name.

JOSEPH F. JAMES.

Washington, D.C., Oct. 10.

INDUSTRIAL NOTES.

The Automatic Type-Writer.

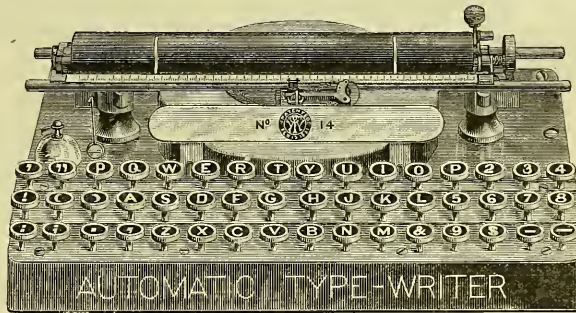
ALL are familiar with the ordinary styles of type-writer on the market, and some have asked if there could not be made a type-writer which should cost less and be more portable by being smaller in size and weight. Several attempts have been made to meet this want, and this week we have an opportunity of describing the "Automatic," which it is claimed serves the purpose well.

Thus, *I* occupies less space than *H*, and *H* less again than *M*.

There are other interesting features to the machine, but we have said enough to show that those interested should examine the merits of the "Automatic."

The Offrell Dynamo.

ALTHOUGH the construction of dynamos and motors has reached such a state of perfection, as regards efficiency and workmanship,



In size the "Automatic" is 11½ inches long, 8½ wide, and 4 high. Its weight is 10 pounds, and with its case, only 12½.

The key-board of 48 keys has been designed with a view to furnishing all the characters in common use. The type and type-bars are so arranged that the type is inked by spring contact with an ink-pad against which it rests when in repose, and the type-bars are so guided in their motion as to give very accurate alignment. No ribbon intervenes between the type and paper, the impression being thus the clearer. It is claimed for the "Automatic," that, as the paper-carriage is light, as the space through which the type must move is small, and as its return motion is accelerated by a spring, the speed of writing is much increased.

By an ingenious device the spacing is made to suit the letter.

that any improvement in this direction is not likely to be made, yet many of the electric machines in the market to day are far from being samples of either of the above qualities; and, to be sure, if we consider them from the point of simplicity and economical construction, there is a big margin for improvement.

Setting out with the object in view of designing a dynamo, that, with minimum expenditure of material, should give maximum output, and at the same time the cost of its manufacture be a minimum, Mr. Olof Offrell, electrical engineer, has designed and built such a dynamo.

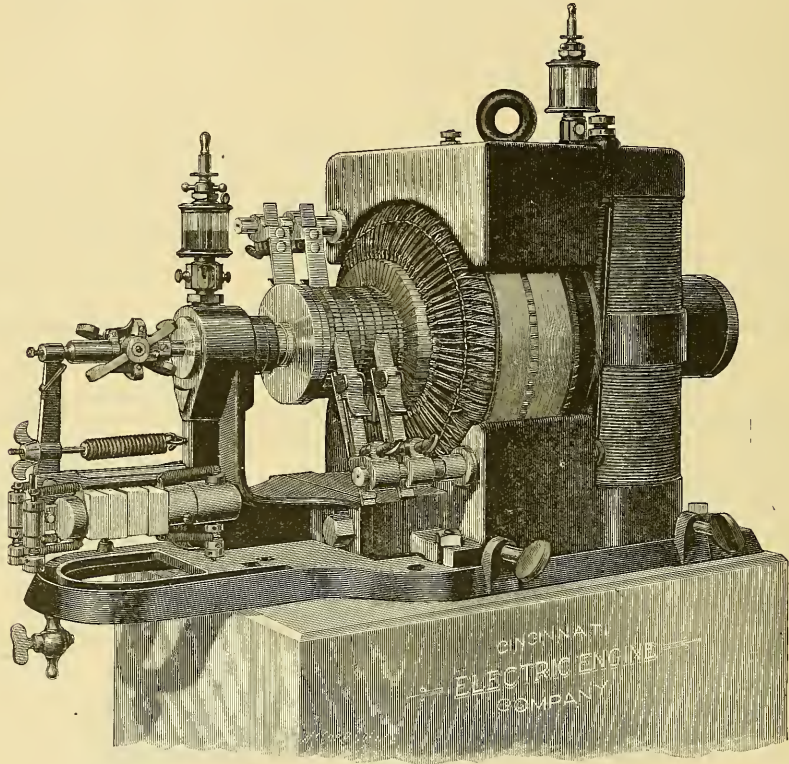
To gain this purpose, only the very best material is used; also advantage is taken of the latest development in dynamo-building. The field-magnet cores are of the very best wrought iron, the pole-

pieces being the softest possible cast iron. The magnets and the pole-pieces form a solid frame, being held together by nuts on the tapped ends of the magnets. The armature, which is of the Gramme type, is supported by brackets of brass bolted to the pole-pieces, and the shaft runs in phosphor-bronze bearings fitted to the brackets. The armature is made of annealed wrought-iron wire supported by a three-armed spider of brass.

The brush arrangement is of improved construction, original with the designer, and enables the tension of the brushes to be adjusted without disturbing the setting of the same, and without exposing the attendant to shocks from the machine. This is effected by an insulated thumb-screw, — aside from the thumb-screw that holds the brushes, — which clamps the brush-holders to the brush-pin. The rocker-arm is also movable. The cables from the brushes are carried to a board on top of the machine, on which are

two horse-power, and, being very compact, occupies a floor-space of only ten by nineteen inches, with a height of twelve inches.

The armature is of the Gramme ring type, and the pulley end of the shaft has its bearing in the neutral part of the field-magnet. The shaft is of English tool steel of the best quality, the bearings are ground true on dead centres, and the armature is so attached as to practically constitute a portion of it, avoiding all danger of loosening, — a point of importance in this class of machinery. Ball bearings are used, admitting of self-alignment. They are made of phosphor-bronze, hand-reamed, and of considerable length, to give an even bearing surface and prevent all tendency to heat. The commutator sections are of drop-forged copper, hard, and of almost pure metal. The commutator is attached to the armature in a novel manner, and can be renewed without disturbing the armature wires.



CINCINNATI ELECTRIC ENGINE COMPANY'S MOTOR.

placed the terminals; also a switch for short-circuiting the field-coils, in case it is desired to "paralyze" the machine while running. Thus the switch and terminals are always in sight, and can be attended to at once, if necessary.

A remarkable feature of this dynamo is that it requires exceedingly small floor-space for its capacity, — a feature of great value when the space is limited, as on board of ships, etc. The floor-space required for a twelve-light dynamo is only twenty-four by twenty-four inches.

A New Constant-Current Electric Motor.

THE electric motor shown in the accompanying illustration is one of a series manufactured and placed on the market by the Electric Engine Company of Cincinnati. It is intended to run on a constant-current or arc-light circuit, has a maximum capacity of

The armature is accurately adjusted to a running balance, and provided with means for forced ventilation. The ordinary rocker-arm supporting the brush-holder has been dispensed with, thus rendering the important parts more readily accessible.

The governor, the construction of which is shown in the figure, maintains the speed constant under all variations of load from zero to the full designed load of the machine, and is remarkably simple, having but one wearing point. It regulates solely by variation of pressure, practically eliminating motion and wear: hence it has great durability and sensitiveness.

For constant potential circuits, this company manufactures motors of similar design, but differing in detail. As they regulate automatically, they do not require governors. These are made for standard potentials of 110, 220, and 550 volts, though they may be made for any specified voltage.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

Will exchange "Princeton Review" for 1883, Hugh Miller's works on geology and other scientific works, for back numbers of "The Auk," "American Naturalist," or other scientific periodicals or books. Write.—J. M. Keck, Chardon, Ohio.

A collection of fifty unclassified shells for the best offer in bird skins; also skins of California birds for those of birds of other localities. Address: Th. E. Stevin, 2413 Sacramento St., San Francisco, Cal.

I have forty varieties of birds' eggs, side blown, first class, in sets, with full data, which I will exchange for books, scientific journals, shells, and curios. Write me, stating what you have to offer.—Dr. W. S. Stronch, Bernadotte, Fulton County, Ill.

"I wish to exchange *Lepidoptera* with parties in the eastern and southern states. I will send western species for those found in other localities."—P. C. Truman, Volga, Brookings Co., Dakota.

Shells and curiosities for marine shells, curiosities or minerals address W. F. Lerch, No. 308 East Fourth St., Davenport, Iowa.

I want to correspond and exchange with a collector of beetles in Texas or Florida.—Wm. D. Richardson, P. O. Box 223, Fredericksburg, Virginia.

100 botanical specimens and analyses for exchange. Send list of those desired and those which can be furnished, and receive a similar list in return. Also cabinet specimens and curiosities for the same. Scientific correspondence solicited.—E. E. Bogue, Orwell, Ashla, County, O.

I will sell to chapters or individual members of the Agassiz Association, 25 fine specimens of fossil plants from the Dakota group (cretaceous), correctly named, for \$2.00. Send post office order to Charles H. Sternberg (author "Young Fossil-Hunters"), 1033 Kentucky Street, Lawrence, Kan.

One mounted single achromatic photographic lens for making 4 X 5 pictures, in excellent condition; also one "new model" double dry-plate holder (4" X 5") for fine geological or mineralogical specimens, properly classified.—Charles E. Frick, 1019 West Lehigh Avenue, Philadelphia, Penn.

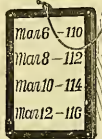
The undersigned wishes to make arrangements for the exchange of *Lepidoptera* of eastern Pennsylvania for those from other localities. All my specimens are named and in good condition.—Charles S. Westcott, 613 North 17th Street, Philadelphia, Penn.

California onyx, for minerals and coins not in my collection.—W. C. Thompson, 612 East 141st Street, New York, N.Y.

Publications received at Editor's Office, Sept. 23-Oct. 12.

ALLSOP, F. C. Practical Electric Bell Fitting. London and New York, E. & F. N. Spon. 142 p. 12°. \$1.25.
 BALLOU, M. M. The New Eldorado: A Summer Journey to Alaska. Boston, Houghton, Mifflin, & Co. 352 p. 12°. \$1.50.
 BERNTHSEN, A. A Text-Book of Organic Chemistry. Tr. by George McGowan, Ph.D. New York, Van Nostrand. 544 p. 12°. \$2.
 BLAVATSKY, H. P. The Key to Theosophy. London, Theosoph. Publ. Co., New York, W. Q. Judge. 307 p. 12°. \$1.
 BURT, MARY E. Literary Landmarks. Boston and New York, Houghton, Mifflin, & Co. 152 p. 16°. 75 cents.
 CHAMBERS, G. F. A Handbook of Descriptive and Practical Astronomy. I. The Sun, Planets, and Comets. 4th ed. Oxford, Clarendon Pr. 676 p. 8°. (New York, Macmillan, \$3.25.)
 COOK BOOK, Presbyterian. Compiled by the ladies of the First Presbyterian Church, Dayton, O. Dayton, Historical Publ. Co. 1836. 175 p. 12°. \$1.
 DARWIN, C. The Structure and Distribution of Coral Reefs. 3d ed. New York, Appleton. 344 p. 12°. \$2.
 ENSEÑANZA Primaria, Boletín de. Vol. I. No. 1. Montevideo, Dornale y Reyes. 80 p. 8°. \$1.
 FERREL, W. A Popular Treatise on the Winds. New York, Wiley. 505 p. 8°. \$4.
 HOUSTON, E. J. A Dictionary of Electrical Words, Terms and Phrases. New York, W. J. Johnston Co. 640 p. 16°. \$2.50.
 KAPP, G. Alternate-Current Machinery. (Van Nostrand Science Series, No. 96.) New York, Van Nostrand. 190 p. 24°. 50 cents.
 KLEMM, L. R. European Schools; or, What I saw in the Schools of Germany, France, Austria, and Switzerland. New York, Appleton. 419 p. 12°. \$2.
 LANGSTON, A. Notes Biographiques sur J.-C. Houzeau. Bruxelles, F. Hayez. 120 p. 8°. \$1.
 LESLEY, J. P. A Dictionary of the Fossils of Pennsylvania and Neighboring States named in the Reports and Catalogues of the [Pennsylvania Geological] Survey. Harrisburg, Geol. Surv. 437 p. 8°. \$1.
 MILLS, W. A Text-Book of Animal Physiology. New York, Appleton. 700 p. 8°. \$2.
 MOTT, H. A. A Chart Relative to the Composition, Digestibility, and Nutritive Value of Food. New York, Wiley. 16. \$1.25.
 MURDOCK, H. The Reconstruction of Europe. Boston and New York, Houghton, Mifflin, & Co. 421 p. 12°. \$2.
 NICHOLS, W. F. Topics in Geography. Boston, Heath. 174 p. 12°. 45 cents.
 PARSONS, L. C. Hygiene and Public Health. Philadelphia, Blakiston. 471 p. 12°. \$2.50.

REDWAY, J. W. The Teacher's Manual of Geography. Boston, Heath. 174 p. 12°. 55 cents.
 SARGENT, C. S. Scientific Papers of Asa Gray. Vol. I. Reviews of Works on Botany and Related Subjects, 1834-37. Vol. II. Essays; Biographical Sketches, 1831-36. Boston and New York, Houghton, Mifflin, & Co. 900 p. 8°. \$5.
 STEPHENS, C. A. Living Matter: Its Cycle of Growth and Decline in Animal Organisms. Norway Lake, Me., The Laboratory Co. 107 p. 12°. \$1.
 TILDEN, W. S. Common School Song-Reader. Boston, Ginn. 176 p. 12°. 45 cents.
 WOMAN'S CYCLE, THE. Vol. I. No. 1. New York, Mrs. C. J. Haley. 20 p. 4°. \$2.50 per year.



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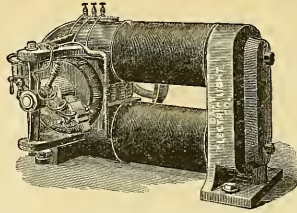
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CALENDAR OF SOCIETIES.

Philosophical Society, Washington.

Oct. 12. — Everett Hayden, Hurricanes in the Bay of North America; Frank Baker, Work of the Life-Saving Crews during the Recent Hurricane; Romyn Hitchcock, The Action of Light on Silver Chloride.

Engineers' Club, St. Louis.

Oct. 9. — President Meier presented a discussion of a new tractor recently invented by H. L. Van Zile, an engineer of Albany, New York. The invention had resulted from certain mathematical investigations, and rendered it possible to make the total power, or pulling force, available for traction. A model had been made, which easily mounted a 20-per-cent grade, while the same model without the improvement could ascend only a 10-per-cent grade. In the discussion, Robert Moore called attention to the similarity of this device to the Fell tractor, which was in successful use on the Summit Railway, over Mount Cenis. Professor Gale spoke of the probable advantages this motor would have for street-railway work, where the grades were serious, and where objections existed to the use of other forms of tractors. Mr. C. H. Sharman then read a paper on "Some Reminiscences Connected with the Construction of the Union Pacific Railroad." Mr. Sharman entered the engineering department of this road in 1866 as rod-man, and remained on the work in various capacities until the completion of the road in 1869, when he held the position of division engineer. A graphic description was given of the difficulties met with in engineering construction at that day at points remote from civilization. Considerable interesting engineering data were presented, but the paper in general deviated somewhat from the strictly technical papers usually presented, being of a more popular and entertaining character.

American Institute of Electrical Engineers, New York.

Oct. 15. — A paper was read by Mr. Thomas D. Lockwood, member, entitled "Electrical Notes of a Transatlantic Trip." It embraced some observations on telegraphy; description of the London operating

room, the different instruments employed, the pneumatic tubes, and a brief discussion of governmentally owned telegraphs; electric lighting as carried on in England; the practice of telephony in Great Britain, certain peculiarities in apparatus and methods; also the use of electric motors. Some of the electrical features of the Paris Exposition were canvassed.

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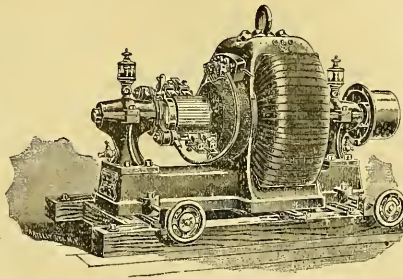
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Overland Monthly.....	4.00	6.80
Political Science Quarterly.....	3.00	5.80
Popular Science Monthly.....	5.00	7.80
Popular Science News.....	1.00	4.25
Portfolio, The.....	7.50	10.30
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Public Opinion.....	3.00	5.80
Popular Science News.....	5.00	7.80
Puck (German).....	5.00	7.80
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Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the "Wants" inserted under this head FREE OF COST, if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.

COLLEGE ALUMNI AND PHYSICIANS.—The American Academy of Medicine is endeavoring to make as complete a list as possible of the Alumni of Literary Colleges, in the United States and Canada, who have received the degree of M.D. All recipients of both degrees, literary and medical, are requested to forward their names at once to Dr. R. J. Dunglison, Secretary, 814 N. 16th Street, Philadelphia, Pa.

WANTED.—A teacher of science in an **ENDOWED MALE COLLEGE** in Ky. Salary \$1200.00. Address "M. H." care of *Science* 47 Lafayette Place, N.Y.

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PHYSIOLOGY AND HYGIENE.—A Fellow of the Mass. Med. Society, Member of the Suffolk District Medical Society, and former Assistant Editor of The Annals of Gynecology, desires a position as instructor in Physiology and Hygiene. Address "N," 47 Lafayette Place, N.Y. City.

WANTED a young man with some knowledge of mineralogy to assist in our Mineral Department. A. E. FOOTE, 1223 Belmont Av., Philada., Pa.

MECHANICIAN.—An optician and maker of instruments of precision of experience would be glad of a position where his skill would be valued in connection with some higher educational institution. Address G. J., care of *SCIENCE*, 47 Lafayette Place, New York.

LIGHTNING.—Concise descriptions of the effects of lightning discharges are desired. State whether the object struck was provided with a lightning rod, the character of the rod, and the way in which it was set up. Beginning at the top, describe briefly the effects. State whether there was any smoke or dust raised, and whether there was any odor. Any reports of recent and of especially interesting discharges will be published in *SCIENCE*.—*Science*, 47 Lafayette Place, New York.

WANTED.—By a large manufacturing house, an intelligent, energetic young man about twenty years of age, to make working drawings of electrical instruments from free-hand sketches and verbal assistance. Must be able to execute tinted drawings and tracings as well, and have a fair knowledge of general physics and principles of electrical measuring instruments. One who has had some practice in brass and machine work preferred, as also one who will remain and learn the business. Specimens of work required. Address, stating salary expected, experience and references, E. G. W., *SCIENCE* Office, N.Y. City.

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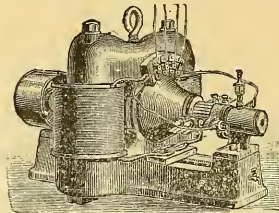
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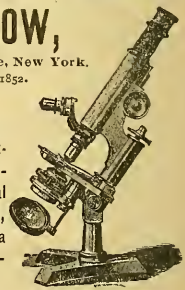


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A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

SEVENTH YEAR.
VOL. XIV. No. 351.

NEW YORK, OCTOBER 25, 1889

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A REMARKABLE ELECTRIC-LIGHT PLANT.

THE Heisler plant operated by the Illinois Valley Electric Light and Power Company is one of the most remarkable incandescent electric-light plants in the world. We illustrate some of its prominent features. The location and arrangement of this plant, so characteristic of the Heisler system, deserve more than ordinary notice. The area covered by one circuit has never been equalled in the history of incandescent lighting. Their circuit of forty-five

The Illinois Valley Electric Light and Power Company, was organized at Ottawa, Ill., in the spring of 1889. Desiring their operating expenses to be a minimum, they looked around for a suitable location. They were fully impressed with the advantages of water-power, and found an excellent site at Marseilles, eight miles distant. The advantages of the incandescent light were such as to lead the projectors of the enterprise to favor its adoption, but some investigation into the cost of the circuits required by some systems revealed the fact that the investment for coppe

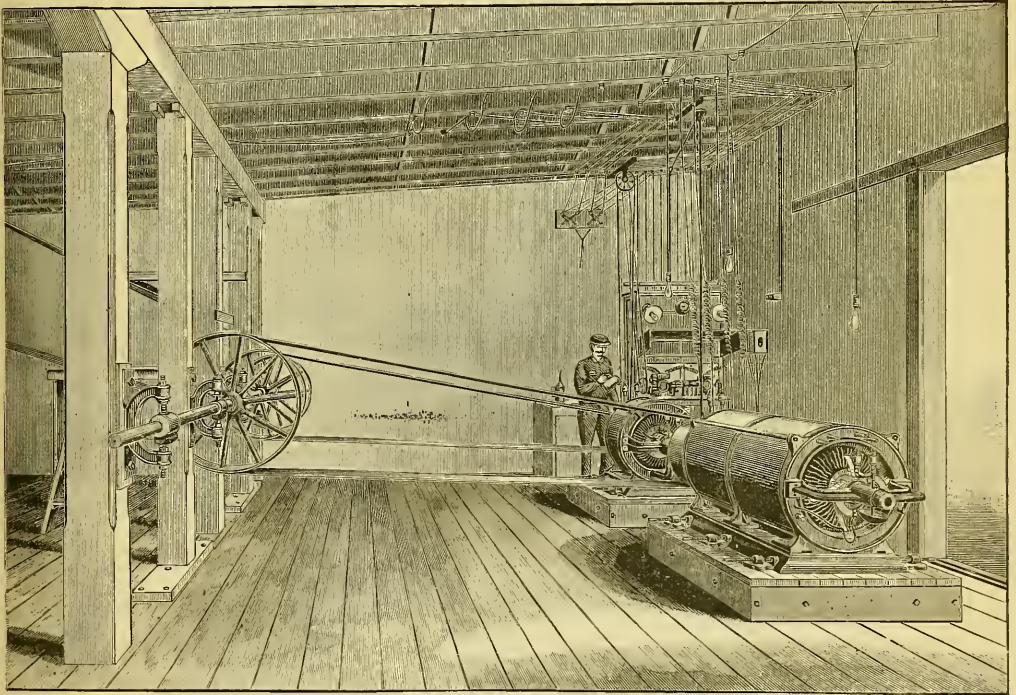


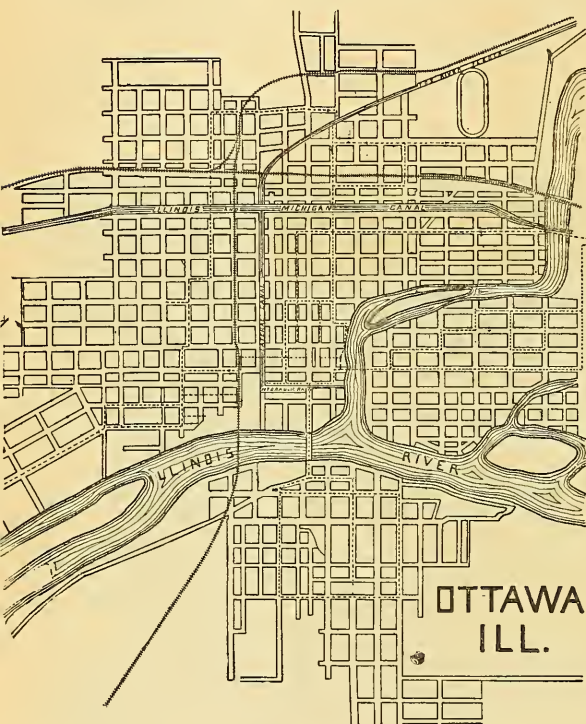
FIG. 1.—INSIDE VIEW OF THE HEISLER DYNAMO-ROOM, MARSEILLES, ILL.

miles is, so far as we have been able to learn, the longest incandescent circuit in the world, nor do we know of a longer arc circuit. Not only is this the case, but the investment in copper for the circuits is a very small part of the total cost of the installation. Another fact characteristic of this system is that the most distant lights burn fully as brightly as those near the dynamos. The results have been eminently satisfactory, both to the parties using the light, and the citizens who inaugurated the enterprise, and carried it through to success.

would be prohibitive. Although somewhat discouraged by this view of the matter, they did not cease their investigations. Hearing of the claims made regarding the adaptability of the Heisler system of St. Louis for such locations, they were induced to look into its merits. The investigation resulted in the adoption of the system, and the installation of an extensive plant at Marseilles. The lights were started in the summer of 1889, and have been successful from the beginning. Arrangements are now being perfected to extend the circuits from Marseilles to Seneca, located five

miles distant in the opposite direction from Ottawa. The capacity of the original apparatus is now almost fully taken up, and enlargements are necessary.

From the accompanying engravings an excellent idea may be secured of the peculiar features of the plant mentioned. The outline map of La Salle County (Fig. 3) shows the relative location of the cities of Ottawa, Marseilles, and Seneca, also the Illinois River, and the Illinois and Michigan Canal. It will be seen that the lighting done by this plant extends for a distance of thirteen miles along the Illinois River, from the centre to the border of La Salle County. Fig. 2 is an outline map of the city of Ottawa. The incandescent circuits are indicated by dotted lines, and can be seen entering the city from the east, on the right of the engraving. This circuit is constructed throughout of No. 8 wire, hard drawn and weather-proof. Fig. 4 is a view of the company's buildings.



FIGS. 2 AND 3.—MAPS OF OTTAWA, ILL., AND OF LA SALLE COUNTY, ILL.

The large building with the cupola, in the foreground, contains the water-wheels, and the small building to the left is the dynamo-room. This engraving also shows the flume as it enters the building, and the circuits leaving the station. Fig. 1 is an inside view of the dynamo-room, showing the machines in position, together with the shafting, pulleys, and belting by which the dynamos are driven. The engraving also shows the method of connection between the dynamo and automatic regulator. On the whole, this station may be ranked as being highly typical of modern progress in incandescent electric-lighting.

CONDENSED FRUITS AND VEGETABLES.

THE introduction of preserved or condensed foods, both of animal and vegetable origin, in hermetically sealed tins, has developed to an enormous extent of late years. One of the most successful of the recent introductions is undoubtedly the pine-apples

that are imported from Singapore. Many persons who have an objection to tinned foods generally, have pronounced these to be of excellent quality and flavor, and though they are to be obtained almost at any grocer's, and at a very cheap rate, they are not in such great demand as might be expected. The prejudice against new products or preparations is difficult to overcome, and this prejudice is more general even among the poorer and working classes than among those better informed. There is a general belief among them, says the *Journal of the Society of Arts*, London, that only the commoner qualities of food-products are put up into tins, and consequently they reject them. The success of the pine-apple, however, treated thus, ought to dispel that notion, and to lead to other fruits, especially those of tropical countries, to be similarly treated for export purposes. There seems to be no reason why mangoes, guavas, rose-apples, and a host of others, should

not become regular articles of import and consumption, and even perhaps some of the other vegetable productions of distant lands. That the ordinary English vegetables and fruits can be preserved for winter use when the fresh ones are not obtainable has been proved over and over again.

The preservation of vegetables and herbs by desiccation by the natural action of the sun has been known to and practised by agriculturists from time immemorial. Within historical times it has been supplemented and improved upon by the introduction of drying in kilns. Both the ancient Chinese and Egyptians used this method in remote ages. The vegetable substances offered great difficulty for stowage and transport in consequence of their bulk, and the imperfect nature of their preservation. This difficulty was very successfully overcome in 1846 by a Mr. Masson, who was head gardener to Louis Philippe, King of the French, and who invented a process by which kiln-dried vegetables, herbs, and fruits can be compressed by powerful hydraulic pressure, re-

taining their hygienic properties for a length of time. By this process a quantity of vegetables sufficient for a mess of forty thousand persons was reduced to the volume of one cubic metre, thus effecting an enormous saving in stowage and in transport.

very largely used, and were mixed, dried, and compressed under certain rules laid down by an international Anglo-French military and naval medical commission, to which the celebrated Alexis Soyer, who was chief inspector of army cookery to the campaign,

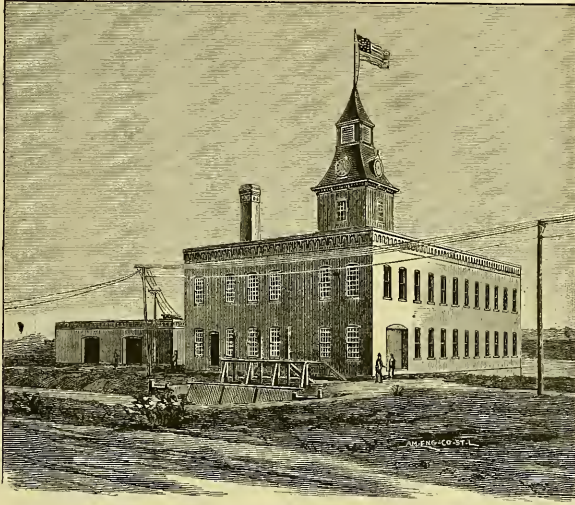


FIG. 4.—HEISLER COMPANY'S BUILDINGS AT MARSEILLES, ILL.

Later on, the invention was patented by Messrs. Chollet & Co. of Paris and London, who introduced improvements, and have ultimately brought the process to its present state of perfection; so that their successors, Messrs. C. Prevet & Co., prepare enormous

quantities of dried and compressed vegetables and fruits for the supply of the British army and navy, the Board of Trade making it compulsory that every outgoing vessel is supplied with a certain quantity.

gave practical assistance. For the mixed vegetables, the following proportions were decided upon, and are still adhered to: potato, 40 per cent; carrot, 30; cabbage, 10; turnip, 10; seasoning herbs (onion, leek, celery, parsley, parsnip, etc.), 10.

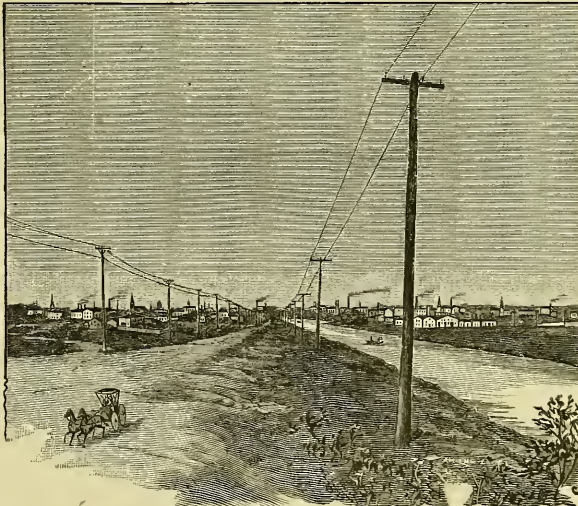


FIG. 5.—HEISLER COMPANY'S POLE LINE.

quantities of dried and compressed vegetables and fruits for the supply of the British army and navy, the Board of Trade making it compulsory that every outgoing vessel is supplied with a certain quantity.

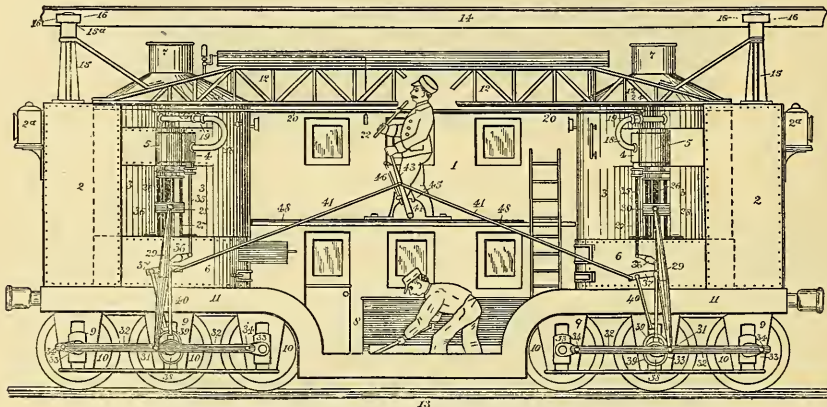
At the time of the Crimean war these prepared vegetables were

The vegetables are gathered in the autumn, when they are in their prime, and carefully sorted, then cleaned, washed, peeled, sliced, and slightly steamed (fixing the saccharine and albuminous parts, preventing to a great extent the volatilization of the essential oils, and thus preserving their hygienic and antiscorbutic proper-

ties). The various manipulations were formerly performed by hand, but all are now done by machinery. The vegetables thus prepared are then dried in kilns and on lattice work trays by currents of moderately hot, dry air, thereby retaining their natural color, flavor, and aroma. This stage of the process requires the greatest care and attention, so as to keep the temperature constantly at the level ascertained by experience to be necessary for each kind of vegetable. The vegetables and herbs are then carefully mixed in the proportions given above, and then compressed to one-eighth of their original bulk (when fresh) by powerful hydraulic pressure into moulds, thus forming square slabs about three-quarters of an inch thick, grooved so as to be divided into cakes of five rations each, at the rate of one ounce per ration, easily separated for convenience of issue. These slabs are then wrapped in paper, and packed by machinery into square tins, which are hermetically soldered. Before the lid is soldered down, a punch stamps it automatically from the inside with the season of manufacture. When two years appear on this stamp, as "1888-89," the first is the year of the crop, and the second the year of compression. The tins are now made of bright "coke" tin-plate of the best quality, it having been found by experience that the vegetables keep much better in this material than in the dull terne-plate formerly used.

THE BOYNTON BICYCLE RAILROAD.

IN last week's issue we briefly described the Boynton Bicycle Railroad at Gravesend, between Bay Ridge and Coney Island, a few miles from this city. The novelty of the Boynton system, and its vast possibilities in the line of high speed combined with safety, which rest on the fact of its running, like the bicycle, on one rail, justify us in giving our readers some further particulars concerning it. Among the advantages inherent in this system (in which the train is like a wide plank on edge), the development of which is only a question of the proper adaptation of means to ends, are the following, as given by a competent and disinterested authority on engineering: 1. A great increase in smoothness of motion at high speeds, permitting an almost indefinite increase of speed without danger in this respect; 2. A diminished air resistance, due to the narrower vehicles and running-gear; 3. A narrower road-bed, less costly to construct and to maintain. To these may be added the much greater ease, smoothness, and safety in rounding curves at high speed, as well as the excellent facilities for electrical propulsion afforded by the guard-rail overhead. Another advantage, the great flexibility of the system, must not be neglected. It is as well adapted to the slower and heavier freight traffic as to the light and rapid passenger service; to the high speed



FREIGHT LOCOMOTIVE FOR THE BOYNTON BICYCLE RAILWAY.

The vegetables and herbs are also prepared separately, as there is a greater demand in some quarters for some kinds than for others: as, for instance, in South Africa, for compressed celery as a cure, when stewed, for rheumatism caused by sleeping on the open veldt; in India, for compressed onions, to make a soup considered a sovereign remedy for the effects of over-indulgence in spirituous liquors; in the Hudson Bay territory, for the same article as a generator of warmth in the stomach; and in Burmah, for compressed apples and pears, which are prepared in a similar manner to the vegetables and herbs. All these vegetables, herbs, and fruits are also obtainable in their dried and desiccated condition, without being compressed into cakes. In either state they are extremely convenient, portable, and useful, as are also the prepared and condensed soups and flours made from potato, pea, lentil, haricot bean, carrot, chestnut, etc. They are, moreover, wholesome; and the use of these vegetables, fruits, etc., will probably become more widely extended.

The Engineering and Building Record appeared in a colored cover last week, and is enlarged by the four pages which the cover made. The improvement has been under consideration for a considerable time, and, as the current volume closes with the last issue for November, it seemed best to make it now. The getting of a cover which should at once be distinctive in color and meet all the other requirements was no easy task, and the reader is left to judge of the result finally reached.

and frequent stoppages of city and suburban rapid-transit trains as to the long runs of the limited express on trunk-lines; to electrical as to steam propulsion; and to elevated or underground as to surface roads. Its development in all these directions must follow as a necessary consequence to its successful introduction in any one of them. For this reason the progress made in perfecting the details of the system, at the Gravesend road and elsewhere, will be watched with unusual interest by the intelligent people of every country in which railroads have been introduced.

The section of road at Gravesend upon which the Boynton system is used had long been abandoned by the company formerly operating it, as they had secured a more direct route with fewer heavy grades. It was in poor condition, owing to the decay consequent on long disuse; but as in some respects at least (such, for instance, as high grades and several sharp curves) it was well adapted for showing the merits of this system, it was secured by the Boynton Company. They equipped it with an overhead guard-rail, and are getting the road-bed and track into good repair as speedily as possible, so that they will soon be able to double the speed of the trains without danger of accident from defective ties, etc. Even in its present state, with the train-speed limited by unfavorable conditions to a fraction of that possible under more favorable circumstances, this short railroad is attracting a great deal of attention, not only from railroad men, but also from men eminent in engineering, electrical, and scientific circles generally.

On Saturday of last week a representative of this paper was

present at an experimental trip over the road, made to test the results of some repairs to the track and road-bed, as well as to give an idea of the workings of the system to a party of gentlemen interested in railroad matters, among whom were a few from Europe. The run over the road was fully up to the expectations of all present, the train gliding along as smoothly, and as free from jar or oscillation, at the highest speed reached as at the slowest. Even when rounding curves of short radius at high speed, where cars are subject to the violent and disagreeable oscillations caused by the difference in level of the rails combined with the centrifugal force due to the swing around the curve, the Boynton car, on its one-rail track, ran as smoothly and steadily as on a tangent. In fact, the only thing to indicate that the car, when rounding a curve, was not running on a straight stretch of track, was the slight incline given the car by the guide-rail overhead to counteract the centrifugal force caused by the rapid motion and curvilinear course of the train. Inequalities in the track also, which make themselves manifest by oscillations in ordinary railroad travelling, merely caused a slight vertical motion of the car, softened, of course, by the springs. To sum up the impressions produced by a ride over the road, every thing seems to indicate that Mr. Boynton's theories are based on correct scientific principles, that his system solves the problem of high speed combined with safety, and that for a continuous speed greater than fifty miles, reaching perhaps a hundred or more, — a speed urgently demanded by present business methods as a natural sequence to telegraphic and telephonic development, — Mr. Boynton's system, or some modification of it, must necessarily be adopted.

Our illustration shows a freight-engine of a type designed by Mr. Boynton for the bicycle or single-rail system of railroad. Though presenting many novel features, being intended for great hauling power rather than high speed, it embodies the same general principles as the high-speed locomotive illustrated and described in our issue of last week. It carries two boilers, two cylinders, and two sets of drivers. The two-story cab is located midway between the boilers, so that one engineer and one fireman control both parts of the engine.

THE KONGO RAILWAY.¹

IN November, 1885, a syndicate of English capitalists, headed by Sir William Mackinnon, was constituted with a view of obtaining from the Kongo State the concession of the railway from the Lower Kongo to the Stanley Pool. The time, however, had not yet come for great enterprises on the Kongo. Stability was not yet sufficiently secured. The political work was not sufficiently advanced; so that capital, in order to insure its security, was obliged to demand powers which the Kongo was unable to grant, so that the negotiations fell through, and the English syndicate was dissolved.

Shortly afterwards the affair was taken in hand, at my suggestion, on a more modest scale, by the *Compagnie du Congo pour le Commerce et l'Industrie*, constituted with a capital of 1,000,000 francs, which sum was afterwards raised to 1,225,000 francs, with the immediate object of studying in a practical and definitive fashion the possibility of laying the railway. The statutes were drawn up, however, in order to allow the *Compagnie* to become, by simply increasing its capital, the company for laying and working the railway. The *Compagnie du Congo* was definitely constituted on the 9th of February, 1887. By the 8th of the following month of May, the first expedition of engineers left for the Kongo. On the 10th of June a second group sailed from Antwerp. At the end of July the gangs, assembled at Matadi, were composed of one director of survey, twelve engineers, and one physician. Those who had arrived first determined the geographical position of Matadi, made some soundings to satisfy themselves of vessels of a large draught being able to land without considerable works, and reconnoitred the environs. From the first days of August, work began. One study-gang walked in advance, reconnoitring the country, and determining rapidly, by means of the levelling-compass, the zone of

the ground to be surveyed. Three gangs, each composed of three engineers, followed, and drew with the tachometer the plan of the reconnoitred zone. Haussas, negroes of the Gold Coast, were employed as staff-holders. The zone on which the operations with the tachometer were performed varied, according to circumstances, from 50 to 200 metres on both sides of the likely axis of the way. The progress of the work, which at the very beginning of the operations was only from 300 to 500 hundred metres per brigade and per day, on the difficult ground near Matadi and Palaballa, soon increased to one or two kilometres, the expedition having passed the mountainous region, and by way of exception was raised to four or five kilometres per day, the maximum space between the stations of the instrument being 300 metres. The operations on the ground continued in 1887 up to December, when the study had been carried on as far as Lukunga. The work then suffered an interruption of four months on account of the rainy season; nevertheless a special gang continued working during January and February, 1888, in order to execute near Matadi the survey of an alteration made in that region to the first direction-line. In May, 1888, the staff having again their full complement, works were resumed. While the chiefs of the gangs went to reconnoitre previously the region which extends between the Lukunga and the Stanley Pool, the other engineers completed the works around Matadi. At the beginning of July the whole staff resumed the operations with the tachometer. On the 4th of November, 1888, the level was set up for the last time at Stanley Pool, and the engineers went back to Europe.

The railway which is proposed to be laid in the cataract region, according to the survey plans and estimates, will have a gauge of 75 centimetres, with steel rails weighing 23 kilos, steel sleepers at equal distances of 80 centimetres, and weighing 23 kilos, the whole of the line weighing 75 tons per kilometre. The total length of the line will be 435 kilometres. The laying of the first 26 kilometres only will offer some important difficulties, while the remainder of the line will be laid under exceptionally easy circumstances, either in plains by straight lines, or along the hillsides by means of curves of great radius. The earthworks of the first 26 kilometres not only will be much more considerable, but a great deal of it will have to be done by excavating the rock; while farther the cuttings can be proceeded with in argillaceous ground, and nearly always in sandy and friable earth.

If we except the first part, there will be few constructive works, the most important of them being a bridge of 100 metres across the Inkissi, two bridges of 80 metres across the Mpozo and the Kwillu, and six bridges ranging between 40 and 60 metres. The others will have a length of from 5 to 20 metres only in the clear. The construction of the abutments of bridges will be everywhere very easy, as firm soil is to be met with at no great depth from the surface of the ground. Nearly everywhere, except on the first section, the nature of the soil will admit of bricks being made; and in the valleys of the Luima, of the Unionzo, Kwillu, and Inkissi, limestone is to be found in abundance. Fragments of quartzite and sand, everywhere to be met with, will supply the ballast.

The maximum of incline will be 46 millimetres per metre, and will be reached three times during the first portion, where, as a rule, steep inclines will be met with. Nevertheless it has been possible to combine the slopes and horizontals so as to render traction as easy as possible, and during the last 400 kilometres the slopes and inclines are very infrequent and generally insignificant. Likewise, in the first section, curves are rather numerous and of short radius, although the latter will never be less than 50 metres. Thus all the difficulties of laying and working accumulate at the starting-point, — a most fortunate circumstance, as the first section also offers greater facilities for laying; and, on the other hand, by establishing a twofold traction for the first 26 kilometres, and, reorganizing the trains beyond Palaballa, it will be possible to work the whole of the line under far greater economical conditions than if the working difficulties had to be dealt with at some distance from the starting-point.

The locomotives, when loaded, will weigh 30 tons, and drag, with the speed of 18 kilometres per hour, an average useful load of 50 tons.

The starting-point of the railway on the Lower Kongo will be

¹ Paper read before the Geographical Section of the British Association by Capt. Thys.

at Matadi, — a point which is easily reached by sea-going steamers, and where inexpensive works will easily enable those steamers to unload their cargoes on wagons. The terminus of the railway at the Stanley Pool will be at Ndolo, at a little distance above Kinchassa, and also above all the rapids which hinder navigation in the caaraat region. Beyond this point light-draught vessels can ascend the Kongo and its affluents for an uninterrupted length of 11,500 kilometres. Ndolo is admirably situated for the building of spacious quays.

Matadi and Ndolo will be the two principal stations. A second-class station will be erected in the district of Kimpésé, where travellers will stop, as two days will be required to pass the distance between Matadi and Stanley Pool. The trains will not run by night. Three other stations will be established along the line, — one at the Lufu, another at the Inkissi, and a third at Ntampa, — thus dividing the total distance between the Lower Kongo and the Stanley Pool into five sections of an average length of 85 kilometres each; each section being itself divided into four sub-sections by three halting-places, with water-tank and crossing-way.

To sum up, the general estimate of the scheme demands a capital of 25,000,000 francs, which will be sufficient to build the road, purchase the rolling stock, cover the general expenses both in Europe and Africa, and meanwhile pay the interest on capital during the construction of the railway, which, according to estimate, will occupy four years.

The figure of 60,000 francs, or more exactly 58,500 francs per kilometre, for the Kongo Railroad, is a maximum price, which has only been reached, on the one hand, because the construction really does, on one portion of the track, involve some difficulties; on the other hand, because the highest valuation has been adopted. When we look to the matter closely, we must even admit that the price we have named is a high one; for, as a matter of fact, the Kongo Railway is an exceptionally easy undertaking. The laying-out of its course was only influenced by purely topographical considerations; and the surveyors had no troublesome allowances to make for connecting the road with any particular establishment for industrial, commercial, or even political purposes. There were no lands to purchase, besides which (and this is an important item, to which I call your full attention) there are and there will be no side profits to be allowed for. The undertaking is, and will remain, completely independent from speculation; the cost of the railway, such as we give it, being strictly that established by the estimates.

Furthermore, the proposed railway is not a wide-gauge railway, but a narrow-gauge railway, adapting itself to all the variations of the ground it will travel over, and exactly befitting the commercial position of a country yet in its infancy. I remember the graphic words used by one of my colleagues on the Board of the Compagnie du Commerce et l'Industrie while we were discussing the width of the road, and I will repeat it to you. "What we want," he said (and we all agreed with him), "is a good and substantial iron track, where locomotives and wagons may be set rolling."

The transport-power of the Kongo Railway, with its seventy-five centimetres gauge, between "bourrelets," will meet all present requirements, and will meet them for a large number of years to come.

The construction of the Kongo Railway will be proceeded with by the Compagnie du Chemin de Fer du Congo, commanding a registered capital of £1,000,000 sterling, of which one-fifth has been subscribed by English capitalists, thanks to the spirited enterprise and the great authority of Sir William Mackinnon.

Thanks to the disinterested intervention of the Belgian Government, who have subscribed £400,000 worth of shares which will never bear more than $3\frac{1}{2}$ per cent interest, and who forfeit all excess of profit in favor of the other shares, it will only require, in order that the ordinary capital invested in the undertaking may reap a return of 8 per cent, that our receipts shall reach 3,000,000 francs, — an amount which, according to the terms laid down by the contract for the early period of the undertaking, will certainly be realized if the up traffic reaches 2,250 tons, if passenger traffic reaches the total figure of 300 up and down passengers, and if the railway in its down journey carries 200 tons of ivory, 600 tons of gutta-percha, and 3,000 tons of miscellaneous goods, paying only

100 francs for carriage. These figures will undoubtedly be reached from the beginning. Even at the present time, 1,800 tons are carried up the Kongo. We only, therefore, provide for an increase of 450 tons within four years. The 200 tons of ivory above mentioned merely represent what is actually conveyed by native carriers. As to the 600 tons of gutta-percha, one single branch of the Compagnie du Haut Congo — the Luébo branch — is in a position to purchase 240 tons per annum; and the 300 remaining tons will be provided by palm-oil, gums, wood for building-purposes, etc.

The opportunities afforded to communication by the 11,500 kilometres of practicable waterway of the Upper Kongo and its tributaries will, indeed, enable us to drain towards the Stanley Pool, for carriage by the railway, the various exchangeable commodities which the immense territories of the Upper Kongo abundantly produce.

HEALTH MATTERS.

A Physiological Study of Absinthe.

As commonly met with, absinthe only contains about thirty minims of essence of absinthe to the litre, the remainder consisting of alcohol, together with from sixteen to a hundred drops each of the essence of anise-seed and star anise-seed, coriander, fennel, peppermint, angelica, hyssop, and mélisse; and the color is given by fresh parsley or nettles. Cadiac and Meunier, as reported in *The Medical Aesthetic*, recently undertook to investigate the action of the various components of the liqueur, in order to ascertain to which of them its peculiarly intoxicating effects were due. They found that hyssop induces epileptiform attacks in ten-grain doses, while fennel induces visual troubles and languor. Poisonous doses of coriander give rise to sudden anaesthesia and muscular convulsions. Mélisse determines a passing stimulation, followed by lassitude and sleepiness. Both varieties of anise-seed possess powerfully stimulating properties, with consecutive visual troubles, muscular inco-ordination, and dulness of sensation, with abrogation of the will and heavy sleep.

Although not, strictly speaking, poisonous, anise-seed is a violent excitant of the nerve-centres, even in the relatively small quantities contained in the usual allowance of the liqueur. If the dose be increased, epileptiform attacks are induced. A litre of ordinary absinthe only contains about thirty drops of the essence, — a dose which, if taken all at once, only gives rise to powerful mental stimulation, increasing the appetite and facilitating digestion. Moreover, it leaves behind it neither depression nor somnolence. The sum total of the effects of the blend is a sensation of comfort and physical and mental activity, followed by lassitude and indisposition to exertion, and, in large doses, to epileptiform attacks. The authors are disposed to attribute the major part of the injurious effects to the collateral essences, and seriously recommend manufacturers to discard the use of several of these, and of anise-seed in particular.

THE NATIVE EGYPTIAN AS A SUBJECT FOR SURGICAL OPERATION. — The native Egyptian is an extremely good subject for surgical operation. Clot Bey, the founder of modern medicine in Egypt, has it that "it requires as much surgery to kill one Egyptian as seven Europeans. In the native hospitals, the man whose thigh has been amputated at two o'clock is sitting up and lively at six." Shock is almost entirely unknown, and dread of an impending operation quite an exception. In explanation may be noted the resignation inculcated by their religion; the very small proportion of meat in, and the total absence of alcohol from, their diet; and in general their regular, abstemious, out-of-door life.

THE DISEASED-MEAT SCARE. — The *Medical Record* comments editorially on Dr. Behrend's article, which has excited much talk and learned editorial writing in the daily press. It says, "But it is yet entirely unproved that the meat of tuberculous cattle ever caused tuberculosis in man. Bovine tuberculosis is generally pulmonary. Tuberculous bacilli are found sometimes in the glands, but practically never in blood or muscle, except in acute general infection. Even if the bacilli do get in meat-muscle, Nocard, who is an ingenious and skillful bacteriologist, has shown that they are destroyed or digested in the tissue. And Nocard has positively

affirmed that one can safely eat the flesh of tuberculous animals the tubercles of which are limited to the viscera and lymphatics. High temperatures destroy the bacillus also, and therefore thorough cooking would make even tuberculous tissue safe. Dr. Behrend ought to know, also, that tuberculous meat can only infect the body through the alimentary tract; but Koch has shown that adult bacilli are destroyed in the stomach, and that the spore bacilli can only get through alive by a narrow margin. But, furthermore, if tuberculous meat were so dangerous, there should be more primary intestinal tuberculosis. In adults this disease is a great rarity, and practically it may be ignored. Even including infants, it does not make up ten per cent of tubercular diseases. We venture to say, therefore, that the 375,000 Londoners who possibly ate the presumably tuberculous meat digested it and its bacillus, and were the better for their repast. It must be very evident, we think, that the danger to adults from eating flesh of tuberculous cattle is so extraordinarily remote that it may be practically ignored. The liver, "lights," and glands of such cattle, however, are perhaps not so safe, and sausage made up from meat seriously affected may not be free from danger. We advise, therefore, as we have done, the governmental inspection of slaughter-houses; but we much more seriously urge the supervision of milk. This, it is known, can carry the tuberculous virus, and, being consumed uncooked by delicate and growing children, is a far more dangerous product than the flesh of tuberculous cattle."

SAWDUST AS A DRESSING FOR WOUNDS.—*Cosmos* suggests the use of fine soft sawdust as a dressing for wounds, and as a vehicle for medicaments or antiseptics. It says that the dust, freed from splinters and sharp bits of wood by sifting, when used alone and dry, makes a clean and grateful dressing; that it readily takes up and holds the discharges without packing or adhering; and that it is easily rendered antiseptic by any of the methods used in preparing antiseptic cotton or wool. The *St. Louis Medical and Surgical Journal* suggests that our yellow pine sawdust, rich as it is in turpentine, would prove of itself a valuable antiseptic application.

DANGER IN SILK THREAD.—Silk thread, says *Sanitary News*, is soaked in acetate of lead to increase its weight, and persons who pass it through the mouth in threading needles, and then bite it off with the teeth, have suffered from lead-poisoning.

SOME DOMESTIC REMEDIES IN THE TRANSVAAL.—Mr. Walter H. Haw, in a letter to *The Lancet* upon medical practice in the Transvaal, gives the following list of remedies in which the Boers have the most implicit faith, and to which they recur in many of the ills of themselves and their families: 1. Cow-dung poultices. 2. Stink blaar (*Datura stramonium*) leaves applied for the relief of pain. These act well, and are often used. 3. Prickly-pear leaves skinned and applied. 4. For children, a young goat killed and opened, the child being put in bodily after removal of the viscera, — a good poultice, probably. 5. Rimpis (threads) of eel-skin worn round the painful joints in chronic rheumatism. This was described to me by a man who was wearing one round almost every joint of his body as being a splendid remedy. 6. Rimpis of the tanned skin of a tame goat worn as above for sprains, etc. 7. The finely chopped hair of a black cat, which should not have the faintest trace of white about it, — a remedy for convulsions. 8. A spoonful of dog's blood taken from the ear, for "buur en de mag" ("inflammation of the bowels"). 9. For snake-bite repeated wolf poultices.

EFFECT OF CANNON-FIRING ON THE EIFFEL TOWER.—Of all the indispositions (and there are many) created by the exhibition, according to the Paris correspondent of *The Lancet*, the most curious is that which is caused by the firing of the cannon on the Eiffel Tower. Every evening at ten o'clock, when the gun is fired for the last time in the day, it is not unusual to see produced a sort of frenzy among the young female visitors to the exhibition. Under the already strong impression produced by the illuminations, the luminous fountains, etc., when the gun is fired, they seem to be seized with a veritable panic. It appears to them that a sudden catastrophe, such as a great fire, has taken place. Cries of admiration escape from some, and of terror from others, when fainting,

attacks of hysteria and of prostration, occur. The subject has attracted the attention of Professor Charcot and other physicians.

POISONING BY POTATOES.—In *The Therapeutic Gazette* is an account of serious symptoms of poisoning which occurred in a hundred and one members of a battalion of French infantry. The symptoms were headache, dilatation of the pupils, colic, diarrhoea, sweating, fever, pain in the epigastrium, vertigo, nausea, thirst, troubles of vision, and cramps. The poison was evidently contained in the food, and, after successive eliminations, suspicion rested upon the potatoes, which were withheld for forty-eight hours, with the result that no new cases developed. It was found on examination that the potatoes simply consisted of sprouts, which, as is well known, contain solanine, an alkaloid of a poisonous character, and which produces results similar to those detailed above.

"AMMINOL" FOR THE DISINFECTION OF SEWAGE.—A new method of precipitating sewage has been tested at Wimbledon, England. The *London Times* now devotes a large amount of space to the consideration of this new disinfectant method, which was discovered by Mr. Wollheim of London, and which, in the opinion of *Medical News*, bids fair to revolutionize the sewage question. The disinfecting power of amminol gas is such, that, when introduced into sewage, it very quickly destroys the microbes of putrefaction and of many diseases. The odor of sewage is almost instantly displaced by that of the re-agent, and in less than an hour the sewage thus treated is both deodorized and sterilized. It is reported that Dr. Klein has in part confirmed the claims of the discoverer, in so far that one sample of sewage examined by him was found to be absolutely sterile after having been treated by the amminol method. If this alleged discovery should be verified, it will undoubtedly become one of the most useful discoveries of the present day, and must materially influence the future of sanitary practice.

VARIATIONS IN THE COMPOSITION OF MILK.—From the results of about fifty thousand analyses made in the laboratory of the Danish Dairy Supply Company, and reported in the *Medical and Surgical Reporter*, it is found that the dry matter less fat is an almost constant value (8.7 to 8.8). The fluctuations in total solids depend almost entirely on variations of the fat. The evening milk contains more fat and more total solids than the morning milk. In October and November the milk is richer in fat and total solids than in other parts of the year.

HOW DRUNKARDS ARE TREATED IN NORWAY.—The London correspondent of the *American Practitioner and News* says that a well-known medical man, who has recently been in Norway, gives a glowing description of their manner of treating dipsomaniacs. An habitual drunkard in Sweden and Norway is treated as a criminal in this sense, that his inordinate love of strong drink renders him liable to imprisonment, and while in confinement it appears he is cured of his bad propensities on a plan which, though simple enough, is said to produce marvellous effects. From the day the confined drunkard is incarcerated, no nourishment is served to him or her but bread and wine. The bread, however, it should be said, cannot be eaten apart from the wine, but is steeped in a bowl of it, and left to soak thus an hour or more before the meal is served to the delinquent. The first day the habitual toper takes his food in this shape without the slightest repugnance; the second day he finds it less agreeable to his palate, and very quickly he evinces a positive aversion to it. Generally, the doctor states, eight or ten days of this regimen is more than sufficient to make a man loathe the very sight of wine, and even refuse the prison dish set before him. This manner of curing drunken habits is said to succeed almost without exception, and men or women who have undergone the treatment not only rarely return to their evil ways, but from sheer disgust they frequently become total abstainers afterward.

THE VENOM OF SNAKES.—The venom of the rattlesnake has been frequently made the subject of study, and, while its action as a poison has been generally conceded, some writers have endeavored to prove its efficacy as a drug. Surgeon L. A. Waddell, M.B., says the *Lancet*, has recently been availing himself of his opportunities as a deputy sanitary commissioner in Bengal to de-

termine a point about which it would seem that much uncertainty existed,—the curious question of the effect of serpent-venom on the serpents themselves. In a paper he has published he quotes the contradictory conclusions arrived at by previous experimenters, and endeavors to show, that, from the accounts of the experiments, it by no means followed that death, when it occurred, was the result of auto-toxic action. Accordingly, he felt that the question was still open, and proceeded to some very interesting investigations, conducted under different conditions of temperature and season, verifying his results by control experiments upon other animals and by *post-mortem* examination of the snakes he employed. In every case the fresh venom was injected into the cobra with an ordinary hypodermic syringe; the serpents operated upon were all healthy, and had recently been caught; the snakes were kept under observation from nine to fifteen days subsequently, and were then killed. The experiments generally confirm and extend the principle formulated by Fontana in 1765, that the venom is neither a poison to the snake itself nor to those of its own species. This immunity is not to be explained upon the mere fact of the animal being cold-blooded, or upon the anatomical conformation of ophidians, since most, if not all, of the non-venomous snakes are susceptible to venom. Surgeon Waddell suggests that it may result from a toleration established through frequent imbibition of the venom in the modified or attenuated form which it assumes when mixed with salivary and gastric juices and absorbed through the alimentary canal; and in support of this hypothesis he mentions the popular belief that certain snake-charmers, by a process of inoculation with venom, gain protection against the bite of a particular species of venomous snake. If this hypothesis can be verified by further experiments, it will go far towards affording indications for combating the action of the venom on man. The subject is of such importance, and the experiments detailed appear so conclusive, that we look forward with interest to the further prosecution of this inquiry.

NOTES AND NEWS.

A SCHEME for bridging the English Channel has actually been discussed by the Iron and Steel Institute of Great Britain. The cost is set by the projectors at \$170,000,000. The danger to navigation, aside from any considerations of cost, is likely to be enough of an objection to prevent the accomplishment of the project for many years to come.

—The International Medical Congress, we learn from *Nature*, will meet next year in Berlin, from Aug. 4 to Aug. 10. Inquiries by intending visitors should be addressed to the general secretary, Dr. Lassar, Karl Strasse, Berlin. The congress will be divided into eighteen sections, and the official languages will be German, English, and French.

—According to *Nature*, the Ethnographic Congress, which held meetings of its various sections every day of the week ending Oct. 5, in Paris, brought its proceedings to a close on Monday afternoon, Oct. 7, in one of the large halls of the College of France. It was decided that the congress should hold its next meeting at Bucharest in the autumn of 1890.

—At the first regular meeting of the Boston Society of Arts, held at the Institute of Technology, Oct. 10, the paper of the evening, as we learn from the *Boston Medical and Surgical Journal*, was upon "Biological or Chemical Water-Analysis," by Professor W. T. Sedgwick of the institute. He analyzed different waters, claiming that one-third of a teaspoonful of Cochituate water, tested by the gelatine process, contains sixty to one hundred bacteria, and yet is as pure as the average water. The State Board of Health was highly commended for its practical system of analyzing water. After an interesting exhibition of filtered waters and vegetable deposits through sand, the meeting was adjourned.

—The Philadelphia *Inquirer's* Pittsburgh special, Oct. 15, says, "That the natural-gas supply in that and adjoining districts has passed its zenith, and is now upon the wane, can no longer be satisfactorily denied. The reason usually given was that new mains were being laid to the wells, or that the size of those already down was being increased. These changes have all been made, and still the desired fuel does not pour through in the necessary

quantities. This state of affairs was first noticed the latter part of last winter; but the coming of warm weather relieved the pressure for domestic purposes, and nothing was heard of a shortage during the summer months. But with the first appearance of a change of temperature this fall the trouble recommenced in an aggravated form. The last move of the natural-gas companies has been to ask the big mills to run only at night, when the demand upon the fuel for other purposes would be slight. Many of the establishments have decided to return to the use of coal, and some have already done so."

—The British consul-general at Constantinople, in his last report, refers to the declining commercial importance of that city. Its trade has suffered considerably since 1878, and more particularly during the past two years. Large wholesale houses which formerly did business with Persia and central Asia, and acted as middlemen between European manufacturers and the merchants of those parts, have in recent years lost their customers, and are gradually disappearing from the city. This is owing, in a measure, to new and more direct routes having been thrown open to markets that were formerly supplied from Constantinople, and also to the fact that produce which used to go to the Turkish capital for shipment to Europe is now despatched direct from the outports. Persia, which previously drew a considerable part of her imports from Constantinople, has latterly commenced to make use of Bushire, and the entire import trade of lower Persia is at present centred in that place. The provinces of Azerbaijan and Mazanderan alone continue to take their supplies by way of Constantinople, and then only when Russian competition permits of their doing so. The export trade of the city has suffered in a similar way. The produce of Turkish Kurdistan, estimated to amount to an annual value of £320,000, which two years ago went through the capital, is now shipped from Bagdad,—a route which is considered to be less expensive and safer. As regards Persian trade especially, Mr. Fawcett observes that during the years 1887-88 it was not satisfactory.

—Two items which appeared on p. 250 of our issue of the 11th inst.—one in relation to the deepest hole in the world, and the other touching the effect of gas on asphalt pavements—should have been credited to *The Engineering and Building Record*. A feature of this journal in which many of our readers would be interested is the insert architectural drawing given each week. These drawings are remarkably well chosen, and are reproduced and printed especially well.

—The *Engineering and Mining Journal* announces that a movement has been started to erect a monument to the joint memories of Fulton and Ericsson in Trinity Churchyard, New York. The idea originated out of an application which has been made and which is likely to be granted, for the interment of the great Swedish inventor's remains in the Livingston Manor vault, which would, as it happens, place them immediately next to the grave of Robert Fulton, so that a joint memorial would seem to be especially appropriate.

—The National Council of the Phi Beta Kappa Society, at its triennial meeting at Saratoga in September, appointed a committee to consider means of securing, in connection with the proposed national commemoration of the discovery of America in 1892, "a proper representation of the intellectual life of the American people, as manifested by their progress in science and literature." The committee was instructed especially to consider, according to *The Publishers' Weekly*, the preparation of a "monumental work," to comprise a series of monographs on the progress of our people, during the four centuries since the discovery by Columbus, in science and literature. The committee was authorized to offer two prizes, of \$3,000 each, "for the best general essays on the progress of science and literature respectively; such essays to embrace a philosophical discussion of the development in the past and of the outlook for the future." The committee appointed is a thoroughly competent and admirably representative one, its members being Bishop Henry C. Potter, chairman; President Eliot of Harvard University; President Dwight of Yale; President Gilman of Johns Hopkins; President Adams of Cornell; President Angell of the University of Michigan; and President Northrup of the University of Minnesota.

— Attempts to prevent the formation of smoke have hitherto mainly had reference to the grate or furnace. Recently there has been exhibited in London a method in which the coal before use is treated chemically, by a process the details of which we have not learned, but which results in no deterioration of the heat-producing qualities of the coal, while it prevents its burning with an excess of smoke. The coal seems to be hardened by this process, which is said to cost not more than twelve cents a ton.

— Professors L. H. Baily, E. S. Goff, and W. H. Green were appointed at the last meeting of the Association of Agricultural Colleges and Experiment Stations to report on the nomenclature of kitchen-garden vegetables. In their report, just issued by the Department of Agriculture, and summarized in *Garden and Forest*, after stating that a name is bestowed upon a plant solely for the purpose of designating, and not for describing it, the committee lay down the following rules: 1. The name of a variety should consist of a single word, or at most of two words. A phrase, descriptive or otherwise, is never allowable; as, "Pride of Italy," "King of Mammoths," "Earliest of All." 2. The name should not be superlative or bombastic. In particular, all such epithets as "New," "Large," "Giant," "Fine," "Selected," "Improved," and the like, should be omitted. If the grower or dealer has a superior stock of a variety, the fact should be stated in the description immediately after the name rather than as a part of the name itself; as, "Trophy, selected stock." 3. If a grower or dealer has procured a new select strain of a well-known variety, it shall be legitimate for him to use his own name in connection with the established name of the variety; as, "Smith's Winningstadt," "Jones' Cardinal." 4. When personal names are given to varieties; titles should be omitted; as, "Major," "General," "Queen." 5. The term "hybrid" should not be used, except in those rare instances in which the variety is known to be of hybrid origin. 6. The originator has the prior right to name the variety; but the oldest name which conforms to these rules should be adopted. 7. This committee reserve the right, in their own publications, to revise objectionable names in conformity with these rules.

— The following description of the way in which floating fields and gardens are formed in China is from an article by Dr. Macgowan, in the *China Review*: "In the month of April, a bamboo raft, ten to twelve feet long and about half as broad, is prepared. The poles are lashed together with interstices of an inch between each. Over this a layer of straw an inch thick is spread, and then a coating two inches thick of adhesive mud taken from the bottom of a canal or pond, which receives the seed. The raft is moored to the bank in still water, and requires no further attention. The straw soon gives way, and the soil also, the roots drawing support from the water alone. In about twenty days the raft becomes covered with the creeper *Ipomea reptans*, and its stems and roots are gathered for cooking. In autumn its small, white petals and yellow stamens, nestling among the round leaves, present a very pretty appearance. In some places marshy land is profitably cultivated in this manner. Besides these floating vegetable-gardens, there are also floating rice-fields. Upon rafts constructed as above, weeds and adherent mud were placed as a flooring; and when the rice shoots were ready for transplanting, they were placed in the floating soil, which being adhesive, and held in place by weed-roots, the plants were maintained in position throughout the season. The rice thus planted ripened in from sixty to seventy in place of a hundred days. The rafts are cabled to the shore, floating on lakes, pools, or sluggish streams. These floating fields served to avert famines, whether by drought or flood. When other fields were submerged, and their crops rotten, these floated and flourished; and when a drought prevailed, they subsided with the falling water, and, while the soil around was arid, advanced to maturity. Agricultural treatises contain plates representing rows of extensive rice-fields moored to sturdy trees on the banks of rivers or lakes which existed formerly in the lacustrine regions of the Lower Yangtze and Yellow Rivers."

— A method for coating porcelain with platinum is described as follows: The porcelain is first covered with platinum chloride to which a little hydrochloric acid has been added. It is then exposed in a muffle to a temperature of 1,000°–1,200° for twenty

minutes. This operation is repeated till a sufficient coating is secured.

— President D. C. Gilman has gone abroad for an absence of some months. While he is away, Professor Ira Remsen will act as president of Johns Hopkins University.

— At the close of the Paris exposition the Belgian exhibits will be mainly transferred to London, where they will form part of a Belgian exhibition to be opened next year. It is to be feared, if we may judge from the emptiness of the Spanish exhibition in London, that this special exhibit may not prove financially successful.

— In Sweden, which boasts being the fatherland of modern explosives, a considerable amount of time and attention is constantly given to experiments in this direction; and an engineer, Mr. J. W. Skoglund, has recently invented a new explosive, which so far, according to *Engineering*, has given great satisfaction. It is called "gray powder" (Swedish *grakrutt*), and has during the summer been tested at Rosersberg Guntery School, in addition to which it will be further tested in the course of the present month by a special commission, and to a considerable extent for comparison with a Belgian powder called *poudre de papier*. It has also been accepted for trials at the fleet. According to the official reports, the gray powder has been used with 25-millimetre as well as with Nordenfelt's machine guns. The former has, with 70 per cent of the new powder against 100 per cent (or the usual charge) of ordinary powder, given a 33 per cent greater initial velocity, without the pressure in the gun being increased more than 5 per cent. With 62 per cent (ordinary charge weight) of gray powder, the initial velocity was increased with 24 per cent without any perceptible increase in pressure. With a charge of 74 per cent (ordinary charge weight) the initial velocity was increased 40 per cent, without the gun being subject to any undue pressure. With regard to the important question of smokelessness, the report states, that, while with Nordenfelt's machine-guns smoke of ordinary powder remains for twenty-five seconds, the gray powder only leaves a transparent steam, which is only visible for five seconds.

— It is satisfactory to learn, on the authority of M. Gulishambaroff, that there is not the slightest ground for the absurd rumor, set in circulation by the acting consul at Batoum, that the Baku oil-supply had begun to show signs of exhaustion. M. Gulishambaroff is the chief petroleum adviser of the Russian Government, and recently has been conducting an investigation into the oil-industry of this country, in conjunction with Mr. Marvin. Having only just arrived from Baku, after one of his regular official visits, he is in a position to speak with authority on the position of affairs in that quarter, irrespective to that general knowledge of the Baku industry, from the earliest time of its European development, which has resulted in the publication of so many books on the subject. So far from there having been a "cave-in" of the supply, says *Engineering*, there has really been a "shut-down" of a large number of wells, to check a wasteful over-production. Instead of 500, only 200 wells have been at work this autumn. Moreover, in order to put a stop to the waste of oil on the surface, the Russian Government has been lately discouraging the commencement of new wells outside the present limit. Administrative action of this sort has long been advocated by Marvin and other non-Russian writers, as well as by Russians themselves. It is no uncommon thing for a native of Baku to tap a supply of 20,000,000 gallons of oil, and waste 19,000,000 out of it, simply from want of foresight in providing a cap for the well, or by the omission to arrange for surface storage. Waste of this character has become such a scandal that to check it the authorities now seize a well that is not properly managed, and empower the neighboring well-owners to gag the supply at the culprit's cost. In view of the rapid increase in the demand for petroleum, it is a satisfaction to know that Baku is as prolific of oil as ever. The oil-trade is rapidly assuming such gigantic proportions that for many a year there will probably be ample room for America, Russia, and Burmah, as well as for the minor fields that will in time furnish a supply for the world's market. But, in any case, petroleum ought not to be wasted as it has been at Baku, and it will be a good thing for Russia when the more careful and economical methods of America are adopted in the Caspian region.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The "Exchange" column is likewise open.

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AMERICAN PUBLIC HEALTH ASSOCIATION.

THE seventeenth annual convention of the American Public Health Association was opened Tuesday in the Brooklyn Institute. About two hundred members from all parts of this country and Canada were present.

The first paper was upon "The Overshading of Our Homes," by Dr. William Thornton Parker of Newport, R.I. It was read by Dr. C. A. Lindsley of New Haven. In the paper the writer said in part, "Overshading is a serious fault, and directly lessens the value of real estate, and noticeably increases disease and shortens life. Houses overshadowed are not healthful, no matter how commodious or well built they may be. This condition of overshadowing is very noticeable in our New England and Middle States towns. The white faces and sickly appearance of so many of our people are largely attributable to this cause, and suggest that medical men should call attention to the growing evil. Where houses are overshadowed, the nervous system also suffers, as well as the general bodily health." The discussion brought out clearly that this is a subject on which doctors disagree.

Dr. Lindsley said that it was his belief that the great number of trees in New Haven was unquestionably the cause of much malaria and other disease in that city. Dr. Henry P. Walcott of Massachusetts remarked that he had lived in a town as much shaded as New Haven, and found no harm from the great number of trees, but a direct benefit. Dr. George M. Sternberg, U.S.A., believed that many malarious places were redeemed by the planting of trees. Dr. Gilhon of Washington mentioned the fact that the Roman Campagna had been freed from malaria to a great degree

by the planting of eucalyptus trees. The swamps in California were dried in the same way.

The second paper, upon "Clothing in its Relation to Hygiene," was by Dr. James F. Hibberd of Richmond, Ind. His conclusions are that many persons dress too warmly, and thus induce disease. Most persons only regard the amount of clothing to be worn so that it should protect sufficiently against cold, and wholly disregard the effect of over-heating and thus disarranging the functions of the skin.

Dr. Hibberd maintained that an insufficiently clothed person was not the one who caught cold, but it was the overclad one who was most subject to it.

He summed up as follows: "It seems time that the relation of clothing to the health of the people of temperate climates engaged in civil industries should be reviewed, and the points for investigation may be summarized thus: viz., 1. The popular and professional estimate of the hygiene of the skin is much below its real importance; 2. The physiology of the skin cannot be largely interfered with without endangering the general health; 3. One of the influential factors in the sound health of man is to establish and maintain in his organization a resisting power to the causes of disease; 4. The tendency is to overdress, enervating the skin, and curtailing its power, and thereby the power of the whole system, to resist the causes of disease; 5. A proper exposure of the surface of the body to envolving low temperature is a valuable general tonic; 6. Ventilation of the skin is indispensable to good health; 7. Habit may enable one to bear wide differences in clothing under similar surroundings without detriment, and this should impress the necessity of cultivating correct habits of dress.

A paper on "Causes and Prevention of Infant Mortality" was presented by Dr. Jerome Walker of Brooklyn. Dr. Walker finds from statistics that the common belief was not sustained that infant mortality in this country had decreased of late years. The hope of the future lies in a radical change, so that mere political doctors may not control the health boards, and in the sanitary education of the masses. The speaker said, "We may conclude from what is known of institutions for children, (1) that a large proportion of the deaths in them are preventable; (2) that the younger the children and the larger the number, the greater the mortality; (3) that the mortality can be lessened, but the decrease costs money, time, patience, and energy; and to obtain the best results the attending and resident physicians should be reliable, should be given control over all medical and sanitary matters, and should be held responsible for the same."

In the next paper, on "The Relations of the Dwellings of the Poor to Infant Mortality," by Alfred F. White, C.E., of Brooklyn, were quoted statistics to show that such institutions as the Peabody Association of London were needed here. Through the reforms thus instituted in tenement-house construction, the infant mortality of London had been reduced to 15 per cent of all deaths, while in this city it was 26 per cent.

Dr. George Homan of St. Louis, secretary of the Missouri State Board of Health, read a paper advocating the employment of better men as local health-officers at higher pay.

In the evening the delegates and their friends went to the Academy of Music. Dr. J. H. Raymond opened the exercises with a short address of welcome. Mayor Chapin welcomed the delegates on behalf of the city, and Dr. Hutchins performed a similar office for the medical profession. Then came the address of President Johnson. His purpose, he said, was to talk to the people, not to scientists. He said,—

"A death from typhoid-fever now means not so much a dispensation of Providence as it means foul water, foul food, or foul air. A city is decimated by a pestilence, and it is found that its foundations are honeycombed with cesspools, and its drinking-water is diluted sewage. The judgments of God, in the light of these revelations, become no more mysterious than the pains of the child that laughingly thrusts its tiny finger into the brilliant flame only to feel the terrible infliction that follows. There has come to be an enthusiasm in the medical profession on this subject which has made itself felt in various ways. This zeal has communicated itself to the public. An intelligent foundation has been laid for sanitary reforms.

"As typhoid-fever is a greater calamity than Texas-fever, as Asiatic cholera is more to be dreaded than hog cholera, so do we need a department of public health more than a department of agriculture, a bureau of vital statistics more than a bureau of animal industry.

"The death-rate of twenty-six of the principal cities of America, with a population of 9,873,448, is 20 per 1,000. I think it morally certain that this rate could be reduced by means and methods now known to sanitary science to 16 per 1,000, and probably still less than that. The death-rate for London for the year 1888 was 18.5 per 1,000. This can be still further reduced. That of New York and Brooklyn for the same year, taken together, is 25.5 per 1,000; New York, 25.9; Brooklyn, 23.7. The death-rate of these two cities, if reduced to that of London, would secure a saving of 7 per 1,000, or annually 15,986 lives. These lives are public wealth.

"But this is not all. For one death annually two persons are sick during the entire year, or, in other words, there are two years of disabling sickness to one death, 31,972 years in New York and Brooklyn of sickness, preventable sickness, annually. The value of these years of sickness cannot be reached with accuracy; but the wages lost on account of sickness, the cost of care and maintenance during sickness and convalescence, and the money-value of the lives destroyed, considering them only as machines, will, in New York and Brooklyn, reach annually into the millions. I venture to suggest to the business-men of these cities that this loss is enough every year to buy a great railroad or to build and subsidize a fleet of ocean-going steel steamships."

The session continues through Friday, while the sanitary exhibition will continue for some weeks.

PROGRESS OF CHINA.

MR. R. S. GUNDRY read a paper on "Industrial and Commercial Progress in China" to the British Association last month. Premising that the wide differences in character and habits of thought between Europeans and the Chinese made it difficult to convey to an English audience an accurate impression of the situation, the paper, as reported in *The Scottish Geographical Magazine*, went on to sketch the leading features of Chinese industry and commerce in so far as they concerned, and had been affected by, foreign enterprise. Beginning to move at a time when she had been defeated in a foreign war, China's first efforts were to provide herself with the warlike material which experience had shown her to be so powerful: hence the early construction of arsenals and steamers. The beginnings of telegraphs, and the acceptance in principle of railways, were due also, in a measure, to warlike stress in connection with Kulja and Tongking; and mining was recognized largely as a means of providing for all this additional expenditure. But imperfection of knowledge, jealousy of foreign supervision, and a disorganized condition of finance, which involves venality and harassing taxation, retard a progressive movement, to which the *literati* who constitute the mind of the nation are still as a body disinclined. The imperial finances, too, have been strained by a series of wars, rebellions, and disasters; and distrust of their officials prevents native capitalists from investing money in enterprises with which the officials persist in meddling. The great staples of tea and silk are severely menaced by the competition of India and Ceylon in the one case, and of southern Europe in the other; and the Chinese are slow to accept improved methods of preparation which would enable them to hold their own. China tea is heavily handicapped also by taxation, in competition with its duty-free rival. Fiscal hinderances, imperfect communications, and consequent cost of transport, have much to do with the slow development of trade. But the wide prevalence of domestic industry, and difficulties of exchange caused by the demonetization of silver, tend also to check the anticipated growth of demand for European manufactures. There seems every prospect that more railways will shortly be constructed, and that machinery will be tentatively admitted for purposes of industrial manufacture; but much time, and a more widespread desire for progress, and radical financial reform, will be required before China is likely to rival Japan in the completeness of its transformation.

JADE IN BURMAH.

ACCORDING to a recent official report from Burmah, the jade-producing country is partly enclosed by the Chindwin and Uru Rivers, and lies between the 25th and 26th parallels of latitude. Jade is also found in the Myadaung district, and the most celebrated of all jade deposits is reported to be a large cliff overhanging the Chindwin, or a branch of that river, distant about eight or nine days' journey from the confluence of the Uru and Chindwin. Of this cliff, called by the Chinese traders "Nantclung," or "difficult of access," nothing is really known, as no traders have gone there for at least twenty years. Within the jade tract described above, small quantities of stone have been found at many places, and abandoned quarries are numerous. The largest quarries now worked are situated in the country of the Merip Kachins. The largest mine is about 50 yards long, 40 broad, and 20 deep. The season for jade operations begins in November, and lasts till May. The most productive quarries are generally flooded, and the labor of quarrying is much increased thereby. In February and March, when the floor of the pit can be kept dry for a few hours by baling, immense fires are lighted at the base of the stone. A careful watch is then kept in a tremendous heat to detect the first signs of splitting. When this occurs, the Kachins attack the stone with pickaxes and hammers, or detach portions by hauling on levers inserted in the cracks. The heat is almost insupportable, the labor severe, and the mortality among the workers is high. The Kachins claim the exclusive right of working the quarries, and there is not much disposition on the part of others to interfere. Traders content themselves with buying the stone from the Kachins. The jade is then taken by Shan and Kachin coolies to Namia Kyank-seik, one long day's journey from Tomo. Thence it is carried by dug-outs down a small stream, which flows into the Tudaw River, about three miles below Sakaw, and down the Tudaw River itself to Mogaung.

MENTAL SCIENCE.

New Experiments upon the Time-Relations of Mental Processes.

IN the preceding issue of this department an account was given of certain experiments measuring the time of re-action to words, both simply and when the movements of the five fingers were associated respectively with five words or five general classes of words. The results revealed a striking difference, according as the attention is directed to the sensory factors of the process and their appreciation, or the motor factors and their execution. The latter is a much briefer act, and seems to require a quite different series of mental processes from the former. To the theories explaining these and other facts we shall recur in this study. Dr. Münsterberg continues the work by applying similar methods to the study of association, judgments, and in general more complex operations.

I. As the more mechanical process in every association consists in hearing and understanding a spoken word and in speaking a word, we can easiest measure how much time is needed to accomplish this part of the process by measuring the time intervening between the speaking of a word by the experimenter and the repetition by the subject. Throughout this study there are two subjects, M and R; and in addition to the time there is given in parentheses the average variation, α , which marks the relative constancy, regularity of the process measured. As the words used in later experiments were both monosyllables and others, these were introduced at the outset, care being taken by the experimenter when calling a polysyllabic word to press the key in speaking the last (or the last accented) syllable, and by the subject always to press the key when speaking the first syllable of his reply-word. The simple repetition of a word, then, was accomplished by M in .403 of a second (α , .060); by R, in .362 of a second (α , .070).

II. Here, instead of repeating the called word, one re-acts by calling as quickly as possible a word associated in any way whatever with the first; that is, an ordinary "association-time." M does this in .845 of a second (α , .140); R, in .948 of a second (α , .170). The shortest time was for "gold-silver" (.390 of a sec-

ond); the longest, for "sing-dance," "mountain-level" (from 1.100 to 1.400 seconds).

III. Instead of accepting the first association formed with the call-word, the experimenter requires a word bearing a definite relation to that word. What this relation is to be is announced just before the call-word itself. The relation is always such as to admit of several replies. Such general rubrics as, given a country to name a city in it, or given a general term to name a particular instance of it, sufficiently well describe what was wanted. However, the same rubric was not repeatedly given in succession, as Cattell had done (for this gives too much scope for preparing the answer), but all kinds of relations were employed in an arbitrary order. This "limited" association occupies M .970 of a second (v , .200), and R 1.103 seconds (v , .210); or .125 and .155 of a second longer than II. The shortest times were found, rather suggestively, in naming an instance of "a German wine, — Rüdelsheimer;" "a number between 10 and 4, — 6;" "a Greek poet, — Homer;" — all between .450 and .600 of a second. The longest were "beast of the desert, — lion;" "French author, — Voltaire;" "a drama of Goethe, — Götz;" — between 1.200 and 1.500 seconds.

IV. Here the associations were still further limited, there being in each case only one correct association: it is in the nature of question and answer. Though, of course, the question was not asked in full, it was easily understood as such; nor was the query such as to immediately suggest an evident answer. The average time was, for M, .808 of a second (v , .180); for R, .889 of a second (v , .140); or .162 and .214 of a second shorter than III. It thus takes longer to name a drama of Schiller, than *the first* drama of Schiller. Times between .400 and .600 of a second were, "Three times four, — Twelve;" "On what river is Cologne? — Rhine;" "In what season is June? — Summer;" "In what continent is India? — Asia." The longest times, 1.100 to 1.300 seconds, were needed to answer the following questions: "By what author is Hamlet? — Shakespeare;" "What is the capital of Baden? — Karlsruhe;" "What is the color of ice? — White;" "Who was the teacher of Plato? — Socrates." These times seem to be influenced by momentary fluctuations of the mind as well as the intrinsic difficulty of the question.

V. As in IV., there is but one correct answer: but this is not obtained simply as an act of memory, but some process of comparison and judgment must be gone through after the question is proposed; e.g., "Which is larger, — a lion or a mouse?" "Who is greater, — Hume or Kant?" First the general nature of the comparison is announced, then the special terms to be compared. An actual test shows no difference in time when the correct answer was the first and when it was the second of the two terms. M's average time was .906 of a second (v , .180); R's, 1.079 (v , .220) seconds. Most quickly answered (.600-.800 of a second) were, "What smells better, — cloves or violets? — Violets;" "Who is greater, — Virgil or Ovid? — Virgil;" "What is prettier, — woods or mountain? — Mountain." It took longest (1.200-1.500 seconds) to answer, "What is healthier, — swimming or dancing? — Swimming;" "What of Goethe do you know better, — drama or lyric? — Lyric;" "What is more difficult, — physics or chemistry? — Chemistry."

VI. This variation consisted in employing the same general line of questions as in the foregoing, but preceding the question with a series of about a dozen words of the same general class as the two to be compared, and mentioning the two among the number. Thus, "Apples, pears, cherries, nuts, peaches, grapes, strawberries, dates, figs, raisins; which do you like better, — grapes or cherries? — Cherries." The questions were prepared in advance, and read as monotonously as possible. The result was, for M, .694 of a second (v , .130); for R, .659 of a second (v , .160); or .212 and .420 of a second shorter than V., — certainly a striking result. Among the shortest times (.400 to .600 of a second) were "[mentioning twelve composers] Who is greater, — Glück or Bach? — Bach;" "[two vowels] Which is more important, — Rome or Madrid? — Rome." Among longest times (.800 to 1.000 second) were "[ten classical dramas] Which is more taking, — Götz or Tasso? — Götz;" "[ten colors] Which goes better with blue, — yellow or green? — Yellow."

VII. Here we combine III. and V. Instead of first asking, "What is a drama of Goethe?" (III.), and then "Which is the finest of Goethe's dramas, — Götz, Faust, etc.?" (VI.), we ask at once, "Which is the finest of Goethe's dramas?" the subject having first to recall what the dramas are, and then to make his choice. For this, M requires .962 (v , .180), and R 1.137 (v , .160), seconds; or only .008 and .034 of a second more than in III. The shortest times (.600-.700 of a second) were in answering "What is the pleasantest odor? — Rose;" "Which is the most important German river? — Rhine;" the longest (1.400 to 1.600), in answering "Who is the most difficult Greek author? — Pindar;" "Who is your favorite French writer? — Corneille."

VIII. By adding a comparison to the process in VII., we have the scheme of VIII.: e.g., "Which is the more westerly, — Berlin, or the most important German river? — [answer] Rhine;" or, "What letter comes first in the alphabet, — L, or the initial letter of the name of the prettiest tree? — [answer] Beech." This very complex process engaged M for 1.844 seconds (v , .370), and R for 1.866 seconds (v , .340). Here the variations in the difficulty of the questions and the alertness of the individual become rather important. A still more complicated scheme was attempted, but the results proved too variable. The questions were of this type: "What is more impressive, — Shakespeare's finest drama, or Wagner's finest opera? [answer] *Lohengrin*." The result for M was 2.197 seconds (v , .970); for R, 2.847 seconds (v , .720). It is the scheme of VIII. with case VII. in each term of the comparison.

IX. This bears the same relation to VIII. that VII. does to IV. The type of query would be, "Which lies more westerly, — Berlin, or the river on which Cologne is situated [it is a comparison in which one term is reached by the substitution of a concrete for a generally described term]?" or, again, "Which is less, — 15, or 20 — 8?" "Who lived later, — Klapstich, or the author of 'Lear'?" The times were, for M, 1.291 seconds (v , .180); for R, 1.337 seconds (v , .230). These times are .553 and .529 of a second less than VIII., although the differences between VII. and IV., which have the same relation pair to pair, were only .154 and .248 of a second.

X. This is IX. preceded by a series of words of the same category as the terms of the comparison: e.g., the experimenter first calls twelve names of parts of the body, and then, "Which is larger, — the hand, or that with which one smells?" "[ten colors] Which is lighter, — blue, or the color of sulphur?" Here we have the same process of shortening the time as in VI. The times are 1.153 seconds for M (v , .170), and 1.145 seconds for R (v , .210); or .138 and .192 of a second less than IX. The results of the ten cases are based upon about 800 experiments.

Finding the current theory¹ entirely unable to explain these results, Dr. Münsterberg attempts an explanation upon the principle "that a stimulus begins to have an effect before the latter is consciously perceived," and that "the process consists in the re-awakening of the effects of previous stimuli, so that it is shortened by any circumstances tending to call up these reproductions in advance of the stimulus." We must note that all these associations are really of the form of judgments. When we are asked to associate a word with a given word, we really do not answer with the first impression that may be passing through our minds at that particular moment; but we give a word called up by the former, and the relation to which we more or less clearly recognize. The question is, "Name a word standing in some relation to the following word;" and our answer is, "This word answers this description." Every such judgment, again, is the assertion of identity between two objects standing in different associative relations. When we say the beech is the prettiest tree, we mean that the thing that from one aspect we call and recognize as a beech, and the concept which from another aspect we describe as the prettiest tree, are one and the same.

The mind can be placed in more or less favorable attitude for the calling-up of these association ties, and thus the time as measured be shortened; and again the calling-up of certain associative

¹ The theory as represented by Wundt would require the limited association to take longer than the unlimited, because it involves the latter and something more; but IV. requires less time than III. or II. Again, as VII. is composed of III. and V., we should get the times by the addition of these two times; but this gives far too large results. Other discrepancies could easily be pointed out.

links in itself be a sufficient means of appreciating the appearance of other closely related trains of thought. Under this general position, it remains to interpret the following four characteristics of the results, which may be regarded as the most essential outcome of the study: first, the time of a limited association is longer than the time of a free association (III. is longer than II.); second, univocal association (where the answer is limited to one) is less than the limited, or even than the free (IV. is less than III. or II.); third, by reading a series of words belonging to the same category as the words to be compared, the time of the mental process is much shortened (VI. is less than V., and X. than IX.); fourth, the combination of any two or three factors in the same process takes less time than the sum of the times needed to perform each of the factors separately (VII. is less than the sum of III. and V., less the time of I., which is counted twice). The first fact is not new, and is explained by considering that in both cases, III. and II., several associations present themselves to the mind, but that, while any one of them will answer in II., some may have to be rejected (or the association inhibited) in case III. The second fact is more striking, and seems to mean that the mind does not run over the general category and select the one answering to the particular relation, but takes the nearest and usually prominent association of the limited character. Irrelevant associations do not consciously reach the focus of apperception. The third fact brings out the mechanism of preparation. When a series of words is read, and we know we are to compare some two terms of the series, we anticipate the general kind of comparison, and so shorten the process. We throw out all those associations with the terms in question other than those which they have in common with the series of words read. The fourth fact accentuates the importance of the position that the mind can do more than one thing at a time. If each mental process had to be finished before the next one is begun, such acts as reading ahead, as forming a sentence or an argument while speaking other words, would be impossible. The results distinctly show how the various processes overlap in time, and form that rich complexity of inter-associated and mutually dependent factors that is the charm as well as the strain of mental labor.

THE NATURE OF NEGATIVE HALLUCINATIONS.—M. J. Foutan has recently devised an interesting method of showing that in hypnotism the physiological processes remain, while their psychic interpretation is altered. If a subject be told that he sees nothing red, every thing of this color falls out of his mental horizon, and we have an ordinary instance of a negative hallucination. If, now, the red object viewed be a red light, and if we suggest to the subject that when a bell is sounded he will again be restored to normal vision, and if as the bell is sounded the light is put out, the subject sees a light of the complementary color, green, just as he would have done when normally viewing a red light. While the brain refuses passage to the sensation of red, the retina is impressed with it, and re-acts to it, just as though the action were normal in every respect.

ELECTRICAL NEWS.

The Telephone on Railways.

THERE has been in use on the Austrian State railways a portable telephone that can easily be attached to a passing wire so as to place the trainmen in connection with the neighboring stations. An exhibition of the apparatus was recently made before a number of Austrian railway-men on a line running from Hüttelsdorf to Purkersdorf, with satisfactory results.

THE DURATION OF A LIGHTNING FLASH.—The researches of Trouvelot, Colladon, and Dufour have shown that the duration of a lightning-flash is not infinitesimal, but that the flash lasts a measurable time. For instance: if one sets a camera in rapid vibration, and exposes in it a plate so as to receive the impression of the flash, it is found that the impressions appear widened out on the negative, showing the negative to have moved during the time the flash was in existence.

ARTHUR WINSLOW has entered upon the duties of State geologist of Missouri, with headquarters at Jefferson City, and the work of the survey is now begun.

BOOK-REVIEWS.

The Struggle for Immortality. By ELIZABETH STUART PHELPS. New York, Houghton, Mifflin, & Co. 16°. \$1.25.

THIS book is characteristic of the times, and could not have been written at any other period. The authoress is a Christian of the new liberal type, — a type so different from the old that it seems another thing, — and she is a passionate believer in immortality. She presents her views and arguments in an epigrammatic style and generally with clearness, and her book is certainly entertaining. Unhappily she is a pessimist of a rather extreme type, declaring expressly that there is far more pain than pleasure in this life, and consequently, that, if there is no other life before us, God is not good. She admits, however, that with rare exceptions men cling tenaciously to this life, which seems very strange if it brings a surplus of pain. She insists that there is more in man than material forces can account for, and adduces the phenomena of hypnotism and telepathy in support of this claim. Her theory of immortality is as set forth in the following passage: "Immortality is not a right, but a privilege. . . . This gift is offered to you or me upon conditions which we can accept or deny at will. The founder of our religion makes, we may say that he constitutes, the conditions. Everlasting life is, in fact, according to this religion, bestowed by Jesus Christ upon the human soul. The consequence of declining this gift and its conditions would seem to be logically, if not theologically, wrapped in the phrase 'everlasting death'" (p. 137). This means, if we understand it, that, if we live like Christ in this world, we shall live forever in another and happier one; but if not, we shall be annihilated. Hence arises a "struggle for immortality" analogous to the struggle for existence here, in which we may win or lose according to our conduct. This seems to us rather singular doctrine; yet there is much in the book that is both true and valuable, and it will serve to some extent as an antidote to the prevailing spirit of negation.

A Dictionary of Electrical Words, Terms and Phrases. By EDWIN J. HOUSTON. New York, The W. J. Johnston Co. 16°. \$2.50.

THE need has long been felt of some work that should give good definitions of the terms which have come into use in the electric science and practice that have been brought into existence mainly within the past ten or twenty years. The larger dictionaries are too slow in adopting new words to serve this special purpose. In fact, some of the terms defined in Houston's "Dictionary" may be out of use, and no longer words in any proper sense as conveyors of ideas, by the time they figure in Worcester or Webster. Such is the march of language with those who are creating apparatus and phenomena never before existing. It is unnecessary to introduce the chief editor of this electrical dictionary to our readers. Professor Houston is too well known to need this. What he has done in the dictionary is, first, to give a concise definition of each word or phrase, and then a brief statement of the principles of the science involved in the definition, that it may be clear, in so little trodden a field, just what the definition means. This statement is frequently illustrated by appropriate cuts. To some extent the short explanations make the work encyclopedic in its character.

This is a first edition, and it may be that the difficulty of introducing a phrase under the most appropriate catch-word, so that it may be readily found, has not been completely overcome; yet such an elaborate system of cross-references has been introduced as to overcome this trouble to a great extent. We must say we have found it satisfactory in use so far.

The publishers are to be commended for the large number of illustrations they have placed at Professor Houston's command.

AMONG THE PUBLISHERS.

THERE is announced to appear Nov. 2, 1889, and each Saturday thereafter, *Nature*, a weekly journal for the gentleman sportsman and naturalist, to which the contributing editors will be William C. Harris, Charles Hallock, Charles Barker Bradford, and J. Charles Davis. The articles will include sketches about all kinds of game-hunting; sketches about all kinds of game-shooting; sketches on

the hunter's camp; sketches on life in the woods; articles on guns, gunning, and ammunition; articles on game birds and animals; articles on game dogs; on the mountains and in the meadows; in the woods and on the waters; abroad in the fields and forests, and stories about rural nature in general; special articles by the leading sportsmen writers. The Nature Publishing Company, No. 10 Warren Street, New York, will publish the paper.

— *Outing* for November has for its leading article, "A Winter's Sport in Florida," by O. A. Mygatt. Other principal articles are "Whaling," by Herbert L. Aldrich; "Our Four-footed Friends," by "Borderer;" and "The Orange Athletic Club." Other articles are, "Lobsters and Lobster Pots;" "Crankslinger Skaddle Rides Back to his Youth," a cycling story by President Bates; "Squirrel-Hunting;" and the hunting story, "Over Rag Wheel Mountain."

— Charles Scribner's Sons published last week "The Viking Age," by Paul B. Du Chaillu. This work is the product of many years of incessant labor in the collection and arrangement of facts which throw light upon the character of the progenitors of the English-speaking race. Recent researches have made it clear that those Northmen who at the decadence of the Roman Empire overran and settled in Britain and the northern coast of Germany and France, were not barbarians, as has long been erroneously supposed, but a most highly civilized and accomplished people. Vast quantities of objects, including arms and armor, gold and silver ornaments of the most skilful workmanship and refined beauty, wood-carving, filigree work, agricultural and domestic implements, magnificent carriages, etc., have been unearthed. The work is in two octavo volumes, and contains 1,400 illustrations.

— The Reform Club, New York, has just issued a tariff dictionary, explaining the specific and ad valorem duties as imposed on every article under the present law, and as proposed by the Mills and Senate bills. It has been prepared by the tariff-reform committee of the club.

— G. P. Putnam's Sons have just ready Alfred Church's "To the Lions," a story of the persecution of the Christians under the early Roman Empire; and "The Story of Boston," by Arthur Gilman, in the series of Great Cities of the Republic.

— Gebbie & Co., Philadelphia, have just issued "Froudacity: West Indian Fables by James Anthony Froude," explained by J. L. Thomas, — a criticism of Mr. Froude's late book on the West Indies, written by a native in defence of his colored companions in the West Indies.

— J. G. Cupples Company announce a little book entitled "The Elixir of Life," being a compilation of what has been written concerning Dr. Brown-Sequard's discovery. It also contains Dr. Brown-Sequard's own account of his famous alleged remedy for debility and old age, Dr. Variot's experiments, and a sketch of Dr. Brown-Sequard's life, and a portrait.

— Longmans, Green, & Co. are about to issue an outline history of the development of modern music, showing the growth of opera, oratorio, and symphony, without digressing into mere biography of composers. It has been prepared by Mr. W. J. Henderson of the *New York Times*, and it will be called "The Story of Music."

— *Sun and Shade*, published by the Photo-Gravure Company, New York, has just concluded the first volume of a most successful year. Starting almost as an experiment, with a list of less than fifty subscribers, it has, by dint of its excellency, won for itself, as its publishers claim, a circulation of four thousand copies monthly. It is a novel undertaking, in that it is simply a picture periodical without letterpress excepting a table of contents. In the next volume will be presented reproductions of leading pictures in the Metropolitan Museum of Art; portraits of prominent leading men, first among which will be one of Mr. W. H. Appleton, the senior of the firm of D. Appleton & Co., to be followed by one of Henry George; and reproductions of the works of American artists, whether painters, sculptors, or architects. The reproductions, by whatever process, are all of the very best quality. The subscription price is four dollars per year.

— J. B. Lippincott Company have just ready a work entitled "Cycling," by R. P. Scott, which will be of interest to all who are fond of the exhilarating and healthful sport afforded by the bicycle,

tricycle, etc. The book contains a great deal of curious and useful information for wheelmen, and is illustrated by numerous engravings showing the development of the "wheel" itself.

— Judge S. M. Green, well known as the author of a number of legal works, embodied in an excellent treatise on crime, to appear shortly from the press of J. B. Lippincott Company, the opinions and settled convictions to which he has been led by a long experience as judge both in the circuit and supreme courts of Michigan. While the volume will naturally be of much service to lawyers, it is not specifically a legal book, but is a popular, and at the same time exhaustive, discussion of the nature, causes, treatment, and prevention of crime. The author looks on the criminal as diseased, and enables us to sympathize with him while we hate his crime, and, moreover, encourages us to bright hopes and strenuous effort for his cure.

— The Geological Survey of Pennsylvania has issued "A Dictionary of the Fossils of Pennsylvania and Neighboring States named in the Reports and Catalogues of the Survey," compiled by J. P. Lesley, State geologist. There are given three thousand figures of all the forms of animal and vegetable life hitherto seen in the geological formations of the State, both those collected by the assistant geologists of Professor H. D. Rogers, fifty years ago, and those collected since 1874.

— The "Bibliographical Catalogue of the Described Transformations of North American Lepidoptera," by Henry Edwards, issued by the Smithsonian Institution as Bulletin No. 35 of the National Museum, will supply a want that has long been felt by many entomologists, and will be acceptable to the students of the earlier stages of North American *Lepidoptera*. In its compilation, the author has occupied a good portion of the spare time at his command for three years past, and has carefully examined every publication that has been accessible to him.

— By permission of the Institution of Civil Engineers, the Scientific Publishing Company of this city publish the admirable paper of Sir Frederick Abel on "Mining Accidents," and the instructive discussion of it by the best-informed experts in Great Britain. This book summarizes the most advanced modern practice in coal-mining and the prevention of accidents; and it should be in the hands of every one interested in mining, as it is unquestionably the most valuable treatise on coal-mining in the language. In order to still further increase its value, the laws governing coal-mining in every State and Territory in the Union, and those of Great Britain and of the chief German mining districts, have been added to it.

— "A Preliminary Catalogue of the Shell-bearing Marine Mollusks and Brachiopods of the South-Eastern Coast of the United States," with illustrations of many of the species, by William Healey Dall, A.M., honorary curator, Department of Mollusks, United States National Museum, has just been issued by the Smithsonian Institution. This work is intended to assist students of the *Mollusca* in the United States by bringing together for their use a large number of excellent figures of species belonging to or illustrating the fauna of the southern and south-eastern coasts of the United States, from Cape Hatteras south to the Straits of Florida, and west to Mexico, with the adjacent waters. These figures are explained and connected by a catalogue of the mollusks known to inhabit that region, either from the presence of authenticated specimens in the National Museum or on the authority of reputable naturalists who have collected in the region, and whose specimens have been seen or reliably identified. This catalogue, arranged for convenience in tabular form, includes not only the species which are illustrated on the plates, but all other species common to the region, as far as known.

— J. E. Munson, Tribune Building, New York, has reprinted his important "Phonographic Phrase-Book," which has long been out of print.

— D. C. Heath & Co. will issue at once Hoffman's "Tales from History." Every student of German should read something of an historical nature, and the difficulty lies in finding something brief enough for class use. These tales are short, and independent of each other, and yet complete enough to insure sustained interest. The notes are both historical and explanatory. This firm will also

issue at the same time Freytag's "Aus dem Staat Friederichs des Grossen," with notes explanatory and critical, by Herman Hager. In this sketch we have not a detailed account of the facts of Frederick's life, but the author directs his attention mainly to the working of the hero's mind, to the gradual building-up of that character which came to be the moulding force of Germany. An appendix adds some notes on the phonetic changes in German, and special attention is given to awaken an interest in the gradual development of the meaning of words.

— Macmillan & Co. have just ready "Select Essays of Dr. Johnson," edited by George B. Hill, in the Temple Library; a selection of the best essays of De Quincey, edited by W. H. Bennett, in the Stott Library; and a new library edition of Wordsworth, in eight octavo volumes.

— From the *Publishers' Weekly's* "Notes on Authors," we learn the following: Friedrich Spielhagen is reported to be writing his autobiography. It is to be issued in instalments in a new German magazine. Miss Kate Field, the author and lecturer, contemplates starting a journal. Gustav Freytag, the novelist, will shortly publish a little work on the late Emperor Frederick, taken from his notes during the war, and his letters from the camp down to the election of the German Emperor. Horatio Seymour of Marquette, Mich., who was formerly State engineer of New York, is preparing for publication the correspondence of Gov. Horatio Seymour, and desires to secure copies of letters not already in his possession.

— In spite of the rapid increase in the number of millionnaires in the United States in recent years, the popular notion is that wealth is yet very much more evenly distributed in this country than in England. Mr. Thomas G. Shearman, the well-known New York statistician, has been engaged for some time in collecting facts to show as precisely as possible the proportion of the wealth of the country held by a few rich men and families; and he finds a greater concentration of wealth here than in any other country. The results of his investigation will appear in *The Forum* for November, from advance sheets of which the following facts are taken. Mr. Shearman makes the following enumeration of owners of more than \$20,000,000 each: \$150,000,000, J. J. Astor, Trinity Church; \$100,000,000, C. Vanderbilt, W. K. Vanderbilt, Jay Gould, Leland Stanford, J. D. Rockefeller; \$70,000,000, estate of A. Packer; \$60,000,000, John I. Blair, estate of Charles Crocker; \$50,000,000, William Astor, W. W. Astor, Russell Sage, E. A. Stevens, estate of Moses Taylor, estate of Brown & Ives; \$40,000,000, P. D. Armour, F. L. Ames, William Rockefeller, H. M. Flagler, Powers & Weightman, estate of P. Goelet; \$35,000,000, C. P. Huntington, D. O. Mills, estates of T. A. Scott, J. W. Garrett; \$30,000,000, G. B. Roberts, Charles Pratt, Ross Winans, E. B. Coxe, Claus Spreckels, A. Belmont, R. J. Livingston, Fred Weyerhauser, Mrs. Mark Hopkins, Mrs. Hetty Green, estates of S. V. Harkness, R. W. Coleman, I. M. Singer; \$25,000,000, A. J. Drexel, J. S. Morgan, J. P. Morgan, Marshall Field, David Dows, J. G. Fair, E. T. Gerry, estates of Gov. Fairbanks, A. T. Stewart, A. Schermerhorn; \$22,500,000, O. H. Payne, estates of F. A. Drexel, I. V. Williamson, W. F. Weld; \$20,000,000, F. W. Vanderbilt, Theo. Havemeyer, H. O. Havemeyer, W. G. Warden, W. P. Thompson, Mrs. Schenley, J. B. Haggin, H. A. Hutchins, estates of W. Sloane, E. S. Higgins, C. Tower, William Thaw, Dr. Hostetter, William Sharon, Peter Donohue. These 70 names represent an aggregate wealth of \$2,700,000,000, an average of more than \$37,500,000 each. Although Mr. Shearman, in making this estimate, did not look for less than twenty-millionnaires, he discovered incidentally fifty others worth more than \$10,000,000 each; and he says that a list of ten persons can be made whose wealth averages \$100,000,000 each, and another list of one hundred persons whose wealth averages \$25,000,000. No such lists can be made up in any other country. "The richest dukes of England," he says, "fall below the average wealth of a dozen American citizens; while the greatest bankers, merchants, and railway magnates of England cannot compare in wealth with many Americans." The average annual income of the richest hundred Englishmen is about \$450,000; but the average annual income of the richest hundred Americans cannot be less than \$1,200,000, and probably exceeds \$1,500,000. The richest of the Rothschilds, and the world-re-

nowned banker, Baron Overstone, each left about \$17,000,000, Earl Dudley, the owner of the richest iron-mines, left \$20,000,000. The Duke of Buccleuch (and the Duke of Buccleuch carries half of Scotland in his pocket) left about \$30,000,000. The Marquis of Bute was worth, in 1872, about \$28,000,000 in land; and he may now be worth \$40,000,000 in all. The Duke of Norfolk may be worth \$40,000,000, and the Duke of Westminster perhaps \$50,000,000. Mr. Shearman's conclusion is that 25,000 persons own one-half the wealth of the United States; and that the whole wealth of country is practically owned by 250,000 persons, or one in sixty of the adult male population; and he predicts, from the rapid recent concentration of wealth, that under present conditions 50,000 persons will practically own all the wealth of the country in thirty years, or less than one in 500 of the adult male population.

— Col. H. G. Prout, in the November *Scribner*, gives the following pen-picture of Emin Pacha, whom he knew about thirteen years ago: "In person Emin is a slender man, of medium height and tough and wiry figure. He is swarthy, with black eyes and hair. His face is that of a studious professional man, and that impression is heightened by the glasses he always wears. His attitudes and movements are, however, very alert. He stands erect and with his heels together, as if he had been trained as a soldier. He was always reticent about himself, and his history was known to no one in the Soudan or the provinces of the equator. He was supposed to be a Mohammedan. I am not sure that he ever said that he was, but I am quite sure that he did not deny it when I knew him. It has become known later that he is German, of university education; but there were many at that time who thought he was a Turk of extraordinary acquirements. He is certainly a man of great abilities in many ways, and of strong character." There is a circle in Paris which pays weekly visits to the studio of a young Russian artist, Marie Bashkirtseff, who died five years ago. This ambitious and gifted young woman left a remarkable journal, which has been published in France, and has attracted many readers because of the frankness with which she here draws the complete story of her life, her ambition, her suffering, and her love. The book has many of the qualities which made Amiel's journal famous. Miss Josephine Lazarus, a sister of the poet, Emma Lazarus, will summarize this notable book in the same number of *Scribner*. William Henry Bishop, author of "The House of the Merchant Prince," who has been living abroad for the past year, has written, also for this number, a picturesque description of the old Spanish university of Salamanca, giving a clear idea of modern Spanish student life.

— In *Lippincott's Monthly Magazine* for November, Edward Heron-Allen contributes an article on "The Violin," which gives much information concerning that instrument. The poet-critic R. H. Stoddard continues his series of papers upon American authors by contributing a sketch of William Cullen Bryant. William S. Walsh has an article upon "Handwriting and Writers," in which he dilates upon the chirography of many famous people. Some funny stories are told of Horace Greeley, arising from the well-known illegibility of his handwriting. In "Does College-Training Pay?" D. R. McAnally severely arraigns the methods of instruction in our colleges, and hurls some hard facts at the dons, which it is to be hoped they will take cognizance of. "The Question of Pure Water for Cities" is an article contributed by William C. Conant, editor of *The Sanitary Era*. It contains suggestions for rendering water pure and drinkable, — suggestions that should be acted upon by the authorities in every large city. Melville Phillips, one of the editors of the *Philadelphia Press*, tells what it costs to issue big newspapers.

— "The Lost Inca," by the Inca Pancho-Ozollo, is one of Cassell's Sunshine Series of original novels. In this story, the scene of which is laid in Peru, the *dramatis personæ* mainly consist of a party of North American engineers and a newly discovered people in the valley of the Inti-Mayu. This party became suddenly and without preparation residents of the valley, and find there much cultivation and refinement, and themselves add many modern scientific appliances to an already advanced civilization. It is an historical fact that an Inca disappeared from history. The Spaniards declared that he was killed in an engagement: there is no proof of it. The bodies of the Spanish soldiers were found, but

none of the Indians; and it is still believed in Peru, among *las barbaras* in the upper Amazonas, that the descendants of this Inca still live. The author has found the Lost Inca: the Last Inca is not yet.

— Col. H. G. Prout (Baroud Bey), in his article on Emin's province in the November *Scribner*, says, "Emin's uncertain power in a savage land is all that remains of the late Khedive's Central African Empire. One day, in Khartoum, Gordon asked me what I thought would be the future of the Equatorial Provinces. I said, 'The power will gradually return to the Arabs, the negroes will kill their friends and tormentors together, and the good old times of war and famine will come back.' I am still of that opinion. Unless the enlightenment of Europe can control the upper Nile country, either through the Soudan or from the south, barbarism will control it. By control I mean physical control, and that must be directed by some one better than the Turk, the Arab, or the Circassian." Dr. James E. Pilcher, captain Medical Department, U.S.A., will describe in the same number the organization and appliances of the modern Sanitary Corps, which aims to relieve and care for the sick and wounded in the time of battle and in peace. The abundant illustrations of this article have been made from photographs of the corps actually at practice-work, and show very clearly the methods, which are of equal interest to all those who are members of the many societies for First Aid to the Injured, and the National Guard, which has adopted this system. In view of the congress of representatives of maritime nations in Washington, Professor J. Russell Soley's article will be of especial interest. He shows how certain principles of international law (which Great Britain has mainly been instrumental in establishing) will re-act to the disadvantage, and even great peril, of that nation in the event of another Anglo-continental war. He also discusses the effect which our navigation laws will have in preventing us to profit from the redistribution of the carrying trade which would ensue. Goethe's house at Weimar, from which the public have been excluded rigidly until within a year, will be fully described by Oscar Browning. The many illustrations are from the first photographs taken since the house was thrown open, and represent the rooms as Goethe left them. Dr. M. Allen Starr will describe the effects of electricity upon the human body. This subject is of special importance, owing to the frequent reports of accidents due to contact with electric wires, to the recent adoption of electricity as a means for executing criminals, and to the extravagant claims of the curative powers of electricity in diseases. Dr. Starr will draw the line very sharply between the legitimate use of electricity and quackery.

— The November issue of *The Chautauquan* presents the following table of contents: "The Burial of Rome," by Rodolfo Lanciani, LL.D.; "The Politics which made and unmade Rome," by President C. K. Adams, LL.D.; "The Life of the Romans," by Principal James Donaldson, LL.D.; "The Story of Sejanus," by George Parsons Lathrop; "Map Quiz" on *The Chautauquan* Map Series; "The Cause of Geographic Conditions," by Professor N. S. Shaler; "Mental Philosophy," by John Habberton; "The Uses of Mathematics," by Professor A. S. Hardy, Ph.D.; "Traits of Human Nature," by the Rev. J. M. Buckley, D.D.; "What shall the State do for me?" by Thomas B. Preston; "English Politics and Society," by J. Ranken Towse; "The Story of No Man's Land," by John R. Spears; "Maria Mitchell," by Harriet Prescott Spofford; "The French Constitution," by Albert Shaw, Ph.D.; "Electricity at the Paris Exposition," by Eugene-Melchior de Vogue; "In Armenian Villages," by Harriet G. Powers; "The Modern Thermometer," by Ernest Ingersoll.

— D. C. Heath & Co. will publish this month Lessing's "Minne von Barnhelm," a comedy in five acts, edited with notes and an extended introduction by Sylvester Primer. The play is highly interesting, since the style is Lessing's best, and the dramatic effects well sustained. The study of Lessing as a dramatist and a critic is essential to a comprehensive knowledge of Germany's great classic period: hence the importance of this masterpiece to students of German. In the introduction the editor gives the progress of German literature from the time of Opitz to Lessing, the condition of the German stage, and something of the intellectual development of the people during this period. A discriminating biogra-

phy of Lessing and a "critical analysis" of the play give a full analysis of the characters and an account of the historical and other sources, while its national importance as being truly German is well brought out.

INDUSTRIAL NOTES.

The Bower-Barff Rustless Iron Process.

ABOUT eighteen months ago, Mr. Henry M. Howe, the eminent metallurgist whose work on steel is now being published in *The Engineering and Mining Journal*, applied to several of the licensees of the Bower-Barff Rustless Iron Company for samples of cast and wrought iron which had been treated by the processes controlled by this company, for the purpose of testing their resistance to oxidation. Mr. Howe, who is now in Paris acting as United States iron and steel commissioner at the exposition, writes to the company as follows in relation to these experiments:—

"I have just summed up the results of my experiments in the matter of protective coatings for iron. I enclose table of results, which you may use if you want, and as you want. The Bower-Barff wins easily, beating even tinned and galvanized badly. The galvanizing was done by the Rhode Island Tool Company, whose work, I understand, is of the very highest; and they were informed that the work was for a test trial. The conditions were rigidly

Loss of Weight of Wrought and Cast Iron with Different Protective Coatings and under Different Conditions, in Pounds per Square Foot of Surface per Annum.

Sheet Iron (No. 23 Gauge, Black).

Protective Coatings.	Exposed to the Weather Inland.		Immersed in	
	Canada.	New York State.	Fresh Water.	Sewage.
Bower-Barffed...	.0	Gain .000.3	.006.7	.003.6
Tinned	Gain .002.0	.000.1	.019.4	.007.1
Nickel-plated. . .	.0	.000.5	.050.4	.003.1
Galvanized	Gain .000.4	.....	.045.9	.080.5
Barffed . . . . .	.001.0	.003.1	.083.9	.117.0
Black; i.e., un-protected....	.001.3	.022.6	.137.0	.169.0
Copper-plated....	.000.2	.005.0	.179.0	.182.0

Cast Iron.

Protective Coatings.	Exposed to the Weather Inland.		Immersed in	
	Canada.	New York State.	Fresh Water.	Sewage.
Bower-Barffed...	Gain .004.0	Gain .003.1	Gain .005.5	.001.4
Bower-Barffed and paraffined . . . . .	.000.6	.001.9	.000.2	.008.4
Galvanized . . . . .	.0	.0	.049.1	.061.0
Tinned . . . . .	.....	Gain .003.1	.065.5	.061.0
Nickel-plated. . .	Gain .003.4	.002.5	.136.7	.083.3
Copper-plated....	.004.0	.005.0	.150.8	.119.2
Black; i.e., un-protected . . . . .	.006.3	.012.0	.148.3	.272.4

identical. It is a fair victory. I shall publish the results as an appendix to my "Metallurgy of Steel," and perhaps more fully thereafter. Immersed in Chestnut Hill Reservoir, Boston, for a year, the Bower-Barffed wrought-iron plate was hardly discolored, except where held by the crate. Another immersed in the Boston main-sewer sewage for a year retained its skin, and was only slightly pitted, while most of the tin was removed from a tinned iron sheet beside it. If you publish these, credit R. W. Lodge with doing the work with me. He put in a good deal of hard work and deserves credit."

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

Morris's "British Butterflies," Morris's "Nests and Eggs of British Birds," Bree's "Birds of Europe" (all colored plates), and other natural history, in exchange for Shakespeariana; either books, pamphlets, engravings, or cuttings.—J. D. Barnett, Box 735, Stratford, Canada.

I have *anodonta* of *alina* (Weatherly), and many other species of shells from the noted Koshkonong Lake and vicinity, also from Western New York, and fossils from the Marcellus shale of New York, which I would be glad to exchange for specimens of scientific value of any kind. I would also like to correspond with persons interested in the collection, sale, or exchange of Indian relics.—D. E. Willard, Albion Academy, Albion, Wis.

Will exchange "Princeton Review" for 1883, Hugh Miller's works on geology and other scientific works, for back numbers of "The Auk," "American Naturalist," or other scientific periodicals or books. Write.—J. M. Keck, Chardon, Ohio.

A collection of fifty unclassified shells for the best offer in bird skins; also skins of California birds for those of birds of other localities. Address Th. E. Slevin, 2413 Sacramento St., San Francisco, Cal.

I have forty varieties of birds' eggs, side blown, first class, in sets, with full data, which I will exchange for books, scientific journals, shells, and curios. Write me, stating what you have to offer.—Dr. W. S. STROOK, Bernadotte, Fulton County, Ill.

I wish to exchange *Lepidoptera* with parties in the eastern and southern states. I will send western species for those found in other localities.—P. C. Truman, Volga, Brookings Co., Dakota.

Shells and curiosities for marine shells, curiosities or minerals address W. F. Lerch, No. 308 East Fourth St., Davenport, Iowa.

I want to correspond and exchange with a collector of beetles in Texas or Florida.—Wm. D. Richardson, P. O. Box 223, Fredericksburg, Virginia.

100 botanical specimens and analyses for exchange. Send list of those desired and those which can be furnished, and receive a similar list in return. Also cabinet specimens and curiosities for the same. Scientific correspondence solicited.—E. E. BOOTE, Orwell, Ashita County, O.

I will sell to chapters or individual members of the Agassiz Association, 25 fine specimens of fossil plants from the Dakota group (cretaceous), correctly named, for \$25.00. Send post-office order to Charles H. Sternberg (author "Young Fossil-Hunters"), 1033 Kentucky Street, Lawrence, Kan.

CALENDAR OF SOCIETIES.

Biological Society, Washington.

Oct. 19.—C. Hart Merriam, "Description of a New Spermophile from the Painted Desert, Arizona;" Theo. Holm, "The Ancestors of *Liriodendron tulipifera*;" Theo. Gill, "On the *Dactylopteroides*."

Engineers' Club, Philadelphia.

Oct. 19.—Mr. George N. Bell presented a paper upon "The Development of Suburban Property," in which it was clearly shown that this cannot be done to the best advantage without the assistance of systematic and intelligent engineering and landscape-gardening. The paper and kindred subjects were discussed by Professor Arthur Beardsley and Messrs. T. M. Cleemann and Howard Murphy.

Western Society of Naturalists.

The Western Society of Naturalists held its second annual meeting in the University of Wisconsin, at Madison, Wis., Wednesday and Thursday, Oct. 24 and 25, beginning Wednesday morning at 9.30 A.M. The president of the society, President T. C. Chamberlain, delivered his address, "The Method of Multiple Working Hypotheses in Investigation, in Instruction, and in Citizenship," on Wednesday evening. The meeting was largely devoted to a discussion of methods of investigation.

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It is almost as palatable as milk. Far better than other so-called Emulsions. A wonderful flesh producer.

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There are poor imitations. Get the genuine.



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To Enjoy a Cup of Perfect Tea. A TRIAL ORDER of 3/4 pounds of Fine Tea, either Oolong, Japan, Imperial, Gunpowder, Young Hyson, Mixed, English Breakfast or Sun Sun Chop, sent by mail on receipt of \$2.00. Be particular and state what kind of Tea you want. Greatest inducement ever offered to get orders for our celebrated Teas, Coffees and Baking Powder. For full particulars address THE GREAT AMERICAN TEA CO. P. O. Box 289, 31 and 33 Vesey St., New York.

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CAPITAL \$250,000.

Hon. ALBERT H. HORTON (Chief Justice, Kansas Supreme Court), Topeka, Kan., Pres't.

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The Company calls the special attention of Investors to the following points :

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- II. Unusual fullness of information, not only about the security itself, but about the general development of the section where the farm is located.
- III. An examination each year of the general business of the Company and the Mortgages themselves by a COMMITTEE OF INVESTORS sent for the purpose.
- IV. Many hundred Mortgages taken and NOT A SINGLE FORECLOSURE.
- V. Exhibitions in New York at frequent intervals, of Kansas and Nebraska Farm Products. The Exhibition at the American Institute in the fall of 1888, received the *HIGHEST AWARD* of superiority.
- VI. Monthly Bulletins giving full information about all Mortgages offered for sale.

Address for Monthly Bulletin and Investors' Committee Report for 1888.

HENRY A. RILEY, General Eastern Manager, 191 Broadway, N.Y.

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\$250,000. For a quarter of a million of dollars a year an advertisement as conspicuous as the familiar one of the "ROYAL BAKING POWDER" can be inserted in a choice position, head of column, and next to reading matter on yearly contract, to appear in every issue of a very large proportion of the newspapers published in America, but not, by any means, in all. A serious objection to attempting in advance to furnish any very definite and exact estimate of the cost of each particular paper to be used arises from the difficulty of making plain any proposed variation from specifications in particular cases; although such variation may better serve the advertiser at a materially lessened cost.

\$100,000 Will insert a one-fourth column advertisement on a yearly contract in a choice position in a judicious selection of the papers of every State and Territory of the Union. At one-fifth of a cent a line for each thousand issues, it will pay for inserting 100 lines of advertising in every publication in America *sixteen times*. Persons often ask for very large estimates who have neither the nerve nor the means to do the advertising. The application reaches us by mail. If we proceed to prepare the estimate asked for without any assurance of good faith on the part of the Advertiser we waste valuable time which is more profitably devoted to promoting the interests of actual customers whose business is already in hand.

\$50,000 Expended in a single month will place a conspicuous advertisement in a choice position in all the leading daily newspapers issued in towns of more than 20,000 population, and in all the weekly and monthly publications which issue more than 50,000 copies regularly. A page for one insertion in the *Century Magazine* costs \$350. One hundred lines in the *New York Daily Times* cost \$35.00 a day. If you constitute us your Agent to expend a fixed sum for you, in advertising, we shall do it to the best of our ability and our reputation for placing advertising on advantageous terms is very good.

\$25,000. The Advertisers whose business is transacted through our office in a manner most uniformly satisfactory and profitable to themselves, are those who trust us most implicitly. They tell us what they wish to accomplish and we prepare and submit plans which the Advertisers examine and revise. We then consult with the Advertiser and compare notes, after which the orders to insert are forwarded to such papers at such rates and for such periods of time as are decided to be best in each case. Twenty-five thousand dollars is sufficient to place a conspicuous advertisement for from one to three months in nearly all of the publications of the country which are really of exceptional value in proportion to the rates demanded.

\$5,000. One of the most successful Advertisers we ever had always ordered his advertisements in this way, "Get the best service you can for me for \$5,000," leaving every detail to us. We were thus enabled to say to a Publisher, if you put this in at a large reduction from your rate it will be no criterion for further transactions. It was a surprise to find ourselves so often able to contract for the insertion of that particular advertisement at half rates, in papers which would not permit us to OFFER their columns at a penny's deviation from their printed schedule. The advertising rates of one New York paper are double those of another which has twice the circulation

of the first. Similar discrepancies are not uncommon. The advertisement intrusted to us to be placed in accordance with our judgment often does double service for half the money. A dollar for twenty-five cents.

\$1,000. If we are given authority to insert advertisements to a limited amount, in such mediums as offer inducements which seem to us specially favorable, we shall not abuse the confidence reposed in us, and shall render statements of whatever is done (if anything) from day to day. When TRUSTED with the placing of an advertisement, we are put upon honor, and are bound in honor to give the best service possible for the money to be used.

\$500. Leading Newspapers, especially the leading Agricultural Newspapers, frequently issue large special editions (of twenty, fifty, a hundred, or even five hundred thousand copies,) and solicit advertisement orders from us on terms which would often be accepted by our patrons if there was time to invite attention to the matter; but the question must generally be decided before there would be time to write and receive a reply, and often the case cannot be fully stated within the limits of a letter.

\$250. Prepare a small advertisement and send with check for \$250, or any other sum. The practice of asking the Agent to name his papers in advance compels him to name such as are well known, otherwise there is reason to suspect that his judgment is biased;—and the best papers do not like to have their rates quoted below their schedule.

\$100. The Advertiser who sends his advertisements asking will often get from five to fifty per cent. more service for his money, than he would had he required us to tell him in advance exactly what service we would promise; for when an estimate has been given its plan and specifications must, in a general way at least, control the advertising to be done: It ties the Agent's hands and prevents his giving his patrons TO-DAY a better service than he could have promised yesterday, because yesterday the opportunity had not presented itself: *to-morrow it may have passed!* Some publications are used most economically on contracts for a single issue; in others insertion for a month may be had as cheaply as for a single week; but in furnishing an estimate in advance, if the Agent attempts to go into details, his correspondence becomes voluminous and the advertiser confused.

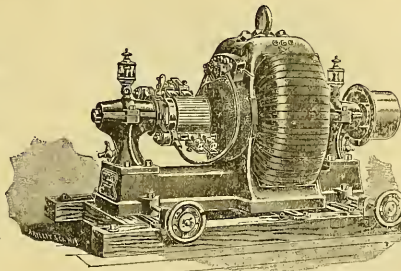
\$50. If you are in the habit of occasionally inserting a small advertisement in a few papers, investing a few dollars and carefully noting the result; we desire you to make trial of our Advertising Bureau, sending us the advertisement and the money, leaving the selection of the papers to us, and judging of the service rendered by results rather than by names, circulation claims or prices. To make up careful estimates calls for much work. It don't pay to make them indiscriminately for every applicant. If such estimates as are asked for were always given the Advertiser who wished to expend \$50 would frequently find himself in possession of a scheme which it would cost \$500 or possibly \$5,000 to carry out.

\$10. We devote all necessary care to placing small orders for Advertising:—even the smallest! Time is saved by sending check with the order. Often the Advertiser is not possessed of sufficient information on the subject to enable him to judge of the merits of an estimate for advertising, and he decides by the footings of the figures whether he will or will not do the work. Yet the estimate binds the Agent and makes it improper for him to make any variation in its specifications, however much his judgment may point to material changes which ought to be made. This is specially liable to be the case when the order comes a considerable time after the estimate was made.

GEO. P. ROWELL & CO., Newspaper Advertising Bureau, 10 Spruce St., N.Y.

C. & C. ELECTRIC MOTOR COMPANY.

Electric Motors
FOR
Arc and Incandescent
Circuits, Most Eco-
nomical Motor on
the Market.
Regulation Perfect.
Motors Designed for all
Power Purposes.



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402 and 404 Greenwich Street, New
York City.

New England Office, 19 Pearl St., Boston
Philadelphia Office, 301 Arch St.

Western Office, 139-141 Adams Street
Chicago.

Southern Office, 25 Carondelet Street,
New Orleans.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.

TEACHER OF NATURAL SCIENCE.— A young lady desires a position as a teacher of Natural Sciences, especially Chemistry and Physics. One year's experience. Testimonials given. Address Miss J. S., No. 31, N. Hanover St., Carlisle, Pa.

SCIENCE-TEACHING.— A specialist in science-teaching, physics, chemistry, and physiography desires an engagement, preferably in a high or a normal school. Is well known as an author of several popular text-books. Address X., care of SCIENCE.

COLLEGE ALUMNI AND PHYSICIANS.—The American Academy of Medicine is endeavoring to make as complete a list as possible of the Alumni of Literary Colleges, in the United States and Canada, who have received the degree of M.D. All recipients of both degrees, literary and medical, are requested to forward their names at once to Dr. R. J. Dunglison, Secretary, 814 N. 16th Street, Philadelphia, Pa.

WANTED.—A teacher of science in an **ENDOWED MALE COLLEGE** in Ky. Salary \$1200.00. Address "M. H." care of *Science* 47 Lafayette Place, N. Y.

WANTED.—Information concerning the handling of air from Caves, for Cooling and ventilating rooms. Address "M. H." care of *Science* 47 Lafayette Place, N. Y.

WANTED a young man with some knowledge of mineralogy to assist in our Mineral Department. A. E. FOOTE, 1223 Belmont Av., Philada., Pa.

LIGHTNING.— Concise descriptions of the effects of lightning discharges are desired. State whether the object struck was provided with a lightning rod, the character of the rod, and the way in which it was set up. Beginning at the top, describe briefly the effects. State whether there was any smoke or dust raised, and whether there was any odor. Any reports of recent and of especially interesting discharges will be published in *Science*.—*Science*, 47 Lafayette Place, New York.

A YOUNG MAN can have lucrative engagement, not only a fixed salary, but according to his work accomplished in travelling for SCIENCE. A personal interview invited.
N. D. C. HODGES,
47 Lafayette Place, New York.

WANTED.— By a large manufacturing house, an intelligent, energetic young man about twenty years of age, to make working drawings of electrical instruments from free-hand sketches and verbal assistance. Must be able to execute tinted drawings and tracings as well, and have a fair knowledge of general physics and principles of electrical measuring instruments. One who has had some practice in brass and machine work preferred, as also one who will remain and learn the business. Specimens of work required. Address, stating salary expected, experience and references, E. G. W., SCIENCE Office, N. Y. City.

PHYSIOLOGY AND HYGIENE.— A Fellow of the Mass. Med. Society, Member of the Suffolk District Medical Society, and former Assistant Editor of The Annals of Gynecology, desires a position as instructor in Physiology and Hygiene. Address "N," 47 Lafayette Place, N. Y. City.

MECHANICIAN—An optician and maker of instruments of precision of experience would be glad of a position where his skill would be valued in connection with some higher educational institution. Address G. J., care of SCIENCE, 47 Lafayette Place, New York.

A TEMPORARY BINDER

for *Science* is now ready, and will be mailed postpaid on receipt of price.

Half Morocco - 75 cents.



This binder is strong, durable and elegant, has gilt side-title, and allows the opening of the pages perfectly flat. Any number can be taken out or replaced without disturbing the others, and the papers are not mutilated for subsequent permanent binding. Filed in this binder, *Science* is always convenient for reference.

N. D. C. HODGES,
47 Lafayette Place, N. Y.



Readers of Science

Corresponding with or visiting Advertisers will confer a great favor by mentioning the paper.

SCIENCE CLUBBING RATES.

10% DISCOUNT.

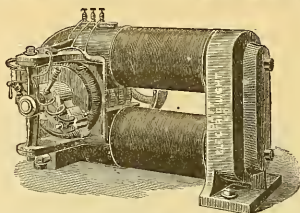
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Agricultural Science.....	\$ 3.50	\$ 5.30
American Agriculturist.....	1.50	4.30
American Architect and Building News Imperial edition.....	10.00	12.80
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Regular ".....	6.00	8.80
American Garden.....	1.00	4.25
American Journal of Philology.....	3.00	6.25
American Machinist.....	2.50	5.30
American Naturalist.....	4.00	7.50
Andover Review.....	4.00	6.80
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Building (weekly).....	6.00	8.80
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Century Magazine.....	4.00	6.80
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Christian Union, The.....	3.00	5.80
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Electrical World.....	3.00	6.80
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Iron Age (weekly).....	4.50	7.30
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Medical and Surgical Journal.....	4.00	7.80
Mechanical Engineer.....	2.00	4.80
Metal Worker.....	1.00	4.25
Microscope, The.....	1.00	4.25
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Overland Monthly.....	4.00	6.80
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Popular Science Monthly.....	5.00	7.80
Popular Science News.....	1.00	4.25
Portfolio.....	7.50	10.30
Practitioner.....	5.00	7.80
Public Opinion.....	3.00	5.80
Puck.....	5.00	7.80
Puck (German).....	5.00	7.80
Quarterly Review (London).....	4.00	6.80
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Arnold, Constable & Co. FALL NOVELTIES.

SILKS.—Brocades, Damassé, Molre Français. Striped, Metal effects in Gold and Silver. Cotele Bengalines. Plain Colored Silks in new and choice colorings.

VELVETS.—Plain Brocade and Striped Velvets for Costumes, Dresses, Cloaks, Evening and Opera Wraps, Dolmans and Trimmings.

DRESS GOODS.—Scotch Clan and Fancy Plaids, Embroidered Robes, Heather Mixtures, Melton and Oxford Suitings, Cashmeres and Serges; choice shades in Camel's Hair for Cloaks, Wraps, Street and Evening Wear.

SUITING AND ULSTER CLOTHS.—English, Scotch and Irish manufacture. Fur Beavers, Elyslans, Irish Friezes, Cassimeres and West of England Broadcloths for Dress Suits, Shetland Wool Coatings, Black and Colored Motelesse. Novel Colorings in Ladies' Cloths.

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 NEW YORK.

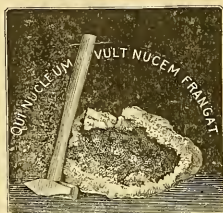
INDUCEMENTS IN DRESS GOODS.

We invite special attention to the following five lines of seasonable, all-wool, low-priced Fabrics, 52 inches wide:

One line Plaids	\$1 00	Worth \$1 25
" " Mixtures	1 00	" 1 25
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These goods merit an early examination. Samples sent on request.

JAMES McCREERY & CO.
 BROADWAY AND ELEVENTH STREET,
 NEW YORK.



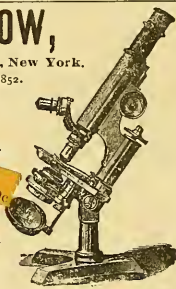
COURSE OF MINERALOGY for young People (gassiz Association Course). Expense for pamphlet, collection correspondence (1st grade), one dollar. Postage 25 cents.—G. Guttenberg, Central High School, Pittsburgh, Pa.

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 Established 1852.

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MINERALS. International Mineral Cabinets, specimens from Europe, Asia, Africa, S. America, Mexico, Greenland, Canada and U.S. 100 spec., \$1.50; 50 spec., \$1.00; 25 spec., \$1. each collection in handsome polished hard-wood case, expressage prepaid. Finest stock of specimens in U.S. Minerals for blowpipe analysis by the pound cheap. Complete Catalogue Free. Consignments from all parts of the world constantly arriving.
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 Manufacturers and Importers of **PHOTOGRAPHIC INSTRUMENTS**, Apparatus and Supplies of every description. Sole proprietors of the Patent Detective, Fairy Novelty, and Biocycle Cameras, and the Celebrated Stanley Dry Plates.
 Amateur Outfits in great variety, from \$5.00 upward. Send for Catalogue or call and examine. **Over 40 years established in this line of business.**

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Catalogue No. 29 nearly ready. Will contain many scarce works pertaining to Natural History, Americana, out of print books, as a whole, interesting.

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MICHIGAN MINING SCHOOL. — For Catalogues address M. E. Wadsworth, A.M., Ph.D., Director.

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And its Detection. With photomicrographic plates and a bibliographical appendix. By J. P. Battershall, 328 pages, 8vo, cloth. Price, \$3.50. Circulars and Catalogues on application. E. & F. N. SPON,
 12 Cortlandt St., New York.

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Repairs Everything.
 It success has brought a lot of imitators copying us in every way possible. Remember that THE LE PAGE GENUINE LePage's Liquid Glue is manufactured solely by the **RUSSIA CEMENT CO.** GREENGLASS, MASS.
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[Entered at the Post-Office of New York, N.Y., as Second-Class Matter.]

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

SEVENTH YEAR.
VOL. XIV. No. 352.

NEW YORK, NOVEMBER 1, 1889.

SINGLE COPIES, TEN CENTS.
\$3.50 PER YEAR, IN ADVANCE.

THE HALPINE TORPEDO-BOAT.

THE object in this invention is to provide a small vessel, if we may call it such, that can be steered electrically from the shore or from a war-vessel, and capable of carrying a torpedo that shall be thrown out on the boats touching any obstruction, such as a ship's side, and then discharged; the boat, however, first automatically backing away from the torpedo, so as to be at a safe distance when the explosion takes place.

The necessity for doing this by some small contrivance is that it

vented years ago. In this torpedo, motive and steering apparatus were provided, to be operated in various ways, but in the end to be controlled electrically from the starting station, whether on shore or shipboard. Some torpedoes of this design worked fairly well, but the explosion involved the destruction of apparatus costing thousands of dollars, so that practical experiments were few.

The Halpine torpedo-boat is a fish torpedo, which, after leaving its torpedo in any desired position, remains a fish, and runs away, so that when the explosion occurs it may be at a safe distance.

This plan is credited to Lieut. Nicholas J. Halpine of the United



THE HALPINE-SAVAGE TOPEDO-BOAT.

may be as inconspicuous as possible, and that it may furnish a small target for an enemy's guns. This last point is not of so much importance, however, since the modern machine-guns can pepper the surface of the water with shot to such an extent that no torpedo craft is likely to escape destruction if seen. These very machine-guns make the use of the so-called torpedo-boats extremely hazardous, and, some would have us believe, entirely un-serviceable. Even at night the search-lights would detect their approach, when the guns would make quick work of them.

To avoid this difficulty of approach, the fish torpedo was in-

States Navy. But just as the plans of the lieutenant were about to materialize, he received orders to join the "Tallapoosa" in South American waters. It thus happened that the further carrying-out of the scheme devolved on Mr. Arthur W. Savage, the inventor of improved small arms. In some of the electrical work Mr. Savage was assisted by Mr. Frank A. Perret of Brooklyn, to whom we had occasion to refer not long since as the inventor of the Perret motor.

Our illustration shows the boat on shore. In the cigar-shaped hull are contained storage-batteries capable of driving the electric

motor attached to the propeller-shaft. A case containing the high explosive is carried in a chamber in the forward end. This chamber slopes downward, so that the torpedo, which has a rocket attachment at its rear end, will be thrown down and out on being released. It is also proposed to invert the boat when occasion may require, and provide means for throwing the torpedo from this chamber into the air, so that it may fall on a vessel's deck.

The position of the opening to this torpedo-chamber may be seen in the illustration, as the small chain connecting with the harpoon in front is attached to the torpedo. When the harpoon strikes a wooden bottom, it is expected to penetrate deeply enough to hold. When it passes through a torpedo-net, the harpoon-head will pass through the meshes till the cross-arms are reached, when a spring catch is released allowing other cross-arms to open inside the net, and nearer the harpoon-head. In any event, the harpoon is held. At the same time the torpedo is released, the rocket chamber in its rear end is ignited, and the torpedo discharged downward. The chain attachment to the harpoon-head then compels a swinging motion, so as to bring the torpedo up against the vessel's bottom.

While all this is going on, the automatic arrangements have reversed the boat, and carried it away from its dangerous position, so that the operator may then guide it safely back for use in another attack.

AMERICAN PUBLIC HEALTH ASSOCIATION.

ON the second day, Wednesday, Oct. 23, Dr. John S. Billings of the United States Army read a paper on "The United States Census in its Relation to Sanitation." He emphasized the importance of the collection of vital statistics. Many do not regard this as so important as other work in behalf of public health. In order to convince the press and the community that the work of a board of health is necessary, you must produce constant, undeniable evidence; and this evidence must be mainly death-rates, to which should be added all the sickness-rates obtainable. To do this there must be a complete registration of deaths and births, and an enumeration of the whole population. Before this association meets again, the eleventh United States census will have been taken, and its methods and results are of great interest to all sanitarians. One of the most important questions to be settled before the census is taken is, "What shall be the boundaries of the special districts of the city for which a separate statement of the population is desired?" In some cities the wards form fairly satisfactory districts for the purpose, and where this is the case it makes the problem very easy. But in many cities these divisions bear no proper relation to different sanitary conditions: therefore in about a dozen of our large cities it is proposed to make a systematic division of the area into sanitary districts having special relations to altitude, character of habitations or of population, etc., and to have special death-rates calculated for each of these districts. This is being done in conference with the health authorities of these cities, and it is hoped that in this way some very interesting data will be obtained which will serve as a foundation for sanitary work in the future.

To make the statistics as correct and useful as possible, all deaths occurring in hospitals should be charged to the ward or district of the city from which the patient was taken to hospital, when this can be ascertained; otherwise the death-rate in the ward in which the hospital is located will be too high, and in the other districts it will be too low. The birthplace of the parents of the decedent should be also reported. Moreover, it is very desirable that in all cases of deaths of colored persons it should be stated whether the decedent was black or of mixed blood, such as mulatto or quadroon. One of the most important questions in the vital and social statistics of this country relates to the fertility, longevity, and liability to certain diseases, of those partly of negro and partly of white blood; and the only way to obtain data on this subject is through the registration of vital statistics. For all cities of ten thousand inhabitants and upward, it is proposed to collect as complete information as possible with regard to altitude, climate, water-supply, density of population, sewerage, proportion of sewered and non-sewered areas, and other points bearing on the healthfulness

of the place which will permit of interesting comparisons with the death-rates. The cordial co-operation of all physicians and sanitarians is solicited in making the data of these reports accurate and complete. It is desired to make these vital statistics an unanswerable argument in favor of systematic public sanitary work and of the granting of State and municipal funds necessary for maintaining such work.

In a paper by Dr. Ezra M. Hunt, secretary of the State Board of Health, Trenton, N.J., on "The Prevention of Phthisis Pulmonalis, and Methods for its Limitation," the author criticised those who regard the infection of phthisis pulmonalis as exclusively due to inhalation of the dried sputa of this disease. The theory was advocated that the breath of a consumptive patient is capable of carrying the contagion.

Dr. W. M. Smith, quarantine officer of the port of New York, read a paper on "Improvements at the New York Quarantine Station."

An excursion to the Quarantine and East River Hospitals, accompanied by Dr. Smith, took up most of the day.

At an evening session, Dr. George M. Sternberg, U.S.A., gave an account of recent researches relating to the etiology of yellow-fever. The investigations were made in Havana, between the middle of March and the first of September, 1889. Ample material has been obtained for a thorough research by modern culture methods. Thirty autopsies have been made in typical cases of yellow-fever. The cultures obtained require further study and extended comparative research before any definite conclusion can be reached as to the specific etiological relation of one or other of the micro-organisms found in yellow-fever cadavers, principally in the intestine. One method followed in the entire series of cases was the preservation of a piece of liver or kidney in an antiseptic wrapping, by which the exterior was sterilized and the entrance of germs from without prevented. Such a piece, after forty-eight hours in the laboratory, appeared fresh, and had no odor, but when cut was found to contain various micro-organisms. The cut surface had an acid re-action. The bacilli were of various species, and corresponding with those found in the contents of the intestine. No satisfactory evidence has been obtained, up to the present time, that any one of these is the veritable yellow-fever germ. One of the most constantly found of these micro-organisms was a large motionless, anaerobic bacillus, resembling that of malignant oedema. This, and others found in a less number of cases, were present in small numbers at death, and in a large proportion of cases the result of an examination made immediately from fresh liver-tissue was negative. Material from a piece of liver, kept as above, and containing micro-organisms, is very pathogenic for guinea-pigs when injected subcutaneously in small quantities, while the fresh tissue may be injected in considerable amount without noticeable effect. The micrococcus of Freire has not been found in any cultures of this series, and the bacilli of Finlay and Gibier have not generally been found in the tissues of yellow-fever cadavers.

Dr. Theobald Smith of Washington read some preliminary observations on the micro-organism of Texas fever. Cultures have been made from the spleens of animals who died of Texas fever, and a variety of bacteria found. A variety of experiments led to the discovery of an organism within the red blood-corpuscles. The intraglobular bodies found are round or oval, and nearly colorless. There is usually one, but two or more may be found in one corpuscle.

This was followed by a paper by D. E. Salmon, D.V.M., chief of the Bureau of Animal Industry, Washington, entitled "Some General Observations on Texas Fever." The resemblance in the characteristics of yellow-fever in man and Texas fever in cattle was noticed. Each disease has a permanently infected and well-known district which is its home. The contagion of both diseases is carried, not by the sick, but by the healthy. Natives in the infected districts have a certain immunity from disease, while non-residents entering the locality will contract the fever. Both diseases, when carried north of their home, require a period of warm weather for development. Neither contagion survives a winter of snow and frost beyond its home. Both diseases are accompanied by an inflammation of the liver which causes yellow discoloration of the tissues, and in both hæmaturia is seen. These points of

similarity may indicate that the germs have a similar nature, but the facts are given as a coincidence.

Edward Atkinson, LL.D., of Boston, Mass., read a paper on "The Art of Cooking." A form of oven heated by an oil-lamp, with great saving of heat and fuel, was shown, and food prepared before the audience.

For the reports of this day we are indebted to *The Medical Record*.

The first paper on Thursday, Oct. 24, was by Health Commissioner Martin of Milwaukee, upon the disposal of garbage in that city. He considered various methods of getting rid of the refuse of cities. Many forms of crematories were in the market for burning garbage, but none worked with absolute satisfaction, and some were intolerable nuisances. Dr. Martin claimed that the cremation of garbage had had its day. He strongly favored the Merz system, which has been in use in Milwaukee since June last. From June 11 last, the quantity of garbage collected is forty tons daily, which, with that brought to the works by the commission dealers, wholesale men, and grocers, brings the total up to fifty tons, which is promptly disposed of. The works are situated in the slaughter-house district, and the building is a two-story frame, 62 by 110 feet. The garbage-teams drive up an inclined roadway to the second story, where the garbage is thrown on the floor to be scraped into the driers, of which there are eight. The time occupied in drying the garbage varies, of course, with the quantity and amount of moisture, but is usually from eight to eleven hours.

Dr. S. S. Kilvington, health commissioner of Minneapolis, presented a paper upon "Statistics on River-Pollution, with Observations Relating to the Destruction of Garbage and Refuse Matter." He said that, out of thirty-five health officials he had communicated with, twenty-three favored the cremation system. He also said that in the Mississippi River, during the past year, eight cities alone deposited 152,675 tons of garbage and offal, 108,250 tons of night-soil, and 3,765 dead animals. In the Ohio River five cities in the same period dumped 46,700 tons of garbage, 21,157 tons of night-soil, and 5,100 dead animals. In the Missouri River, four cities cast 36,000 tons of garbage, 22,400 tons of night-soil, and 31,600 dead animals. No theory of self-purification of running water will dwarf the magnitude of this sanitary crime. The speaker doubted the practicability of using garbage as a fertilizer, because, while it contained fertilizing elements, they were not sufficiently concentrated for agricultural use. The trouble with the Merz system was, that it dealt only with garbage which had to be separated from other refuse. He urged the cremation of animal and household waste as far as possible in kitchen ranges and furnaces. Dr. Kilvington said that he had found no reason in the last year to change his belief that cremation, if not a perfect process, is at least the most desirable method for the disposal of the greater part of a city's refuse. After a few more speeches, Dr. Gibbon of the Marine Hospital offered a resolution providing that the committee on garbage be increased from eight members to nine, and be asked to report at the next convention as to the best method of handling refuse. This was adopted.

An important paper upon "Food in its Relation to Health" was presented by Professor W. O. Atwater. He spoke of the evils of over-eating, and gave tables of dietaries of various people, going to show that people in this country over-eat enormously, especially in the matter of meat and sweetmeats. Charts were shown on which the dietaries of people of various countries were displayed, compared with a standard dietary. The smallest dietary on which persons had lived for any great length of time was that of the Greely party in the Arctic regions. The standard as estimated by German physiologists was exceeded by nearly all classes of workers in this country. Dr. Atwater compared the amount of food eaten by college professors, students, and families in New England, and gave many details of experiments. He said that the amount of food needed for intellectual exertion had not been estimated, and would require long and complex experiments, but it would be done some day. Much smaller quantities of food were needed than were actually used by many people in this country, with the result of undermining health to a great degree. The great cattle and pork business of the West, and the great corn-crop of this country, were responsible for the immense consumption of meat, and the

cheapness of sugar was responsible for the enormous consumption of sweetmeats.

In the discussion, Dr. Jerome Walker gave some facts from the experience in his own family. He claimed that meat once a day was enough for any ordinary person. The practice of children consuming large amounts of crackers was sharply condemned.

Edward Atkinson of Boston said he had carefully estimated the average size of the American man from facts obtained from dealers in ready-made clothing, and had found an increase. Mr. Atkinson said he had tried to reduce his waist without success, and by avoiding fat and sugar he had brought in seven devils worse than the first.

At the afternoon session the first paper was read by Dr. E. Plater of Ottawa, Can., on "The Prevention and Restriction of Tuberculosis in Man." He dwelt upon the importance of lung development as a means of prevention, and favored systematic exercises in the schools, calculated to produce such development.

Dr. P. H. Kretzschmar of Brooklyn read the next paper, on "The Prevention of Pulmonary Consumption." He said there was no such thing as consumption without bacilli. For that reason he had no doubt that the disease could be spread by contagion. Dr. Kretzschmar then went on to treat of the influence of heredity on pulmonary disease. He laid down the following propositions: First, If there are many children in a family, those born after the sixth or after the seventh are apt to develop pulmonary consumption; Second, If the children in a large family are born at short intervals, say, one year, the younger ones are apt to develop pulmonary consumption; Third, If the offspring of healthy parents, born under conditions named above, escape the disease, their children are apt to develop pulmonary consumption.

The doctor confessed that these views were novel, but said he believed that they were fully justified by his own experience and that of other physicians who had recorded their observations. Out of 556 cases which had been treated in Dr. Brohmer's sanitarium in Goerhersdorf, 4 were suffering from other diseases than consumption, 46 failed to give a satisfactory account of their family antecedents, 184 were offsprings of consumptive parents or grandparents; in 65 cases the disease came from the father, in 76 from the mother, in 14 cases from both sides, 16 times from the father's parents, 12 times from the mother's parents, and twice from the grandparents of both father and mother. Of the 322 remaining cases, 109 were from families with many children, and none of them were earlier born than sixth or seventh; 32 belonged to families where children had followed one another rapidly, mostly at intervals of one year; 147 were cases of acquired disposition. Of the 175 cases unaccounted for, 135 had parents who were born subject to conditions described in the doctor's first proposition.

In the discussion, Dr. Hibbard of Richmond, Va., dwelt chiefly on the necessity of easy-fitting clothing as a means of prevention. Then Dr. Plater took the floor in radical opposition to the whole theory of hereditary consumption. He was briefly answered by Dr. Kretzschmar.

Dr. Cyrus Edson of New York read a paper of great interest to medical men on the use of sulphur dioxide as a disinfectant. He had found this of great importance in tenement-house work against contagion in New York. This statement precipitated a discussion in the course of which the views of Dr. Edson as to the value of this agent were supported by Dr. Gray of Montreal, who told about its use in successfully stamping out a terrible epidemic in his city within six months. He said sulphur dioxide was of doubtful value only in the case of diphtheria.

Dr. Raymond of Brooklyn said the use of water with this agent was absolutely necessary. He asked whether the New York authorities had any record which would show the permanent effect of disinfection at any given time. Dr. Edson replied that the New York record showed every thing about the sanitary history of every house in the city where contagious diseases had occurred for three years back. Dr. Maxwell of Florida opposed Dr. Edson's conclusions, and insisted that it was doubtful whether sulphuric fumes were a safe disinfectant in any form. He backed up his position by reverting to the complete failure of this disinfectant in the yellow-fever epidemic at Tampa, Fla., Memphis, Tenn., and elsewhere in the South.

Many delegates took part in this debate. Dr. Edson said that the use of water with sulphur dioxide was a point on which he had not touched. Unhappy memories in his experience were connected with this practice. He tried it on 500 pairs of children's trousers. The water made a bleaching powder out of the disinfecting agent, and he had to pay damages on the trousers.

A general impression seemed to prevail, that, while sulphur was of use, it needed to be used with great care and thoroughness. Some delegates favored the substitution of chlorine. In answer to a question, Dr. Edson explained that in New York, when a room was to be disinfected, three pounds of sulphur were used for every thousand cubic feet of air. The sulphur was put on a dish in a tub of water, four ounces of alcohol to every three pounds were poured over it, and the alcohol was ignited.

Dr. John H. Roach of Chicago sent in the following preamble and resolution: "Whereas Asiatic cholera, leaving its usual restricted bounds, threatens to advance by the same lines that it has followed in the last four epidemics, be it resolved, that the American Public Health Association desires to call renewed attention to this fact, and to urge that quarantine authorities on the Atlantic and Pacific seaboard, and Boards of Health throughout the country, make every effort to prepare for this threatened danger." The resolution was at once referred to the executive committee.

In the evening a paper on "Sanitary Entombment," by the Rev. Charles R. Treat of this city, was the first. A carefully written paper on "Do the Sanitary Interests of the United States demand the Acquisition of Cuba?" was read by Dr. Benjamin Lee, secretary of the Pennsylvania State Board of Health. He summarized his conclusions as follows:—

"The exigencies of traffic and travel render rapid and constant communication between the United States and Havana a necessity. Havana is one of the most notorious breeding-places of yellow-fever, and is never free from its presence. The only means by which the germs of this disease can be eradicated are a proper system of sewerage and drainage, which shall deliver the filth of the city at a distant point into the waters of the ocean, and the removal of all the feculent soil. There is no hope that the Spanish Government will ever undertake a work of this magnitude for a dependency.

"The introduction of yellow-fever into the United States through both legitimate and illegal channels of trade must be of frequent occurrence so long as this condition of things continues. A single widespread epidemic of yellow-fever would cost the United States more in money — to say nothing of the grief and misery which it would entail — than the purchase money of Cuba.

"The precautions against the spread of small-pox in Cuba are entirely inadequate, and are rendered ineffective by reason of the superstition of a large proportion of the inhabitants: hence epidemics of that loathsome disease are of frequent occurrence.

"Leprosy prevails in Havana and the island of Cuba to a serious and constantly increasing extent. Leprosy is absolutely unrestricted in this island. While there is an immense and admirably administered leper-hospital in Havana, its inmates go and come among the residents of the city and country at will, until locomotion is rendered impossible by mutilation. The ravages of the disease are confined to no class or race. Leprosy has already obtained a foothold in the United States in the ports nearest to and in most constant communication with the island of Cuba. Leprosy has but one history, that of constant progression unless it is checked by isolation of the most absolute and unrelenting character. No centre of leprosy has ever originated in the United States. The importation of the first case of a series can always be distinctly traced."

A paper on "Railway Sanitation," by Dr. Samuel W. Latta, medical examiner for the Pennsylvania Railroad Voluntary Relief Department, was read, and, after some general discussion, the association adjourned till Friday.

On Friday the first paper read was by D. E. Salmon, D.V.M., chief of the Bureau of Animal Industry, Washington, D.C., upon "The Necessity for a More Rigorous Inspection of Meat-producing Animals at the Time of Slaughter."

Dr. Albert M. Gihon, U.S.N., read a paper on "The Causes of Infant Mortality," prepared by Dr. R. O. Beard, assistant commis-

sioner of health of Minneapolis. The various causes of the deaths of infants were carefully considered, being classified as arising from the bacillus tuberculosis and from nutritional and nervous disorders. For the first class the remedies were to be found in fresh air, disinfection, and the application of heat to all forms of infant food. The prevention of infantile disorders would be greatly promoted by the education of the people in sanitary matters. One of the great mistakes of the present day was to regard infants' stomachs as of a different character from those of adults. The writer said, "How long would the best of us of mature years withstand the terrors of marasmus if we should be confined in one or two close, stove-warmed or furnace heated rooms for an entire winter, without an excuse for ventilation or a sniff of outdoor air; if we were strangers, born and bred, to the taste of pure water or of any water; if we were compelled to be perpetually 'hungry' in order to get any thing to drink; if we revelled in ten or twelve square meals a day, and lunched at pleasure through the live-long night? And yet this is no parody upon the lives of infants in the majority of families in the humbler walks of life, and even among the educated classes. It devolves upon the medical profession, in the face of this prevailing ignorance, to educate the public in the principles of infant hygiene."

The paper further considered the various forms of food for children, and the writer said in conclusion, "The too frequent feeding of infants is a vice almost universally prevalent, and quite generally countenanced, or actually encouraged, by the profession. It is grounded in custom as absurd as the incasement of Chinese infants' feet in permanent baby-shoes. It is entrenched behind that most dangerous of all arguments — the argument from experience — among the ignorant, while it is condemned by every careful observation of the lower orders of animal life, and by every physiological principle bearing upon infancy."

Dr. G. C. Ashmun said that no class of the community needed instruction more in regard to this matter than the medical profession. While so much misinformation upon the subject existed, physicians needed carefully to consider the subject. Dr. Hibbard suggested that in the first twenty-four hours of the life of a child a foundation was laid for a life of health or disease. Health Officer Smith recommended more care in preparing death statistics, and that certificates setting forth debility, marasmus, or heart-failure as the causes of death be returned for correction. Dr. George H. Rohe suggested that all infants' food should be sterilized by boiling for ten or fifteen minutes. He wanted a fuller study of the causes of cholera-infantum. The outcome was the adoption of a motion by Dr. J. H. Raymond for a committee of five to consider the whole subject of mortality among infants, and to report at some future meeting.

Two papers by Edgar Richards, microscopist of the United States Treasury Department, — upon "American Methods of Manufacturing Oleomargarine" and "The Oleomargarine Law of the United States," — were read by title. Charleston was selected as the place for the next meeting, and the date of meeting will be not earlier than Nov. 1, 1890. The following officers were elected: president, Dr. H. B. Baker of Lansing, Mich.; first vice-president, Dr. Frederic Montizambert of Quebec; second vice-president, Dr. Joseph H. Raymond of Brooklyn; secretary, Dr. Irving N. Watson of Concord, N.H.; treasurer, Dr. J. Berrian Lindsley of Nashville, Tenn.; executive committee, Drs. L. F. Solomon of Louisiana, William Bailey of Kentucky, H. B. Horlbeck of South Carolina, Walter Wyman of Washington, D.C., J. F. Kennedy of Iowa, Peter H. Bryce of Toronto, and the twelve ex-presidents of the association.

The total number of members who have attended the convention is 144. Resolutions of thanks were adopted for the hospitality of Brooklyn, with special thanks to Ex-Health Commissioner Raymond for his work in caring for the association.

ELECTRICAL NEWS.

A New Ammeter.

PROFESSOR H. J. RYAN of Cornell has invented an ammeter which *The Crank* states to be remarkable for its simplicity and accuracy, and describes as follows. It works on the same principle

as the Thompson electrical balance; but the latter is an expensive instrument, beyond the reach of the ordinary electrical engineer, and is not readily portable.

Professor Ryan's invention, consisting of a method of suspension and the laying-off of a scale, renders the construction of the apparatus a matter of a few hours' labor by any fair mechanic.

As in the Thompson balance, the current passes through two parallel fixed coils, and through a coil swinging between them. In the Thompson balance the current passes into this swinging coil through the suspension, consisting of a great number of fine copper wires, which will conduct a large current, but at the same time offers but little resistance to the movement of the swinging arm. The mounting of these wires is a very laborious operation, which adds greatly to the cost of the machine. Professor Ryan overcomes this difficulty thus. From each end of the axis of the arm a single silk thread extends upward through a hole in the hard-rubber framework above. These holes are drilled at an angle with the vertical, and the threads bearing on their upper acute edges form what is practically a knife-edge suspension. The current is taken into the coil by means of two broad strips of thin silver foil, fastened at one end to the base, at the other to the arm near the axis. This foil is so thin and light that it offers practically no resistance to the swinging arm, but at the same time is capable of carrying a very large current.

The balancing of the coil-bearing arm is accomplished by the movement of an arm carrying a weight and a pointer, and swinging in the horizontal plane. This arm has the greatest moment about the axis of suspension when it is perpendicular to it, and the least when it is parallel to it. In moving from one of the positions to the other, the pointer swings over a quadrant.

The force tending to move the coil, and hence the moment required to balance it, must be proportional to the square of the current. If on a line through the pointer pivot, and perpendicular to the axis of suspension, distances be laid off proportional to the squares of the currents, and perpendiculars be erected at those points, the distances of their intersections with the arc of the quadrant from the axis of suspension will be proportional to the squares of the corresponding currents. If these points be marked with the square roots of their respective distances, the instrument will give direct readings.

INDICATING TEMPERATURES AT A DISTANCE.—For many purposes it would be convenient if the temperature indicated by a thermometer, in some situation not easily accessible, could be telegraphed, as it were, to some spot convenient to the observer. Many methods more or less successful have been devised; and M. Morin, a French inventor, as we learn from *Engineering*, has recently patented another method, which, if of a somewhat limited range of applicability, may nevertheless be useful in certain situations. In a few words, his apparatus consists of a thermometer, with a scale about 8 inches long, reading from 0° to 30° C. The bore of the tube is about .02 of an inch in diameter, and the bulb is constructed to hold about 7 cubic centimetres of mercury. A platinum wire, with a diameter of about .0008 of an inch, runs from one end of the tube to the other, being connected with platinum terminals fused through the glass. The length of wire comprised between the 0° and 30° marks on the scale has a resistance of 200 ohms. The resistance of the whole thermometer, therefore, will vary considerably as the mercury rises and falls in the tube, and it is on this fact that the arrangements for telegraphing the temperature to a distant point depend. The receiving instrument consists of a low-resistance Deprez-d'Arsonval galvanometer, and an auxiliary resistance of about 200 ohms. Two Leclanché cells of large size connected in parallel, the electromotive force of which is very constant for varying temperatures, are employed to send a current through the thermometer, resistance, and galvanometer; and the deflection of the latter indicates the height of the mercury in the thermometer-tube.

METAL SHEETS AS ELECTRICAL SCREENS.—Professor O. Lodge contributed a paper, at the recent meeting of the British Association, "On the Failure of Metal Screens to screen off the Electrostatic Effect of Moving or Varying Charges," which is interesting, inasmuch as Maxwell suggested the bird-cage form as

the best form of lightning-protector. Professor Lodge has found, that, as long as a charge is stationary, the thinnest film of a conductor is indeed a perfect screen. An ordinary wire gauze is also impervious to electric disturbances from without, and so is a silver-coated beaker, as long as the coating is not too thin. This was investigated by placing a very light needle, highly charged with opposite electricities at its ends, within the beaker. When, however, the coating became thinner and thinner, so that the resistance of the silver film increased from a fraction of an ohm to 100 ohms and more, and when the charged bodies were rapidly approached, being shot towards the beaker sometimes, the needle was deflected, the deflections becoming measurable at 1000 ohms' resistance. One may simply say that the protection ceased as soon as the silver film became translucent, as Hertz has observed in his classical researches.

AUTOMATIC ELECTRIC BALANCE.—There has been exhibited in Paris an electric balance, the invention of Mr. William Snelgrove. The placing of the object to be weighed in the pan closes an electric circuit. The current along this circuit operates a motor attached to the weight on the beam, causing it to run out on the beam till an equipoise is established, when the circuit is broken. When the pan is cleared, every thing returns to the original condition.

HEALTH MATTERS.

Chloroform as an Anæsthetic.

A CONTRIBUTOR to *The Lancet* states that in the medical journals for the last ten years there are reported one hundred and twenty (if not more) cases of death under chloroform. Many of these are very imperfectly described, but in at least forty-nine cases the patients were in good general health at the time of administration, and required an anæsthetic merely for the performance of some minor operation; e.g., extraction of teeth (eleven cases of death), reduction of dislocations (nine cases), eye operations, fistulæ, and so on. In some fifty-nine cases death occurred before the commencement of the operation, and so was clearly due to the chloroform alone. In about twenty of the cases it is noted that chloroform had been successfully given on previous occasions, in one as many as eight different times before the fatal administration. It is evident from the foregoing that chloroform is uncertain in its action; that not only do people die while under chloroform, but also from it; frequently, too, even when it is used by skillful hands. Of course, it is possible to retort that "it was not properly given," which may be correct. This will not alter the fact that these accidents prove chloroform to be a powerful agent, very difficult to administer properly; indeed, so difficult and dangerous that it is scarcely suitable for a routine anæsthetic, when a drug less powerful for evil can replace it.

The nauseous flavor and the sense of suffocation from ether can be entirely done away with by the use of nitrous oxide, and its inhalation made more agreeable than even that of chloroform, while the patient quickly becomes unconscious without the struggling so common with chloroform. The writer goes on to say, "I have not yet found a single patient who has once inhaled ether preceded by nitrous oxide complain of suffocation, or object to take it again on the ground of its unpleasantness.

"The readiness with which chloroform affects the heart, the smallness of a fatal dose, and especially the ease and suddenness with which such a dose can be inhaled, almost by a couple of deep inspirations, will make its safe exhibition always a difficult task to invariably accomplish. Having had many years' experience, I have gradually come to believe chloroform to be a less safe anæsthetic than ether."

Preventable Blindness.

At a meeting of the Boston Society for Medical Observation, April 1, 1889, a paper was read by Hasket Derby, M.D., on this subject. We have recently published the report of the Albany committee on the increase in blindness. A certain proportion of this loss of sight is preventable. Being desirous of estimating the relative number of such cases in his own community, Dr. Derby

applied for permission to examine the inmates of the Perkins Institution for the Blind in South Boston, and was enabled to take notes of 183 cases, all but one of which he personally examined. The single exception was absent at the time of the visit, but his recorded history left no doubt as to the cause of his loss of sight. Following the classification of Magnus, Dr. Derby divided these cases into four classes: I. Congenital blindness; II. Blindness in consequence of idiopathic diseases of the eye; III. Blindness of traumatic origin; IV. Blindness attributable to general disease.

It is with the figures in the second class that we are more immediately concerned, and especially with those of blindness dependent on the ophthalmia of new-born children. There were 34 such cases out of 183, being a percentage of about 18.6. This is, however, a smaller proportion than has been obtained by other observers, and can only be accounted for by the limited number of individuals he was able to examine. At the Sheffield School for the Blind, Mr. Snell found 38.3 per cent blind from this cause, and observers in general estimate that some 30 per cent of all blindness is due to this disease. Even the examination at South Boston reveals the fact that at least one in every five of the inmates of the institution need not necessarily have ever come there. For it is an established fact that the ophthalmia of new-born children can, with few exceptions, be successfully prevented when there is reason to apprehend its occurrence. It is also not an exaggeration to claim that hardly a disease of the eye yields with more certainty to appropriate treatment. Modern observers are united in the belief that efforts at disinfection should mainly be directed to the eyes of the child, which are most apt to receive the poisonous matter after birth. Such being the case, is strict cleanliness alone sufficient, or should an active disinfectant in addition be employed?

Experiments carried on by different observers have demonstrated that the purulent infection of the eyes of new-born children can be reduced to a minimum by the use of a disinfectant, and that the most efficacious disinfectant is the nitrate of silver. Simple cleansing of the eyes with water was found by Bischoff to reduce the number of cases only one-half. Crede, the original proposer of the use of nitrate of silver, had, before the introduction of prophylaxis, 314 cases among 2,897 children, 10.8 per cent. After beginning to use the 2-per-cent solution of nitrate of silver, he had but from one to two cases in 1,760 children, being 0.1 to 0.2 of one per cent. Other agents have been tried.

In the present state of our knowledge, it is not presumptuous to assert that a case of this disease, terminating in a manner fatal to sight, and treated without topical applications of nitrate of silver, would be regarded as having been culpably neglected. So much for the principal factor that operates in causing preventable blindness: Of that from trachoma it is less necessary to speak, as that disease appears to be greatly decreasing in this community. The greater care used in the regulation of emigration, the gradual improvement in the housing and sanitary surroundings of the poor, and the discovery of jequiracy as a remedy, are all working such a change for the better that one is almost justified in looking forward to a time when "granular lids" will be a tradition of the past. There is but one other cause of preventable blindness on which Dr. Derby briefly dwelt, — traumatic sympathetic ophthalmia, — of which he found 12 cases at the Blind Asylum, something over 6 per cent of all affections investigated. With young children the occasion for the occurrence of this disease is most frequently the wounding the other eye by forks, scissors, and knives carelessly left in their way. It can be guarded against by the timely removal of the injured eye.

To sum up the results of his investigation, Dr. Derby found 34 cases of ophthalmia neonatorum, 4 of trachoma, and 12 of the results of sympathetic ophthalmia, — together, 50 instances of preventable blindness; in all, 27 per cent of the inmates of the South Boston Asylum who need never have gone there had they received suitable care or enlightened treatment at the proper time. To diminish such a percentage in the future, the more careful medical education of the present day will not alone suffice. Those who propose to follow the profession of nursing must also be properly instructed, and some degree of knowledge on these subjects be diffused in the community.

SUGGESTIVE THERAPEUTICS. — Binswanger, in the *Therapeutische Monatschrift*, Heft iii., 1, 2, 3, 4, 1889, warns against the inconsiderate and incautious employment of hypnotism. He says that hypnotism under all circumstances has a disturbing effect upon the mental condition, and that subjects of experiment are always transiently hysterical, that the results in different individuals cannot be predicted, and that unfavorable results may follow. He further says, according to the *American Journal of Insanity*, that in severe hysteria is the chief ground for suggestive treatment, where the hypnotic suggestion is the most effective and the least dangerous. When other methods are available for cure, hypnotism is not needed, and in hysteria minor it should be kept in mind that the possibility of a transition into hysteria major cannot be excluded in the use of hypnotism.

OXYGEN INHALATION. — The opinions held among medical men concerning the therapeutic value of inhalations of pure oxygen are so various that any careful observations upon the subject are worthy of attention. In the *Practitioner* (August, 1889) Dr. Thompson discusses the subject from a theoretical point of view, and gives also the result of experiments upon animals and of observations upon patients. From experiment, and from consideration of the laws of physics as they bear upon the absorption of oxygen by the blood, it is quite evident, that, if an animal in a state of perfect health is made to breathe pure oxygen at the pressure under which this gas exists in the atmosphere, but very little more oxygen will be taken into the blood than if it breathed common air. In order to make any considerable amount enter the blood above that which is usually absorbed by it, a degree of pressure is necessary which causes mechanical interference with circulation and respiration. The old idea that animals cannot live in an atmosphere of pure oxygen is erroneous. As might be expected from the foregoing statements, it is now proven that animals can live for many hours in pure oxygen, under ordinary atmospheric pressure, without any symptoms or appreciable change, provided the CO₂ exhaled and the nitrogenous waste products of the body be removed. The vague and inconstant sensations, experienced by healthy persons who inhale pure oxygen freely, may be due to impurities contained in it. Practically, Dr. Thompson, as we learn from a summary in *Medical News*, has found the inhalation of oxygen valuable in many cases. In anemia and chlorosis he has derived no decided benefit from it. In malignant diphtheria with rapid respiration, subjective dyspnoea, and cyanosis, relief was afforded only to the subjective dyspnoea, the cyanosis remaining the same, and the patient dying from pulmonary oedema and heart-failure. In a case of illumination-gas poisoning, with persistent unconsciousness and subsequent pneumonia, the continuous inhalation of oxygen had no effect whatever, either upon the breathing or upon the cyanosis which occurred during several attacks of pulmonary oedema. In a case of malignant endocarditis, with extensive valvular disease and dilatation, oxygen failed to relieve the dyspnoea, either before or after obstruction occurred in the lungs. In pneumonia, with rapid breathing, dyspnoea, and cyanosis, he has often found oxygen of very great value. The dyspnoea may diminish, while the cyanosis quickly vanishes, and the respiration becomes slower and more natural. So also in capillary bronchitis and asthma, especially when it is accompanied by much bronchial secretion. In uræmic dyspnoea he has found it of great use. In one such case, with normal lungs and very intense dyspnoea, lasting for three days, each inhalation of oxygen was followed in fifteen minutes by slowing and quieting of the breathing, slight improvement in the cyanosis, and great increase of comfort to the patient. Upon stopping the inhalation, the dyspnoea always returned. A bibliography of the subject is appended to the article.

NOTES AND NEWS.

THROUGH the efforts of Professor J. E. Denton, Stevens Institute is to have a new foundry and machine-shop. The building will be 40 feet long by 26 feet wide, and will adjoin the end of the main shop. It will be two stories high. The lower floor will be used as a foundry and blacksmith's shop, and the upper floor for wood-turning and carpentry.

— Mr. C. L. Heisler of Cornell is building a new form of calorimeter of his own design.

— Ernest G. Merrit of Cornell has been appointed instructor in physics at that university.

— Harris J. Ryan, M.E., instructor in physics at Cornell, has been appointed assistant professor of mechanical engineering.

— E. P. Roberts, M.E., last year assistant professor of electrical engineering at Cornell, is now with the Brush Electric Light Company, Cleveland, O.

— A new Yale movement, proposed by prominent graduates and patrons of the university, is for the establishment of a department of music, to be liberally endowed.

— Professor W. O. Atwater has been appointed director of the New Jersey Agricultural Experiment Station at Rutgers College. If he accepts, he will also retain his place at the head of the Washington Station.

— Francis John Henry Jenkinson, M.A., fellow of Trinity College, has been elected without opposition to the office of librarian of Cambridge University, England, vacant by the resignation of Professor Robertson Smith.

— During the summer, Professor Ryan and Mr. Merrit of Cornell were at work on alternating-current curves and converters. The results are very satisfactory, and will be published in a short time, says *The Crank*.

— The cap and gown movement at Johns Hopkins has received a setback. The class of '90 has voted against it, and the junior class has followed the example. The freshmen are not strong enough to make the movement a success.

— Dr. Albert Shaw is delivering at Cornell a series of lectures on the results of his fifteen months of study of European cities. It is rumored that he is likely to be called to the chair of political economy, left vacant by President Andrews of Brown.

— At a meeting of the New York Electrical Society in Clinton Hall on Oct. 24, Mr. A. A. Knudson read a paper descriptive of the recent electrical exposition at St. John, N.B., of which he had charge; and Mr. Joseph Wetzler, who had just returned from the Paris Exposition, described some of the electric plants and installations he had visited in Europe.

— Gen. M. C. Meigs of Washington has published a chart giving a graphic and tabular representation of the progress of population in the United States from 1750 to 1900, showing clearly the results of his study of the subject. To this he has added some notes of Great Britain, of Europe, of Spain, and of France, showing the law of population. While England doubled in forty years, Great Britain and Ireland required sixty-six years to double, owing to the decrease of the Irish population in their original seat.

— The *Student* of Amherst is advocating the formation of State clubs in the college similar to the organizations in other colleges. It says, "We have thirteen men from Connecticut. Why can't they defy fate and organize a thirteen club? Illinois sends eleven students who could influence others in that State to 'come East' to college; New York State sends sixty-one, whose influence could certainly be brought to bear upon the preparatory schools in the large cities, showing the advantages to be derived at Amherst. Other States send from seven to fifteen men each."

— From a series of experiments in preventing the injuries of the plum curculio, Mr. Clarence M. Weed, of the Ohio Agricultural Experiment Station, has arrived at the following conclusions: (1) that about three-fourths of the cherries liable to injury by the plum curculio can be saved by two or three applications of London-purple in a water spray, in the proportion of one ounce to ten gallons water; (2) that a sufficiently large proportion of the plum-crop can be saved by the same treatment to insure a good yield when a fair amount of fruit is set; (3) that, if an interval of a month or more occurs between the last application and the ripening of the fruit, no danger to health need be apprehended from its use; and (4) that spraying with the arsenites is cheaper and more practical than any other known method of preventing the injuries of this insect. The experiments were carried on through two sea-

sons, upon two varieties of cherry-trees and four varieties of plum-trees, during which a grand total of 65,000 cherries were individually examined. They are described in full in Bulletin No. 6, Vol. II., of the Ohio Station.

— Some Italian observers have been recently testing the senses of criminals, and they find these duller than in the average of people. Signor Ottolenghi, in Turin, found last year a less acute sense of smell in criminals; and he now affirms the same for taste, which he tested, according to *Nature*, by applying bitter and sweet substances (strychnine and saccharine) in dilute solution to the tongue. He finds also the taste of the habitual criminal less acute than that of the casual offender, and a slightly more acute taste in male than in female criminals. Experiments with regard to hearing were made by Signor Gradenigo (also in Turin); and, of 82 criminals, he found 55 (or 67.3 per cent) to have less than the normal acuteness, the greatest inferiority being in the oldest. In female criminals the relations were somewhat better: 15 out of 28 had hearing under the average. The limits of variations in acuteness also appeared to be much wider in criminals than in normal persons. Ear-disease was common. Signor Gradenigo attributes these things to bad hygienic conditions of life, and vicious habits.

— The projected course in military science and tactics at the Sheffield Scientific School has not yet been completed. Lieut. Totten is reported in the *Times* to say, "The course as it is crystallizing tends toward a discussion of military economy in reference to this country. In handling the American military problem, I shall attempt to discuss re-organization rather than the organization as it now stands. The topics which are so ably treated of in the magazines will be avoided, as the magazines are at the disposal of all. In discussion of tactics I shall avoid the American definition, which is mere 'drill,' preferring the European idea of 'use,' illustrating the tactical use of infantry by reference to the Turko-Russian war, and the tactical use of artillery by reference to the Franco-Prussian war. The United States is behind the times in the military line. This course of instruction is an important one, and I shall do all in my power to awaken the students to the military needs and possibilities of this country. We have not yet made any arrangements for the organization of a military company at Yale, but I should like nothing better than a splendid battalion, worthy of the institution." It is expected that the course will consist of twelve lectures, to be delivered weekly, beginning early in January.

— In a recent bulletin of the Ohio Agricultural Experiment Station, a number of experiments to determine the preventive or remedial value of various methods recommended to prevent the injuries of the striped cucumber beetle are described. They were carried on under the direction of Mr. Clarence M. Weed, entomologist and botanist of the station. These methods were, for the sake of convenience, divided into four classes: 1. The use of offensive odors; 2. Mechanical coatings of the leaves; 3. Poisonous coatings of the leaves; 4. Enclosing plants under tents or gauze-covered frames. The experiments were made on a large scale under ordinary field conditions, during the summer of 1889, when the striped beetles were exceedingly abundant. Five substances of the first class were tested; viz., hen-manure, cow-manure, kerosene, carbolic acid, and bisulphide of carbon. None of these proved practically successful. Three substances of the second class were tested; viz., coal-soot, gypsum, and saltpetre. Of these, coal-soot and saltpetre proved worthless, while gypsum showed some beneficial effect, not sufficient, however, wholly to save the plants. Three substances of the third class were applied; viz., pyrethrum, slug-shot, and peroxide of silicates. Pyrethrum killed those beetles with which it came in contact when first applied, but soon lost its efficacy. Slug-shot injured the plants to which it was applied. Peroxide of silicates had a decided effect in preventing injury, and, where the plants had been well started before being attacked, saved them from destruction; but it did not save them where the beetles were so numerous that they burrowed down to meet the sprouting plants. The results obtained from the fourth method, that of fencing out the insects by covering the plants with some form of tent or gauze-covered frame, were by far the most satisfactory. The cheapest and most successful method employed is that of

protecting each hill by a piece of plant-cloth or cheese-cloth about two feet square. This may be done simply by placing it over the plants, and fastening the edges down by small stones or loose earth. It is better, however, to hold it up by means of a half barrel-hoop or a wire bent in the form of a croquet arch.

— Since the Johns Hopkins Hospital was opened, the *Times* reports that over 400 patients have been received. It now contains 109. The training-school for nurses is making good progress. Arrangements are being made to publish regularly the discoveries and observations of the experts of the hospital. This publication department is expected to be of value to medical literature. The *Bulletin* will be issued monthly, and will correspond with the *Circular* of the university, but other more important papers will be added from time to time. In the *Bulletin* will be the proceedings of the newly organized medical society. This society is modelled on the plan of the one connected with the *Charité* of Berlin; and its object is to bring the men connected with the hospital into closer connection, to stimulate research, and to protect the claims of priority of work done by the members. Dr. Welch is the president, and Dr. Robb is the secretary.

— A new soft alloy, which adheres so firmly to metallic, glass, and porcelain surfaces that it can be used as a solder, and which, in fact, is invaluable when the articles to be soldered are of such a nature that they cannot bear a high degree of temperature, consists of finely pulverized copper dust, which is obtained, according to *Iron*, by shaking a solution of sulphate of copper with granulated zinc. The temperature of the solution rises considerably, and the metallic copper is precipitated in the form of a brownish powder; twenty, thirty, or thirty-six parts of this copper dust, according to the hardness desired, being placed in a cast-iron or porcelain-lined mortar and well mixed with some sulphuric acid, having a specific gravity of 1.85. To the paste thus formed are added seventy parts by weight of mercury, with constant stirring; and, when thus thoroughly mixed, the amalgam is well rained in warm water to remove the acid, and then set aside to cool. In ten or twelve hours it is hard enough to scratch tin. On being used, it is heated to a temperature of 375° C., and, when kneaded in an iron mortar, becomes as soft as wax. In this ductile state it can be spread upon any surface, to which, as it cools and hardens, it adheres with great tenacity.

— Professor Arthur Winslow, who was lately elected State geologist of Missouri, has established his headquarters at the State capitol. The State appropriated \$20,000 for the maintenance of a geological bureau during the years 1889–90. In 1873–74 Professor Broadhead made a partial survey of some portions of the State, but for lack of funds was unable to continue the same. The United States Topographic Survey covers the counties of Jasper, Barton, Vernon, Bates, Cass, Jackson, Clay, Platte, Ray, Lafayette, Johnson, Henry, St. Clair, Cedar, Dade, Lawrence, Greene, Polk, Hickory, Benton, Pettis, Saline, Carroll, Howard, Cooper, Morgan, Camden, Miller, Cole, Moniteau, Boone and parts of Monroe, Audrain, Pike, Montgomery, Callaway, and St. Louis. This is but a fraction of the mineral-bearing lands of Missouri. The director of the United States survey has notified Professor Winslow that the government will co-operate with the State, and will put a full corps of surveyors in the field next spring, who will work in such localities as the State geologist may direct. Professor Walter P. Jenney has been assigned work in surveying the lead and zinc deposits. James D. Robertson of Washington University, St. Louis, has been appointed assistant to State geologist; Dr. Hambach of Washington University, St. Louis, assistant paleontologist for the State; Elston Lonsdale of Columbia, aid to paleontologist; Leo Gluck of Lamonte, aide and mining engineer. Professors Jenney and Robertson have been assigned work at Joplin, and they will perform co-operative work in regard to the lead and zinc deposits of that locality, and, when completed, extend eastward. Professor Lonsdale has been directed to collect material from the vicinity of Columbia. Leo Gluck has been assigned to the coal-fields. His first work will be in Pettis, Johnson, Lafayette, and Bates Counties. Professor Winslow will first take up the lead and zinc deposits, detail examination of coal-fields, study of building-stone, clays, and sands of the State respectively. The coal-fields of the

South-west will receive attention prior to other localities, on account of their magnitude. An investigation of the lead and zinc fields will commence first at Joplin, and extend to Springfield, and from thence to Franklin County. Building-stone, clay, and sand will be examined from all parts of the State, and tests of the quality and durability made. Regarding the local reports from Ripley, Madison, and other South-east counties, of the discovery of gold and silver ore in paying quantities, Professor Winslow says that he has no official information regarding the same. He says that there is silver in South-east Missouri, but whether or not it can be found in paying quantities he is not able to say.

— James Prescott Joule, one of the discoverers of the mechanical equivalent of heat, died at his home in Sale, near Manchester, England, on the 11th of October, after many years of feeble health. Dr. Joule was born at Salford, Dec. 24, 1818. In his early days he studied chemistry under Dalton. In 1841 and 1842 he worked on the subject which made his name known among physicists, and in 1843, at the Cork meeting of the British Association, published the results in a paper entitled "The Calorific Effects of Magneto-Electricity, and on the Mechanical Value of Heat." For the experimental proof contained in this paper of a definite quantitative relation between heat and work, Dr. Joule was honored by the presentation of medals by the Royal Society, the English Society of Arts, and others. He was the author of a large number of papers, which have been published in collected form by the Physical Society.

— *Garden and Forest* states that President Horace Davis, of the University of California, recently received an inquiry from Algeria concerning experience on the Pacific coast with grasses for restraining drifting sands. As much of this kind of work has been done at Golden Gate Park, in San Francisco, the experience of Mr. John McLaren, the efficient superintendent of the park, was asked, and his statement has been forwarded to the distant applicant. Part of the information given by Mr. McLaren is quoted as follows in the *Pacific Rural Press*: "The grasses found most successful here are the Sea Bent grass (*Calamagrostis arenaria*) and the Bermuda grass (*Cynodon dactylon*), both of which have been entirely successful in holding the loose sand. I would plant the Sea Bent in the most exposed places, and the Bermuda on the protected slopes. We plant in rows one and one-half to two feet apart and one foot deep. Where practicable, the plough is used, dropping the roots in each alternate furrow. Where the dunes are too steep for ploughing, pits are dug with the spade, and, after planting, the sand is trodden firmly with the foot. The plantations have to be examined after heavy wind-storms to replant any roots exposed by the wind. If seeds only can be procured, I would suggest that they be sown in nursery rows, and the plants set out the following season." Of course, there are also many shrubs used, and the nursery at the park has propagated a vast number of the *Leptospermum* and other shrubs which have been found serviceable.

— It has always been the desire of engineers to obtain "black" prints from plans and drawings, in place of the present blue-prints. The discovery of a new substance by a French chemist, M. Pechard, announced in *Iron*, may make such a result possible. It is a mixed acid derived from oxalic and molybdic acids, and is therefore termed "oxalomolybdic acid." The crystals of oxalomolybdic acid, when dry, may be preserved unchanged, either in sunshine or in the dark; but if moist they quickly become colored blue when exposed to the sun's rays. If characters be written on paper with the solution, they remain invisible in a weak light; but, when exposed to sunshine, they rapidly become visible, turning to a deeper indigo-color. It is curious that this effect only happens when the solution is spread over paper or other surfaces; for the solution itself may be kept unaltered in the bottle for any length of time, except for a trace of blue at the edge of the meniscus, where by surface action a little is spread against the interior glass walls. If a sheet of paper be immersed in a saturated solution of the acid, dried in the dark, and then exposed behind an ordinary photographic negative, a very sharp print in blue may be obtained by exposure to sunlight for about ten minutes. The color instantly disappears in contact with water; so that, if a piece of this sensitized paper be wholly exposed to sunlight, one may write in white

upon the blue ground by using a pen dipped in water. If, however, the paper with its blue markings be exposed to a gentle heat for a few minutes, the blue changes to black, and the characters are then no longer destroyed by water.

—At the thirty-ninth meeting of the Institute of Electrical Engineers of this city, on Oct. 29, Mr. George B. Prescott, jun., read an interesting paper on some methods of regulating accumulator batteries in electric lighting. The paper was well illustrated by numerous diagrams.

—There was a preliminary meeting of the International Congress on Celestial Photography at Meudon, France, on Sept. 20, to consider the programme that had been drawn up by the provisional committee. A few slight alterations were made in the original scheme, as we learn from *Nature*, but the details of the work were not entered into. It was, however, decided that the greatest latitude should be allowed in the choice of instruments, and that each observer should employ that instrument to which he was accustomed, having no regard to uniformity. In order to indicate the spectroscopic work included in the programme, a change in the style of the congress was agreed to. It is henceforth to be the "International Congress on Celestial Photography and Spectroscopy."

—Mr. Hannay summarized his new white-lead process at the recent British Association meeting by stating that the lead ore as it comes from the mines is volatilized and oxidized by the air, the fumes are condensed in a slightly acid liquor, and the resulting sludge is washed and dried for the market without having been touched by the men. He does not employ women at all in his Glasgow works. The condensed material is extremely fine, firm, and of great covering power. The volatilization is effected in an ordinary lead-smelting furnace, but here the object is to get as much fume as possible. The advantages of this process are, that the white lead is made in a day instead of the three months of the Dutch process; that it starts with the ore, and not with the purified metal; that it is obtained in a fine powder instead of a hard crust, which has to be ground; and most important of all, as *Engineering* points out, that there is hardly any danger for the workmen. Some of these advantages, claimed specially as regards the purity of the product, were, however, questioned by Sir Lowthian Bell, although the process might develop.

—In the April bulletin of the Hatch Experiment Station of the Massachusetts Agricultural College at Amherst, report was made of the results of heating, during the months of January and February, two greenhouses built side by side, of the same size, one by means of steam, and the other by hot water; the conditions being the same as far as possible, except that the house heated by hot water was more exposed to the prevailing westerly winds than the other. The results were so marked, and so decidedly in favor of the hot-water system, that the report has provoked many inquiries and some criticism. In order to make their position more fully understood, and to answer some of the questions that have arisen, they make some further explanation of the conditions under which the tests were made, and report the results obtained for the months of March and April. With other boilers and with other conditions, different results may possibly be obtained; but they know of no recorded experiments where accurate observations have been made, most of the reports being based upon guess-work or casual observation. The boilers used consist of cast sections, arranged in such a manner over the grate as to form a return flue arrangement, the smoke passing off in the front. In the hot-water boiler five sections were used, the area of heating surface exposed to the fire being 74.5 feet. The steam boiler consists of eight sections, the aggregate area exposed to the fire being 61.12 feet below the water-line, and 24 feet above, making the total heating surface of the steam boiler 85.12 feet. Tables are published in the bulletin for October showing the comparative results of the use of the two boilers for the months of March and April, 1889. These tables show that the average temperature of the house heated by hot water was 2.3 degrees higher than that heated by steam, and that the amount of coal consumed was one ton 106 pounds less in the former than in the latter. The total coal consumed by the hot-water boiler from Dec. 23, 1888, to April 24, 1889, was four tons

1,155 pounds. The average daily temperature for the four months was 53.5°. The total coal consumed by steam boiler from Dec. 23, 1888, to April 24, 1889, was 5 tons 1,261 pounds. The average daily temperature for the four months was 51.2°.

—The strawberry crop in Massachusetts this season, as reported by Samuel J. Maynard of the Hatch Experiment Station, Amherst, Mass., has been much smaller than for the past ten years. The causes that have contributed to this failure are in part the cold, wet summer of 1888, which promoted a late growth, in which the fruit-buds were not matured sufficiently to withstand the winter; the long, open winter, in which the plants were not well protected, and the continued wet weather of the past spring, preventing perfect fertilization. Few, if any, of the new varieties have shown qualities which make them superior to those already in general cultivation. The tendency of the market has been to demand large berries at the expense of quality. Such berries can only be grown under the highest state of cultivation, which many growers have not yet learned is a necessity to the profitable growth of the strawberry.

—Mr. Clarence M. Weed, entomologist and botanist of the Ohio Agricultural Experiment Station, summarizes the results of a series of experiments on the prevention of injuries of the potato-rot as follows: (1) that a large proportion of the injury done by the potato-rot can be prevented by spraying the vines with the Bordeaux mixture; (2) that this treatment apparently diminishes the amount of scab affecting the tubers; (3) that by adding London-purple to the mixture the same treatment may be made effective in preventing the injuries both of the rot and Colorado potato-beetle.

—Extralite, a compound which belongs to the panclastite group of explosives, is very similar to roborite, securite, bellite, romite, etc., and, like them, depends for its action upon a non-explosive combustible agent which becomes explosive by the admixture of an oxidizing agent. It is a mixture of ammonium nitrate, potassium chlorate, and naphthalene, and in appearance resembles C sugar as far as color and consistency are concerned. It is claimed for it that it is safe to handle, not liable to spontaneous ignition or accidental explosion (such as may be caused by striking or concussion due to falling against hard surfaces, like iron or stone), not liable to freeze, not explosive in ignition by flame, and can only be exploded by percussion-caps and when within rigid enclosure. The latter quality has made its use practicable for shells and other projectiles, but it is chiefly for mining and blasting purposes that it is recommended. In some experiments performed with it on the line of excavation and blasting for the laying of water-pipes in Central Park, opposite West 97th Street, and described in *The Engineering and Mining Journal*, its claims were fully demonstrated. A fire was built of wood and paper saturated with kerosene, into which several cartridges were opened, but the preparation only burned away without any evidence of its explosive power. A percussion-cap and fuze were attached to an extralite cartridge, and the fuze lighted. The cap went off, but the cartridge remained intact. Equally futile were all efforts to explode it by pounding it on a rock. Finally three borings in the solid rock were loaded with it. One hole was eighteen inches deep, and eight ounces of the explosive were rammed into it. The others were twelve and eight inches respectively, and four ounces were put into them. The charges were connected and fired. The result was perfectly satisfactory, and demonstrated its special power as a rendering agent. While dynamite has greater influence, by its very rapid action in pulverizing the surrounding rock, this explosive, although equally as powerful, by its more retarded action expends its force in shattering larger weights of rocks. It is claimed for this preparation that its use for blasting purposes in mines is of great value, owing to the fact that no noxious fumes are generated, and that the powder is almost smokeless. This statement has been disputed in England by those who have used roborite, although that explosive has received very high recommendations from certain quarters. It is interesting to note that extralite is the first of this class of explosives to be manufactured in the United States, and, owing to its general safety, it may prove a formidable rival to the various dynamites now on the market.

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Communications will be welcomed from any quarter. Abstracts of scientific papers are solicited, and twenty copies of the issue containing such will be mailed the author on request in advance. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents.

Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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TO-DAY QUITE AN IMPORTANT CHANGE takes place in the office of the hydrographer of the Navy Department. Lieut. George L. Dyer, who has occupied that position, vacates the office to perform a tour of duty at sea in conformity to the usage obtaining in our naval service, which, however efficient an officer may have been in the performance of duty, requires that tours of service on shore must alternate with those afloat. During the time that Lieut. Dyer has been associated with the office, both as principal assistant and as hydrographer, numerous changes of great benefit to the naval service have taken place. The establishing of the branch hydrographic offices has proved remarkably successful, and their importance is acknowledged by the maritime community the world over. The issue of the "Pilot Charts" and their supplements was begun, and they have rendered themselves indispensable authorities for all shipping that crosses the Atlantic. The office in Washington has been greatly enlarged, and its facilities for coping with the marvellous increase of work have been greatly improved. The assumption of the collection of meteorological data from the merchant marine, the improvement in the office publications, and the establishment on a permanent basis of the division of marine meteorology, are all matters of the greatest benefit and importance, and bear the impress of the ability of the officer controlling them. The matter of the use of oil at sea and the dissemination of data collected in relation thereto among seafaring people has probably

received as much of the personal attention of Lieut. Dyer as any other important feature of his *régime*; and he leaves his office with the satisfaction of knowing that his efforts in the great cause of humanity have been the means of saving hundreds of lives and much property, the value of which can hardly be estimated. We take pleasure in wishing Lieut. Dyer an enjoyable cruise, with the hope that his pouring oil upon the troubled waters for the sake of others may result in his having smooth seas and safe voyages wherever duty may call him.

AS THE DISCUSSION of a possible world's fair somewhere on this continent in 1892 is now going on, a study of the results of the Paris Exposition is in order. Any such exhibition brings to the city in which it is located a great accession of transient population, with a resulting strain upon the resources of that city in its facilities for transporting, housing, and feeding. Every stranger, when he reaches Paris, is recorded by the police; every pound of food and pint of drink that enters the city gates is taxed; the railways make prompt and detailed returns of their business; the theatres make returns; and in various ways the facts that show how a great city is affected by these crowds of strangers are better known in Paris than they could be in any American or English city. Such of these statistics as have been published show that the total number of visitors, or visits, will exceed 24,000,000. The maximum attendance so far was on Sunday, Oct. 13, when 402,000 were recorded. This may, however, be exceeded, as the attendance shows a tendency to increase as the closing day, Nov. 6, draws nearer; the fall in the price of tickets, which has been very great, doubtless having its effect as well. Up to Sept. 30, the attendance recorded at the gates was 19,405,701, and the daily average had been 130,000. The daily averages at previous exhibitions have been, at London, 1851, 40,000; Paris, 1855, 24,000; London, 1862, 34,000; Paris, 1867, 42,000; Vienna, 1873, 40,000; Philadelphia, 1876, 61,000; and Paris, 1878, 70,000; so that the average daily attendance of the exhibition about to close has been nearly double that at the last held in Paris, which was the largest up to that time. The transportation statistics are too imperfect yet to be of much interest, the greater portion of the travel of the railways coming as late as August, for which month the returns are not available. Still we find that in May, June, and July, 10,704,703 persons arrived in Paris in 1889, against 9,647,289 in 1888, an increase of 1,057,414; and in the same period 10,782,766 left, against 9,562,019 in 1888, an increase of 1,220,747. There were, on the average, 25,000 more passengers passed through the principal Paris stations each day during these months than in the corresponding months of 1888. It is estimated that 120,000 Americans flocked to the exhibition. Of the patronage of the hotels it can be said that they received more than twice as many guests in the three months for which we have figures as in 1888. That Paris consumed more food during the exhibition cannot be doubted, but it is strange to have to record a falling-off in the consumption of beef when so many supposed beef-eaters were added to the population. Nor did these visitors show any inclination to feast on horses or donkeys, two items of food which showed only the normal increase of late years. The theatre-owners, and the proprietors of places of amusement in general, feared that the exhibition might prove a damaging rival. The tax returns show just the opposite, being more than double those in the previous year.

ANNUAL REPORT OF THE HYDROGRAPHER.

The annual report of the hydrographer of the Navy Department contains much of great value to the maritime community, and gives a most comprehensive review of many of the important changes that have taken place in that office during the period that Lieut. Dyer, the outgoing hydrographer, has been connected with it.

The necessity for an earnest co-operation with the Army Signal Service is particularly dwelt upon, and it is clearly shown what

great benefits have already been derived by the community at large from the two services acting in unison. It is further stated in regard to marine meteorology that the navy can now be kept conversant with the latest information touching upon this important subject, the serious study of which had been neglected by the department for many years. One of the reforms of the office has been the establishing on a permanent footing of this division, where the collection and dissemination of data could be carried on without interruption, and where instructions for the service could be prepared and revised in accordance with the progress of the science of meteorology. It is suggested that the Navy Department should establish stations throughout the West Indies, and, in co-operation with the Signal Service, bring the subject of West Indian hurricane warnings to a greater degree of perfection.

The policy of the office in encouraging its employees to improve the character of their work, either by the invention of apparatus or in the preparation of original matter in manuscript, has shown remarkably good results, as have also the efforts made to improve the chart service to ships of war. It is concisely pointed out where improvements can be made in this latter feature, and recommendations are submitted that are well calculated to secure in the near future a still better service. It is also hoped that with the increase in the number of charts, and the augmentation of our foreign commerce, the revenue derived from the increased sale of charts will finally result in making the office self-supporting.

Considerable attention is paid to the subject of the international marine conference, and to the collection by the branch offices of material of value placed before the United States delegates for their consideration; and it is confidently believed that the publicity given to the subject of floating wrecks, fogs, ice, safe routes, and so forth, by the monthly "Pilot Charts" and by the branch offices, has had an important bearing upon the bringing-together of the delegates forming the conference. At the same time full credit is given to Mr. Francis Houghton, superintendent of the Maritime Exchange of New York, to whose active and efficient management is mainly due the passage of the act of Congress creating the conference.

It is suggested that all naval surveying work be under the immediate supervision of the Hydrographic Office, as it is thought that greater economy is possible by such an arrangement, and that the requisite degree of efficiency can only be attained by uniting all the functions of a surveying office with those that the Hydrographic Office possesses at present. A surveying branch being considered a necessary part of the naval establishment, it is thought that special inducements must be held out to officers who are willing to take up this work; and it is hoped that the days for perfunctory service in the Hydrographic Office have departed.

The system of branch offices having proved its great value to the maritime community, its extension is recommended to include every shipping port of importance on our coasts. It is thought by so doing that the Navy Department can maintain itself as the natural leader in all subjects of a hydrographic nature, to which the best interest of the government and the technical education of its officers clearly entitle it.

It is recommended to erect a separate and specially constructed building for the use of the office, the necessity of having commodious and well-lighted rooms for draughtsmen and engravers being obvious. Series of charts for China and the East, a pilot chart for the Pacific, and permanent parties for the determination of the earth's magnetism, together with more extended surveys of those portions of the world in which our trade is active and growing, are all points well worthy of the enacting clause of Congress.

BOOK-REVIEWS.

Hygiene and Public Health. By LOUIS C. PARKES, M.D. Philadelphia, Blakiston. 12°. \$2.50.

DR. PARKES comes before us indorsed as the assistant professor of hygiene and public health at University College, London; and he assures us that it is as a result of his experience as a teacher at that institution that he was led to believe that a small book, clearly written, on hygiene, would serve a good purpose. The author has aimed to cover the whole field of sanitary science, and

has given such elementary information on every topic as will enable the reader to refer with advantage to the larger text-books.

The necessity under which health-officers often find themselves of dealing with figures and statistics has induced Dr. Parkes to introduce as a closing chapter a discussion of statistics, and how to handle them in so far as they are likely to be of value to those whom he aims to assist. Medical men find trouble in this mathematical part of their work, and will be interested in this novel chapter.

As good drainage is all-important for the preservation of public health, we find Dr. Parkes has devoted considerable space to the methods of disposal of refuse.

The opening chapter is, however, on water. It is one of the longest, and is written with the good judgment displayed throughout the book.

The other chapters are on ventilation, warming and lighting, climate (in which it is possible undue attention is given occasionally to matters which might be assumed as known), soils and building-sites (a chapter likely to interest many), exercise, and contagion. Throughout, the book is written so as to be interesting and intelligible to laymen and doctors alike, and we take pleasure in calling attention to it.

Alternate-Current Machinery. By GISEBERT KAPP. New York, Van Nostrand. 24°. 50 cents.

THIS timely little volume had its origin in a paper read before the Institute of Civil Engineers, London, by Mr. Kapp, whose name and reputation as an electrician are well known to all interested in the progress of electrical science. It is reprinted, in convenient pocket form, from the minutes of the proceedings of the society before which it was read, and contains, besides Mr. Kapp's paper, the comments and criticisms made upon it by many eminent electricians, members of the institute, and Mr. Kapp's replies and explanations. The book appears at an opportune moment, as the matter it contains derives additional interest from the fact that the sharp competition at present existing between advocates of the direct-current and those of the alternate-current systems of electric lighting is compelling closer attention to all that is published concerning both systems, or groups of systems.

The subject comprised under the title of the work is divided by the author into six sub-sections: 1. Alternators; 2. Transformers; 3. Motors; 4. Meters; 5. Mains; 6. Accessory apparatus for use in central stations and on the premises of the persons supplied with current from such stations. The question of lamps Mr. Kapp considers as somewhat foreign to the subject under consideration, as glow, or incandescent, lamps are equally suitable to be fed by alternating and direct currents, and arc lamps are adapted to either current by changes easily made. Alternators, transformers, and motors, — the three main points, — of course receive more attention from Mr. Kapp than the subsidiary ones, though no point has been left far in the background.

A Handbook of Descriptive and Practical Astronomy. I. The Sun, Planets, and Comets. BY GEORGE F. CHAMBERS. 4th ed. Oxford, Clarendon Press. 8°. 3s.

NEARLY thirty years ago Mr. Chambers had ready the first edition of this handbook, which was designed as a handbook that should be attractive to the general reader and of occasional service to the professional astronomer. The author aimed to make a book that should be popular without being vapid, and scientific without being unduly technical. That he was reasonably successful we all know.

A second edition followed in 1861, and a third in 1876. And it should be called to mind that this was the work of an English barrister, who could spare for his hobby, as it were, but a part of his time, mainly absorbed by his professional engagements.

The volume we have before us is the first volume of the fourth edition. The plan at first was to break the work up into two volumes, but the material proved so large in amount that three were finally decided upon; and the author finds himself in a position where he can carry out his original conception of what such a treatise should be.

In this volume we have the descriptive astronomy of the sun,

planets, and comets; the second, to be issued at an early date, will contain an account of astronomical instruments and practical astronomy; and the third will be devoted to the starry heavens. Each volume will have its own index, and will be sold, as it in truth will be, as a distinct book, though of course forming part of the series of three.

Of speculation there is little to be found within the covers. If one looks for discussion of the possibility of life on any of the planets aside from the earth, he is likely to be disappointed. But the book is full of straightforward statements of the facts so far as we know them, and it may be said that it is well brought up to date.

Chambers's Encyclopædia. New edition. Vol. IV. Dionysius of Friction. Philadelphia, Lippincott. 8°. \$3.

THIS volume contains a goodly number of articles of specially scientific interest. The list of American contributors is not large, nor is it to be expected that it should be. Oliver Wendell Holmes, perhaps, leads in importance in this list with an article on Emerson. The others by Americans are on local geographical matters and on Ben Franklin.

It is perhaps unnecessary to call attention again to the purpose of this encyclopædia, which gives authoritative matter well condensed in its short articles, which often come down to a single paragraph; yet many ask which is the best of the encyclopædias, and show that they are not acquainted with the characteristics of those offered.

In this volume we have short articles, devoid of all technicalities, on dynamos, electric light and railway, by Professor J. A. Ewing; earthquake, by Professor James Geikie; electricity, by Professor C. G. Knott; evolution, by Professor Patrick Geddes; exhibitions, by H. Roscoe Dumville; force, by Professor Tait. But we could fill a page with a list like this.

There are eight colored maps in the volume, — one of the District of Columbia, another of Florida, the others being devoted to Europe, England, and France. A colored plate shows the flags of all nations.

There is as much space given to electricity as to any other subject in the volume, the article sketching the phenomena of electrification, electric currents, and resistance, and the resulting electrolysis and thermo-electric effects. We do not find any reference to the lately developed Hertz effects, which were probably published too recently for insertion. The limitations in the scope of this main article are atoned for in the adjunct articles on atmospheric and medical electricity, electric fishes, electric light, railways, electro-metallurgy, and others to the number of a dozen or more.

The article on exhibitions is naturally examined at this time, and it is somewhat amusing to find the Paris exhibition of this year referred to in the past tense; which shows, however, a due amount of care in bringing the matter up to date.

Hints to Travellers, Scientific and General. Edited for the Council of the Royal Geographical Society by DOUGLAS W. FRESHFIELD and Capt. W. J. L. WHARTON. 6th ed. London, The Royal Geographical Society. 24°.

THESE "Hints to Travellers" had their origin in a report made to the council of the Royal Geographical Society as long ago as 1854. This report was drawn up by Admiral Fitzroy and Lieut. Raper of the Royal Navy, and aimed to answer the numerous queries addressed to the society as to the proper instrumental outfit for explorers.

This report, to which were added some suggestions by Admirals Smyth and Beechey, Col. Sykes, and Mr. Francis Galton, was published in the journal of the society, and republished in pamphlet form.

The exhaustion of this first edition led, in 1864, to a revision, in which Sir George Back, Admiral Collinson, and Mr. Galton, assisted; chapters on photography by Dr. Pole, and collection of objects in natural history by Mr. Bates, being added.

The editions of 1871, 1878, and the fifth, the date of which we do not now recall, followed. In each some wise development of the original plan, without any undue increase in the bulk of the volume, has taken place. The second edition was designed to

help a person proposing to explore some wild country, who would know what astronomical and other scientific outfit he ought to take with him, and what observations he might attempt, with a prospect of obtaining valuable results. In the fifth edition one object was to furnish such help as might be possible within the compass of a pocket-book to the explorer who had acquainted himself with the use of instruments, that he might win the more valuable geographical results during his wanderings. Geology and anthropology were added subjects, to which some attention was paid, and some medical and surgical information were introduced from the pen of Surgeon-Major Dobson.

The present editors have not attempted any change in the character of the book, the previous alterations and additions having met with general approval. Capt. Abbey has brought up to date the photography, and the meteorology has been revised by Mr. H. F. Blanford. Mr. J. S. Keltie has something to say on commercial geography.

Coal and the Coal Mines. By HOMER GREENE. Boston and New York, Houghton, Mifflin, & Co. 24°. 75 cents.

THIS is one of the Riverside Library for Young People. The object of this series is to furnish books which shall contain reliable information written in language likely to be intelligible and attractive to young people without a descent to "childese." This special number is not so long as to be likely to weary a young person attempting to read it, and it is published at a low price; so that it is the more likely to fall into the hands of those for whom it is intended.

Young folks are not young folks long; and each of us, as he has passed through that stage, has needed, among other things, the books suited to a year, or at most two or three years, then to be thrown aside for others. So in "Coal and the Coal Mines" the publishers have made no attempt to show the capabilities of their art, except in making a book that opens well, and is clearly printed. Every feature is in good taste, but there is no evidence of lavishness in wide margins and heavy calendered paper. It is an attractive and serviceable book for the use it is to have.

We say "it is to have," for we judge that "Coal and the Coal Mines" is sure to have a good many readers, — young readers, and very likely old ones. There is to be found within the covers a straightforward statement of how coal was discovered, how it was found that it could be used to best advantage, and how, when at last it was needed for use in large amounts, ingenuity was set at work to get the coal from the earth.

All this could be told so that little human interest should exist in the telling. But Mr. Greene has lived among the miners; and he carries his reader with the miner down to his hazardous work, letting him know wherein it is hazardous and wherein alluring, and carries him through to the end of a day of profit, or possibly of destruction. Some of the tales he has to tell are intensely exciting, and make one look on a shovelful of coals with a feeling of interest in the human skill and courage that have placed them at our disposal, and wonder whether we are quite justified in throwing them heedlessly on the fire.

Yes, we think those who take up "Coal and the Coal Mines" will finish it, and that they will be the better-informed men or women, boys or girls, for the reading of it.

AMONG THE PUBLISHERS.

THE Worthington Company will publish on Nov. 1 "A Study of Ben Jonson," by Algernon Charles Swinburne.

— De Wolfe, Fiske, & Co. have ready "Essentials of the Metric System," by George Jackson, with explanation of its principles, and examples for practice.

— The Writers' Publishing Company, New York, have just issued "A Directory of Catholic Colleges, Academies, and Leading Schools in the United States for 1889 and 1890."

— J. W. Bouton is soliciting subscriptions for the "Salon of Paris" for 1889. Like its predecessors, it will illustrate the principal works by the photogravure process, one hundred plates being promised in various colors, and the majority of them full-page.

—Dodd, Mead, & Co. will publish immediately "The Diary of Philip Hone," edited by Bayard Tuckerman. Philip Hone, an old Knickerbocker, was mayor of New York, and for many years high in the councils of the Whig party, and closely identified with the leading interests of New York City in the early part of this century. His diary extends from 1828 to 1845, and is rich in reminiscences of the political and social life and events of that period. "The Life of John Davis, the Navigator," by Clemens R. Markham, the first of a series of great explorers and explorations, is also nearly ready.

—Charles Scribner's Sons published last week a "History of the United States," by Henry Adams. Mr. Adams's work, when complete, will cover the period embracing the two administrations of Jefferson and the two following of Madison, from 1801 to 1817. The two volumes now ready are devoted to the first administration of Jefferson, and to the political, financial, and international questions that arose after the transfer of the control of the government from the Federalists to the then-called Republican party. The first half-dozen chapters are given over to a review of the economic, social, and intellectual status of the country at the beginning of the century, the domestic and foreign policy of Jefferson's administration being then taken up.

—The sixth edition of the well known "Treatise on Dynamics of a Particle," by Professor Tait and the late Mr. W. J. Steele (New York, Macmillan), has been issued. The work was begun by Professor Tait and Mr. Steele towards the end of 1852, and first appeared in 1856. "At Mr. Steele's early death," says Professor Tait in the preface, "his allotted share of the work was uncompleted, and I had to undertake the final arrangement of the whole. In the subsequent editions it has derived much benefit from revision, first by Mr. Stirling of Trinity in 1865, then by Mr. W. D. Niven of Trinity in 1871, and by Professor Greenhill of Emmanuel in 1878. It last appeared after a general revision by myself, with the assistance of Dr. C. G. Knott and of my colleague, Professor Chrystal. The present edition has been prepared by me, with the assistance of Dr. W. Peddie."

—*Agricultural Science* is about to enter upon the fourth year of its existence. From the beginning it has sought to present to its readers, either as original contributions or in the form of abstracts, that work relating to the sciences underlying and as applied to agriculture, such as would serve as an aid in scientific investigation. Popular writing has never found a place in its pages, for the reason that that field is already occupied by ably edited agricultural journals. Among those contributing original articles during 1889 may be mentioned the following: Dr. H. E. Stockbridge, director Indiana Agricultural Experiment Station; E. S. Goff, professor of horticulture University of Wisconsin; Professor H. H. Harrington, chemist to Texas Agricultural Experiment Station; Dr. H. W. Wiley, chemist to the United States Department of Agriculture; H. L. Bolley, of Purdue University Botanical Laboratory; F. W. A. Woll, of the Wisconsin Agricultural Experiment Station chemical laboratory; Milton Whitney, professor of agriculture in South Carolina University, and vice-director of the experiment station; Dr. E. Lewis Sturtevant, late director of the New York State Agricultural Experiment Station; Dr. W. E. Stone, chemist to the Tennessee Agricultural Experiment Station; Dr. H. P. Armsby, director of Pennsylvania Agricultural Experiment Station; J. B. Harrison, chemist to Government laboratory, Barbadoes, West Indies; and others. C. S. Plumb, of the University of Tennessee, Knoxville, Tenn., the publisher, states that the foreign subscription list has steadily gained from the first, so that at the present time it extends pretty well over Europe, as well as to Japan and the West Indies, while its original contributions are being translated into prominent scientific journals abroad. Consequently, as it also goes into nearly every experiment station in America, it furnishes the best kind of a medium for those persons who wish to submit scientific papers on agriculture to the largest and most appreciative audience. All are invited to do what they can to aid in increasing the effectiveness of this journal, either by subscriptions or publishing in its pages original contributions. Foreign subscribers are also invited to favor the magazine with contributions, which will be printed either in French or German.

—D. G. Brinton, M.D. (2041 Chestnut Street, Philadelphia) announces for publication "Rig Veda Americana," sacred songs of the ancient Mexicans, with a gloss in Nahuatl. The very ancient religious chants, on which the title of the "American Rig Veda" has been bestowed, are preserved in two Nahuatl manuscripts,—one at Madrid, the other at Florence,—both of which the author personally collated. The gloss, found in the former only, is a sixteenth-century commentary on the obscurities of the text. The songs, or chants, are valuable not merely as curious antiquities, but as throwing light on the religious thought and mythology of the native Mexicans, and as illustrating the archaic forms and sacred locutions of their tongue. They are, without doubt, the most ancient authentic examples of American literature and language in existence. The edition will be quite small; the price, \$3, payable on receipt of the volume.

—J. B. Lippincott Company will publish shortly "With Gauge and Swallow," by Judge Tourgée, a new novel which gives free scope to his fondness for socio-political questions.

—To the many other valuable features of "Webster's Dictionary," Messrs. G. & C. Merriam & Co. have added a pronouncing gazetteer of the world, containing over 25,000 titles, and making over too pages of new matter, briefly describing the countries, cities, towns, and natural features of every part of the globe, compiled from recent and authentic sources. The aim of this gazetteer is to answer concisely the main questions that may be asked about any of the leading titles in modern geography,— "What is the orthography of the given name?" "What is its correct local pronunciation?" "What are the main features, natural or artificial, of the place itself?" On all these points it has been their object to bring together accurate information in the briefest form.

—"The Journal of Marie Bashkirtseff," a young Russian artist who died in Paris in 1884 at the age of twenty-three, and which has attracted the admiring attention of the foremost critics of Europe, will be published by Messrs. Cassell & Co. about Nov. 11. Among the most enthusiastic in their praise of this journal is the Right Hon. William E. Gladstone, who, in an article in the *Nineteenth Century*, pronounces it "a book without a parallel." The translation has been made by Mrs. Mary J. Serrano. A portrait of Mlle. Bashkirtseff, and reproduction from her paintings now owned by the Luxembourg Gallery, will accompany this edition.

—Fechner's "Elemente der Psychophysik," the volume that formed the starting-point of all discussion and experimentation in the study of the intensity of sensations, and which has long been out of print, has now, after the death of the author, been reprinted under the supervision of Professor Wundt. A valuable index of Fechner's works, and many useful references, are added.

Ready This Week:

RECENT ECONOMIC CHANGES,

And their Effect on the Production and Distribution of Wealth and the Well-being of Society.

By DAVID A. WELLS,

President American Social Science Association.

12mo, 449.xii pages cloth. - - - - Price, \$2.00.

The economic changes that have occurred during the last quarter of a century have unquestionably been more important and varied during any former period of the world's history. The problems which our advancing civilization is forcing upon the attention of society are accordingly of the utmost urgency and importance. To trace out, and exhibit in something like regular order, the causes and extent of the industrial and social changes and accompanying disturbances which have especially characterized the last fifteen or twenty years, and to carefully balance what seems to have been good and what seems to have been evil, have been the main purpose of the author.

D. APPLETON & CO., PUBLISHERS,

1, 3, & 5 BOND STREET, NEW YORK.

—Harper & Brothers will publish shortly "Cathedrals and Abbeys in Great Britain and Ireland," a large volume containing over forty illustrations. The Rev. Richard Wheatley, D.D., has prepared the descriptive text.

—The *Forum* for November contains the following articles: "American Rights in Behring Sea," by President J. B. Angell of the University of Michigan, which is an historical explanation of the jurisdiction over these waters, and a correction of the erroneous popular supposition concerning it; "Public Opinion and the Civil Service," by E. L. Godkin, editor of the *New York Evening Post*, who describes the puzzling stage in the agitation for reform, both political parties preaching it, and neither heartily practising it (he declares an advance to complete reform or the fatal degradation of the government inevitable, and points out the deep meaning of the agitation); "Modern Claims upon the Pulpit," by the Very Rev. F. W. Farrar, Archdeacon of Westminster, who declares that the two worst pitfalls of the pulpit are theological dogma and speculative discussion, taking very radical ground against dogmatic theology; "The Owners of the United States," by Thomas G. Shearman, the New York statistician (this article we referred to at length in last week's issue); "Industrial Co-operation in England," by Professor F. G. Peabody of Harvard, — a study made in England, of the practical workings of the system, its success, statistics of its growth, and its moral significance, explaining why co-operation has not yet succeeded in the United States; "Municipal Control of Gas-Works," by Bronson C. Keeler of St. Louis, — a comparison of municipal and private control in the principal cities, American and European, and the cost of gas and its price to the consumer in each of these cities; "The Cost of Universities," by President David J. Hill of the University of Rochester, who sets down the wealth, the income, and the expenses (including salaries to professors) of the chief German and American schools, and explains their financial conduct; "Wendell Phillips as an Orator," by Rev. Carlos Martyn of New York, — a critical study; "Requirements of National Defence," by Adjutant-Gen. J. C. Kelton of the United States Army, who shows the inadequacy of the militia of the States, and explains what would constitute a sufficient trained force in case of sudden war, — a military study of our defenceless condition, and the duty of the National Government; "The Domain of Romance," by Maurice Thompson, — a critical article to show that this is the most romantic era of modern times, and that Darwin is the master-mind of the epoch; "Types of American Women," by Professor H. H. Boyesen of Columbia College.

— "A Review of the Family Delphinidae," with forty-seven plates, by Frederick W. True, curator of the Department of Mammals, United States National Museum, is issued as Bulletin No. 36 of the museum. More than four years ago the writer formed a determination to prepare a monograph of the species of dolphins which occur on the coasts of North America. It immediately became apparent, however, that a proper comparison of the species described respectively by European and American naturalists could not be made without an examination of the types. A large proportion of the species of the family were established by Gray, whose descriptions are for the most part too brief and vague to serve as the basis of critical comparisons, while the descriptions of some other writers on the subject are almost equally insufficient. Such being the condition of the literature, he resolved to visit the museums of Europe, and to examine all the type specimens to which he could gain access. Professor Baird, the late director of the museum, very kindly consented to his being absent during the winter of 1883-84, and he accordingly spent about four months in England and on the continent of Europe in the study of the specimens in question. This bulletin is the result.

—The New York Society of Pedagogy has published through Messrs. Appleton a pamphlet by George B. Newcomb, on "Teaching School Children to Think." The author remarks on the obvious fact that the reasoning-powers of children are exercised in their earliest years, though the higher powers of abstraction are not developed until later. He then goes on to suggest modes by which the power of thought may be cultivated in the child's mind; but we do not find any thing new or striking in what he says. His most useful suggestion is that the teacher should not only present

facts in rational connection, but also take care that they be rationally apprehended by the child. He has a few words in favor of manual training, but what that has to do with cultivating the reasoning-powers we are unable to see. By the way, we should be glad to know from what number of the London *Times* Mr. Newcomb took the quotation given on p. 12.

—November begins the twentieth year of *The Century Magazine*. The opening pages are devoted to a generous instalment of the long-expected autobiography of Joseph Jefferson. The first of the "Present-day Papers" is entitled "The Problems of Modern Society," and it has a preface signed by the group who are putting forth these timely essays. Dr. Langdon writes this paper. The other members of this group are Professor Shields, Bishop Potter, Drs. Munger and Dike, Seth Low, and Professor Ely. George Kennan has a chapter of "Adventures in Eastern Siberia." The history, purposes, and methods of the new "Grolier Club" of New York are fully described by Brander Matthews, and illustrated with drawings of rare Grolier book-covers, etc. Mrs. Foote, in her "Pictures of the Far West," portrays "The Winter Camp." The authors of the Lincoln Life treat of "The Second Inaugural," "Five Forks," and "Appomattox." Mr. Cole's unique engravings of the "Old Masters" are to continue with few intermissions during the coming year. This month he gives two examples of Benozzo Gozzoli. One of the most curious articles which *The Century* has published is entitled "The 'Newness,'" and is by the late Robert Carter, himself an eye-witness of the vagaries of the transcendental movement in New England. There are brief papers on "The Southern Cadets in Action," "Who ever saw a Dead Cavalryman?" "Shooting into Libby Prison," "Prohibition," "American Game Laws," "Copyright Reform," "Free Kindergartens," "Governor Seymour," "The Methodist Church South," etc.

— "Unless we can concentrate legislative leadership, we shall suffer something like national paralysis. We have no one in Congress who stands for the nation, . . . and so management and combination which may be effected in the dark are given the place that should be held by centred and responsible leadership in the focus of the national gaze." This is the keynote of the paper by Mr. Woodrow Wilson, on the "Character of Democracy in the United States," which opens the *Atlantic Monthly* for November. Another political paper, called "The French-in-Canada," is contributed by Mr. Eben Greenough Scott, whose paper on "La Nouvelle France" will be remembered. Artists and amateurs will be interested in "Allston and his Unfinished Picture," — passages from the journals of Mr. Richard H. Dana, — a series of extracts contributed by Mr. Charles Francis Adams about Mr. Allston's last and unfinished picture of "Daniel interpreting to Belshazzar the Writing on the Wall." "Materials for Landscape Art in America," by Charles H. Moore of Harvard University, will also interest the same class of readers. There are also a half-literary, half-historical article on "Some Romances of the Revolution" (a consideration of William Gilmore Simms's novels); a paper on "The Nieces of Mazarin;" and a sketch on "Marie Bashkirtseff," which gives a picture of this impressionable, and in a certain sense typical, "daughter of Gaul."

—In 1878 there was published by Professor J. M. Macoun, of the Geological Survey, Ottawa, Can., a check-list of the plants at that time known to occur in Canada. This list has for some years been out of print; and since it was issued many new species have been discovered, and the names of many more have been changed. At the earnest request of botanists both in Canada and the United States, he has published, and now offers for sale, what he believes to be a complete list of the phænogamous and vascular cryptogamous plants of Canada. The "Catalogue of Canadian Plants," issued by the Geological and Natural History Survey of Canada, has been used as a basis, but a large number of species discovered since it was published are included in the list. Many genera, too, have been revised by specialists, and their revisions have been used in the preparation of the check-list. Where names of species or varieties have been changed, both the name by which a plant is now known and that by which it is called in the catalogue are shown in the list.

— Thomas Whittaker has just published a new edition, with some changes, of Miss Anne Ayres' "Life and Work of William Augustus Muhlenberg."

— Mr. Warren K. Moorehead announces a new work on Ohio Valley earthworks. This work contains 41 full-page illustrations made from photographs taken in the field, and a detailed account of exploration in the mounds and graves of Fort Ancient.

— Messrs. Ginn & Co. announce as ready, "Elementary Mathematical Tables," by A. Macfarlane, D.Sc., LL.D., professor of physics in the University of Texas. This collection of tables contains logarithms, antilogarithms, addition logarithms, subtraction logarithms, logarithmic sines and cosines, logarithmic tangents and cotangents, natural sines and cosines, natural tangents and cotangents, natural secants and cosecants, arcs, reciprocals, squares, cubes, square roots, cube roots, circumferences, circular areas, spherical contents, powers, constants, hyperbolic logarithms, exponentials, divisors, least divisors, interest tables, first nine multiples of numbers up to 1000, with a large number of auxiliary tables. The tables are mostly four-place: they have a uniform decimal arrangement similar to that of seven-place logarithmic tables; they are mostly synoptic, are provided with differences and proportional parts, and are arranged so that the function may be read off for any position of the decimal point in the argument. The tables are designed to be useful not only in computing and in the graphic method, but also in the teaching of arithmetic and in the illustration of the theorems of algebra.

— Mr. Gordon L. Ford of Brooklyn has in press a number of interesting unpublished agreements between Washington and his overseers and workmen, throwing much light upon the management of his estates, as well as on the "labor question" of colonial Virginia. The agreements are copied from the originals in Washington's writing, and all date before the Revolution. In this volume will also be included a correspondence that Washington had in 1774 with a number of merchants and others, concerning a scheme he entertained of importing German Palatines to settle upon his western lands, and one of Washington's advertisements for runaway servants. Very little of this material has been published heretofore, and "Washington as an Employer and Importer of Labor" will present a new phase of his character. The edition will be limited to five hundred copies.

— M. Réan is at work on the fourth volume of his "History of Israel." He is also correcting, says the New York *Tribune*, the proof-sheets of a new book to be entitled "The Future of Science." It is an essay entirely written as long ago as 1848, and deals, among other topics, with the theory of development subsequently enunciated by Darwin. In various other matters M. Réan is shown to have anticipated subsequent discoveries in the fields of knowledge, and to have indicated the general direction to which science was tending. He has neither added to nor excised a single passage from his earlier essay, the only alterations introduced being those of style.

LETTERS TO THE EDITOR.

* * * Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Electric Eccentricities.

DURING the great fire that raged over northern Wisconsin in 1871, and which wiped out not only the prosperous village of Pestigo, but, in the aggregate of farmhouses, half a dozen villages like Pestigo, there were many evidences of electrical phenomena present. The flames were seen to possess that sudden rapidity of action which only electricity can impart. They would leap over wide spaces with the greatest rapidity, leaving many objects in the rear that one would suppose could not escape, and striking others beyond, and least exposed, in the most unaccountable manner. The details of that great disaster would disclose many curious and

instructive facts. People were found dead without any apparent injury, though lying out in the open fields, and far from the burnt woods. Of course, it is popularly supposed that these suffocated in the superheated atmosphere. However that may be, one circumstance coming under my own observation proves conclusively the presence of electricity, and a very curious action of the subtle fluid, too. Shortly after the fire, the editor of the Green Bay *Advocate* exhibited a copper coin taken from the pocket of one of the victims found dead in the middle of a large clearing. The coin was fused, but no sign of injury whatever was discovered on the man's person. GEO. GIBSON.

Hudson, Wis., Oct. 22.

[Is it not possible that the coin was fused before it went into the unfortunate man's pocket? — ED.]

A Lightning Discharge in Quebec.

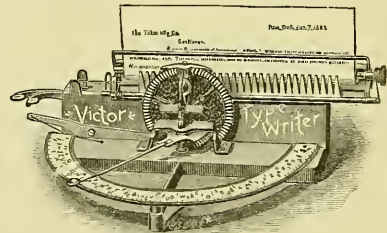
As you request observations of lightning, I take occasion to send you some made by myself. On the 29th of June, 1887, a violent thunder-storm broke over Quebec about six o'clock in the evening. The wind was blowing from the west. At Lévis, opposite Quebec, a church was being built at that time, and the wood-work of the tower had just been finished. The roof was finished, and it was covered with galvanized iron. This sheathing was connected by lightning-rods with the earth. The first fall of rain wet the west portion of the tower; and, in an instant after, the lightning struck the tower, leaving intact the east portion, but shattering completely all those parts of the wood rendered semi-conducting by the rain. After reaching the metallic covering of the roof, the electricity was probably conducted by the rods to the earth, as no further trace of it could be found. The great beams of the wood-work had been broken by the discharge, and the wood in great part splintered. The annual rings had separated one from another without any trace of carbonization. J. C. K. LAFLAMME.

Quebec, Oct. 20.

INDUSTRIAL NOTES.

The Victor Type-Writer.

A FEW years ago there was only one type-writer on the market; but such has been the activity of inventors, that there are now a score or more to be had, so that the most varied tastes in type-writers may easily be satisfied. The older and better-known key machines, familiar in all business-offices, still maintain their leader-



ship, though they are closely followed by machines of more recent invention. The most recent of these key type-writers was described in these columns a few weeks ago.

In some of the key-board machines there is a key for each character, as the Caligraph, the Yost, and the Automatic. In others a shifting or changing device gives two or three characters for each key, as the Remington, the Hammond, and others. The keys on these machines, therefore, range in number from thirty to eighty or more.

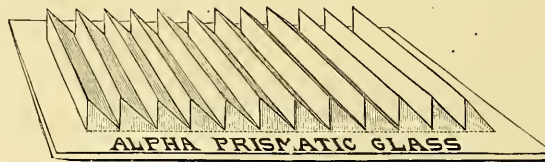
There is another class of type-writers in the market, without a key board, in which the character to be printed is first sought out

on an index, and the impression is made either by pressing down the pointer when in the proper position, or by moving with the left hand some device which presses the type against the paper. Of this latter variety of the "lever" or single-key class of machines, the Victor type-writer, shown in the illustration, is a good example. The characters, eighty in number, are arranged in three rows on the semi-circular index-plate in front, over which the pointer is moved by the right hand until the desired character is reached. This movement of the pointer is transmitted by gearing to the vertical type-wheel in the centre. The types, which are carried on the ends of radial springs at the periphery of the wheel, are moved around so that when the pointer is over *a*, for instance, on the index, the type *a* is at the printing point. The impression is then produced by pressing with the left hand the finger-piece shown at the left of the engraving. The paper is carried between two rollers on a sliding carriage, which travels behind the type-wheel, moving the proper distance automatically after each impression.

The Victor, though a very cheap machine, prints capitals and small letters, figures and fractions, and punctuation-marks, is simple in construction, small and light, and, for so cheap a machine, prints rapidly and well. This type-writer is one of the interesting exhibits at the American Institute Fair in this city.

Light in Dark Places.

THERE is many a room down in the depths of a city building — for we may measure such buildings in depth from the roof, which is the only part on which sunlight strikes, rather than in height from the sidewalk — where it would be a relief to suffering humanity if an occasional ray of sunlight could be induced to enter. To



say nothing of the basement offices in some of the down-town buildings of New York, let one consider the condition as to light of the average city flat. There is a room in front with windows on the street, and there is a room in the rear with windows on the yard. There are rooms between these extremes with windows, to be sure, but to what purpose is a mystery. These windows open on air-shafts not more than three or four feet wide, and shafts so deep, if you are near the ground floor, that no light seems quite energetic enough to have ventured so far: at least, if it does go down, it rests absorbed in the dust-begrimed walls of the shaft, incapable of turning a sharp corner into the room.

It is now possible to see in this city an experiment that shows it to be perfectly feasible to help a most remarkable amount of these stray rays from the bottom of a black air-shaft into a window at its side. This is done by placing in the window panes of prismatic glass like that we illustrate. The effect is, that a newspaper may be read at the farther side of the room, whereas, with a window of the ordinary glass, reading in any part is impossible. The experiment is arranged so that, when a shutter is removed from the window of one kind, the other is closed, and the transformation is striking.

New Electric Railways.

DURING the past few weeks the Thomson-Houston Electric Company of Boston has completed the electrical equipment of a number of street-railways, on which the electric cars are now in daily operation. Among them are the following: Central Railway, Peoria, Ill.; Citizens' Electrical Street Railway, Decatur, Ill.; Metropolitan Street Railway, Kansas City, Mo.; Omaha Motor Railway, Omaha, Neb.; Ottumwa Street Railway, Ottumwa, Ill.; Quincy Street Railway, Quincy, Mass.; Richmond Street Railway, Richmond, Ind. The total number of cars in use on these roads is 63; and

the number of miles operated, about 44. The company has also closed the following important contracts: Albany City Railway, Albany, N.Y.; City Electric Street Railway, Nashville, Tenn.; Kearney Street Railway Company, Kearney, Neb.; Macon City & Suburban Railway Company, Macon, Ga.; Metropolitan Street Railway, Toronto, Ont.; St. Paul City Railway Company, St. Paul, Minn.; St. Paul & Minneapolis Railway, St. Paul, Minn.; Union Depot Railway, St. Louis, Mo. The number of cars in use on these roads is 116; and the number of miles operated, about 114. This gives a grand total of 179 cars, running or contracted for, and 158 miles of track.

A contract has been recently closed for an electric railway at San José, Cal., which is the first Thomson-Houston road in the State. As one electric railway has already failed in this city, the selection of another was not made without careful investigation, which resulted in making the contract with the Thomson-Houston Electric Company. Ornamental double-bracket iron poles will be used, and nothing will be left undone in making the road a model in every respect.

The Julien Electric Traction Company.

IN view of the recent decision of Judge Lacombe, assigning to the Julien Electric Traction Company a definite and specific process of making its storage-batteries as distinguished from other methods, this company have concluded to temporarily suspend the operation of their cars in this city, pending the manufacture of batteries according to the method prescribed by the court. The factory at Camden, they state in a circular to their stockholders, will expedite the manufacture of batteries so as to enable them within a few

weeks to resume operations. In the circular they say, "It is gratifying to know that the court has finally determined the respective rights of this company and the complainants as to the methods to be employed by each in making batteries, more especially as the method we shall now employ is not only practical, but, in the opinion of such competent experts as Professor Cross of the Institute of Technology, Professor Brackett of Princeton College, and Professor Edward Weston of Newark, is superior to the method awarded to the complainant."

The company further state that they find in *L'Ingenieur Conseil* of Oct. 12, just received from abroad, the following information in relation to the granting of prizes at the Universal Exposition at Paris for the different types of accumulators or storage-batteries, which is translated as follows: "The official list of prizes distributed to exhibitors has just been published. We give herewith the award of merit which the jury has assigned to the different manufacturers of accumulators: grand prize, M. Gaston Planté (deceased); gold medal, The Société l'Électrique of Brussels, who manufacture the Julien accumulators; silver medals, The Electric Power Storage Company of London, which exploits the Faure-Sellon-Volckmar accumulators; silver medal, to the French Société of Accumulators (Phillipart Brothers), who exploit in France the Faure-Sellon-Volckmar accumulators. Silver medals were also awarded to M. Gadot, who also exploits the Faure-Sellon-Volckmar accumulators in France; and to M. Emile Regnier, who exploits accumulators of his own system. The other manufacturers of accumulators obtained either bronze medals or honorable mention. When we consider that the grand prize was given to M. Planté purely as an honor to the memory of a *savant* who in 1859 invented the secondary pile, the highest distinction was in reality granted to L'Électrique (or Julien) in this important branch of electricity."

Publications received at Editor's Office,
Oct. 14-26.

ANECDOTES Nouvelles. Lectures faciles et amusantes et Ré citations à l'Usage des Classes de Français. New York, C. E. Merrill & Co. 71 p. 12^o. 40 cents.

Björnstrom, F. Hypnotism: Its History And Present Development. Tr. by Baron Nils Fosse, M.G. (Humboldt-Library Series, No. 113.) New York, Humboldt Publ. Co. 126 p. 8^o. Cloth, 75 cents; paper, 35 cents.

BRYANT, W. C. Ulysses among the Phœnicians. From the Translation of Homer's Odyssey. (Riverside Literature Series, No. 43.) Boston and New York, Houghton, Mifflin, & Co. 72 p. 16^o. 15 cents.

CHAMBERS'S ENCYCLOPEDIA. New Ed. Vol. 11. Dionysius to Friction. Philadelphia, Lippincott. 828 p. 8^o. \$3.

CHRISTIE, G. G. Handbook of Commercial Geography. London and New York, Longmans, Green, & Co. 515 p. 8^o. \$2.

DU CHAILLU, P. B. The Viking Age. Vols. I. and II. New York, Scribner. 1123 p. 8^o. \$7.50.

FRESHFIELD, D. W., and WHITTAKER, W. J. L. Hints to Travellers, Scientific and General. 6th ed. London, Rog. Geogr. Soc. 430 p. 16^o. \$1.50.

GREENE, H. Coal and the Coal Mines. Boston and New York, Houghton, Mifflin, & Co. 246 p. 16^o. 75 cents.

INDIA RUBBER World and Electrical Trades Review. Vol. 1. No. 1. *nc*. New York, India Rubber Publishing Co. 4^o. 82 pages. \$2.

PHELPS, Elizabeth Stuart. The Struggle for Immortality. Boston and New York, Houghton, Mifflin, & Co. 245 p. 16^o. \$1.25.

SCOTT, W. C. Caring Art, Energy, and Locomotion. Philadelphia, Lippincott. 305 p. 12^o. \$2.

STRASBURGER, P. Handbook of Practical Botany. Ed. by W. Hillhouse. 2d ed. London, Swan Sonnenschein & Co. 425 p. 8^o. (New York, Macmillan, \$2.50.)

WALKER, S. F. Electricity in our Homes and Work shops. London, Whittaker & Co.; New York, Van Nostrand. 165 p. 16^o. \$1.50.

WASHINGTON Life Insurance Company, The. Historical, Actuarial, and Medical Statistics. New York, Washington Life Ins. Co. 161 p. 8^o.

WATSON, H. W., and BURROUGS, S. H. The Mathematical Theory of Electricity and Magnetism. Vol. II. Magnetism and Electrodynamics. Oxford, Clarendon Pr. 256 p. 8^o. (New York, Macmillan, \$2.60.)

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

Morris's "British Butterflies," Morris's "Nests and Eggs of British Birds," Bree's "Birds of Europe" (all colored plates), and other natural history, in exchange for Shakespeareana; either books, pamphlets, engravings, or cuts. — J. D. Barnett, Box 725, Stratford, Canada.

I have *andopoda of alina* (Weatherly), and many other species of shells from the noted Koskonong Lake and vicinity; also from Western New York, and fossils from the Marcellus shale of New York, which I would be glad to exchange for specimens of scientific value of any kind. I would also like to correspond with persons interested in the collection, sale, or exchange of Indian relics. — D. E. Willard, Albion Academy, Albion, Wis.

Will exchange "Princeton Review" for 1883, Hugh Miller's works on geology and other scientific works, for back numbers of "The Auk," "American Naturalist," or other scientific periodicals or books. Write. — J. M. Keck, Chardon, Ohio.

A collection of fifty unclassified shells for the best offer in bird skins; also skins of California birds for those of birds of other localities. Address Th. E. Slevin, 2443 Sacramento St., San Francisco, Cal.

I have forty varieties of birds' eggs, side blown, first class, in sets, with full data, which I will exchange for books, scientific journals, shells, and curios. Write mentioning what you have to offer. — Dr. W. S. SPROUSE, Bernadotte, Fulton County, Ill.

I wish to exchange *Lepidoptera* with parties in the eastern and southern states. Any list will western species for those found in other localities. — P. C. Truman, Volga, Groesbeek Co., Dakota.

Shells and curiosities for marine shells, curiosities or minerals address W. F. Lerch, No. 308 East Fourth St., Davenport, Iowa.

I want to correspond and exchange with a collector of beetles in Texas or Florida. — Wm. D. Richardson, P.O. Box 223, Fredericksburg, Virginia.

100 botanical specimens and analyses for exchange. Send list of those desired and those which can be furnished, and receive a similar list in return. Also cabinet specimens and curiosities for the same. Scientific correspondence solicited. — E. E. BOGUE, Orwell, Ashta, County, O.

I will sell to chapters or individual members of the Agassiz Association, 25 fine specimens of fossil plants from the Dakota group (cretaceous), correctly named, for \$2.50. Send post-office order to Charles H. Sternberg (author "Young Fossil-Hunters"), 1033 Kentucky Street, Lawrence, Kan.

The undersigned wishes to make arrangements for the exchange of *Lepidoptera* of eastern Pennsylvania for those from other localities. All my specimens are named and in good condition. — Charles S. Westcott, 613 North 27th Street, Philadelphia, Penn.

CALENDAR OF SOCIETIES.

Philosophical Society, Washington.

Oct. 26. — Romyn Hitchcock, The Action of Light on Silver Chloride; F. W. Clarke, Relative Abundance of the Chemical Elements; William Hallock, Note on Chemical Action between Solids.

Engineers' Club, Philadelphia.

Oct. 19. — The secretary presented for Mr. Conway B. Hunt a very complete description of repairing a bridge pier's foundation. These repairs were made to what is known as Pier No. 1 of the Aqueduct Bridge over the Potomac River. The rock bottom of the river is from twenty five to thirty-five feet below low tide. After an extraordinary freshet, a settlement was discovered; and investigation showed that a cavity had been scoured under the pier, extending the full length of the pier and across its up stream end. This cavity was about four feet high, and extended about six feet back under the pier. The author then gave a very full description of the manner in which this pier was constructed, from which it appears that all of the masonry had not been extended to the rock. After the first settlement was observed, it was found to continue, and repairs were at once begun. These were made by lowering concrete in loosely filled bags, which were packed in the irregular cavity by divers, and by lowering concrete in tubes, which were tripped and the material pushed with hoes and special tools into all the remaining portions of the cavity, until it was completely filled with a substantially solid mass of concrete. The outer surface of the pile of bags was finished with loose concrete. The method of preparing the concrete and doing the work was then described. The repairs occupied about eleven working days, and about one hundred and ten cubic yards of concrete were used.

Natural Science Association, Staten Island.

Oct. 10. — William T. Davis, Notes in regard to Butternut-Trees on Staten Island.

American Institute of Electrical Engineers, New York.

Oct. 29. — George B. Prescott, jun., Some Methods of Regulating Accumulators in Electric Lighting.



Some Children Growing Too Fast

become listless, fretful, without energy, thin and weak. But you can fortify them and build them up, by the use of

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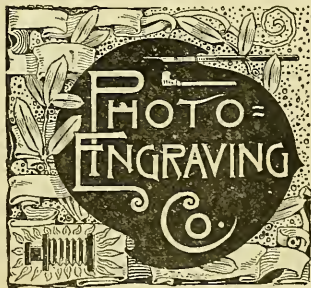
They will take it readily, for it is almost as palatable as milk. And it should be remembered that AS A PREVENTIVE OR CURE OF COUGHS OR COLDS, IN BOTH THE OLD AND YOUNG, IT IS UNEQUALLED. Avoid substitutions offered.

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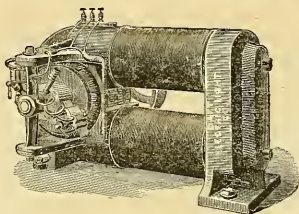
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Two armor'd knights in mortal combat meet
Armed cap-a-pie—that is, from head to feet.
The helmet, breastplate, shield and spear of one
Shone like the dazzling brightness of the sun.
The other suit of mail begrimed with rust
Was scarcely proof against his foe-man's thrust,

And after many a parry, guard and lunge
He thought it wisest to throw up the sponge.
"See here," he cried, "this isn't fair, you know,
Your armor's polished with Sapollo.
I cannot see to fight—I'm sure to fail—
SAPOLLO protects you from BLACK-MAIL!"

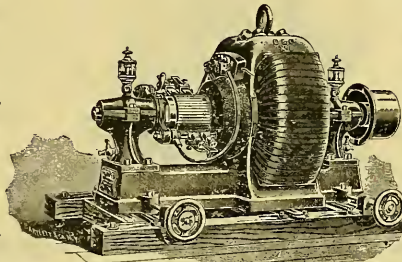
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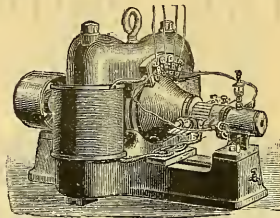
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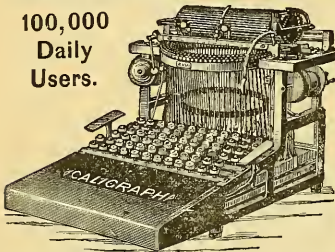
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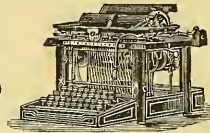
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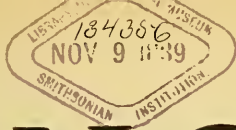
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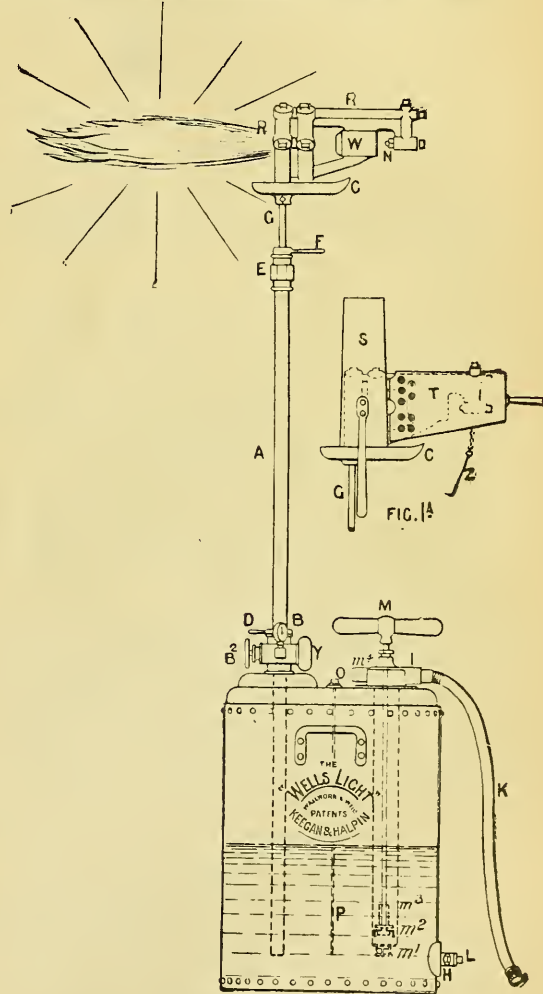
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THE WELLS LIGHT.

MANY of our readers may be familiar with the old form of a self-acting blast-lamp, for the use of alcohol, in which the alcohol was first vaporized by the heat of the lamp itself, and then this vapor, escaping under pressure, was burned. The object in this old lamp was to produce a high degree of heat. The object in this lamp we describe to-day is to produce a large amount of light.

The tank *P* contains kerosene, which is forced in by the pump till a pressure of about twenty pounds above that of the atmosphere is produced. This pressure forces the oil up through the piping *R*, surrounding the flame, in which piping it becomes vaporized; the vapor escaping under the pressure at *W*, and burning with a brilliant flame, as shown.

The flame is about two feet long, and is said to burn well un-



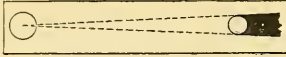
protected except when a high wind is blowing, when a wind-protector provided with the lamp allows all to go on well once more.

It will be apparent that a preliminary warming-up is necessary, to bring the piping around the flame to the proper temperature,

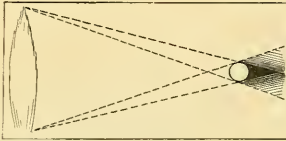
before this lamp can be lighted. This is done by burning a little oil in the dish *C* under the burner, or by a special lighting contrivance which brings a hot flame to bear on the vaporizing parts of the apparatus. As the lamp is primarily intended for out-door illumination, even the use of the oil in the cup is unobjectionable.

While this warming-up is in progress, the burner is covered with a sheet-iron hood, to confine the heat.

We have referred occasionally to the Manchester Ship Canal that is to make Manchester, England, a seaport. We now learn that these Wells lights are used for the night-work, and understand that their portability and large flames, rendering shadows less sharply marked, have caused them to be looked on with favor.



SHADOW FROM ARC-LIGHT.



SHADOW FROM OIL-FLAME.

The effect of the large flame of this oil-light in doing away with the black shadows which are found so objectionable when an electric arc-light is used is illustrated in the accompanying diagrams.

CERTAIN PROVISIONS OF CONTINENTAL LEGISLATION CONCERNING FOOD ADULTERATION.¹

DURING the past year I have had occasion to look up the subject of the laws and regulations now in force in European countries in reference to the sale of unwholesome or falsified foods, and believe that a brief *résumé* of certain provisions of such legislation may not be uninteresting to the members of this association.

To attempt to summarize what has been done in each country involves more or less of a review of its police administration, which would make this paper too long. Copies of these foreign laws, decrees, and regulations, and a list of our State laws on the adulteration of food and drugs, dairy products, and butter substitutes, will be found in the reports of the commissioner of internal revenue for 1888 and 1889, to which I would refer those specially interested in this subject.

In examining this mass of legislation, I was impressed with the large scope of the powers of the police authorities in continental Europe, and that there are many of these functions which our States might adopt with profit. For instance: in addition to what we consider the ordinary police duties relating to the enforcement of the laws and regulations respecting public order, the suppression of crime and violence, the supervision of the excise, of public places of amusements, etc., we find the following as being specified as part of the duties of the police administration in matters relating to public health: viz., —

(a) The registering and licensing, after previous examination by a board of experts duly appointed for that purpose, of all physicians, surgeons, accoucheurs, midwives, orthopedists, dentists, pedicures, trained nurses, and veterinarians.

(b) The registering and licensing, after suitable examination, of all pharmacists and of their assistants; also the inspection of all drug-stores, and the enforcement of rigid regulations concerning the sale of poisons.

(c) The supervision and inspection of all hospitals, whether public or private, public baths, prisons, schools, slaughter-houses, markets, stores, and other public and private establishments, in regard to their sanitary maintenance.

(d) The enforcement of all laws, and the making of all needful regulations to carry out their provisions, in regard to public health,

¹ Presented at the annual meeting of the American Public Health Association, Oct. 22–25, and published by permission.

especially those concerning epidemic or contagious diseases of men or animals.

(e) The supervision and inspection of all articles which serve as foods, properly speaking, or as beverages, as well as those which are employed in the preparation, production, manufacture, or preservation of such foods, including the places where such articles are sold, stored, or manufactured (see the laws on sanitary police, of France, Belgium, most of the cantons of Switzerland, Germany, Italy, etc.).

It is to certain features of the laws and regulations on this last subject that I wish to call your attention. These may conveniently be divided into four heads; viz., general, special, penal, and executive provisions.

General Provisions.

The word "food" may be said to include all commodities, materials, or ingredients, of whatsoever character, intended for human consumption.

A food is considered as adulterated or falsified (a) when any substance has been added which does not exist in the normal product, or is only found there in an appreciably lower proportion; (b) when any substance has been subtracted that is normally present in the product, and which is not found in the abnormal product or only in an appreciably lower proportion; (c) when it is an imitation of, or sold under the name of, another article; and (d) when any substance has been substituted, wholly or in part, for the article.

The selling, offering for sale, or otherwise putting on the market, as well as the use, of any food commodity which is unwholesome, altered, or decomposed, is prohibited under severe penalties.

The selling and offering for sale, for the purpose of slaughtering, of animals infected with contagious and other diseases, as well as the selling and offering for sale of the meat from such diseased animals, is prohibited. Power to regulate the proper inspection before and after slaughtering is left to the competent authorities.

The employment of poisonous coloring-matters in the manufacture of clothing, wall-papers, toys, eating, drinking, and cooking utensils, and other articles of common use, as well as their use in wrappers and vessels intended for the packing or for the preservation of food, are also prohibited.

Every dealer in food commodities must be responsible for the quality of his merchandise, whether of foreign or domestic origin.

Every food material must be sold under its true name.

Every dealer having an artificial product imitating a natural product in his possession, whether the same is intended for sale or is claimed to be solely for his own use, must announce such fact by conspicuous placards in his shop. All such artificial products must be duly labelled in a conspicuous and legible manner, bearing the name of the merchandise accompanied by the prefix "artificial."

The manufacture of, trade in, and offering for sale of, substances intended for the adulteration of articles for food is forbidden or restricted to certain prescribed methods and substances by stringent regulations of the competent authorities.

The power to regulate and to supervise the methods and the means for carrying out the provisions of these laws is placed with the competent authorities.

Special Provisions.

These include clear and concise definitions of the different food-products, as well as very often an accurate statement of what shall be the minimum chemical composition of such foods or their ingredients. The latter feature, however, is, owing to the constant advance made in the methods of chemical analysis, and also, it must be said, to the shifting character of adulterants used, much better left to frequently revised regulations by competent authorities than to the precise wording of a law.

1. BUTTER AND CHEESE. — These must be made from milk or cream, or both, and with or without common salt. Any admixture of a foreign fat not derived solely from milk makes the product artificial, and it must consequently be so labelled and sold. Most of these countries have special laws on the manufacture and trade in artificial butters (see reports of the commissioner of internal revenue for 1888 and 1889).

2. CONFECTIONERY.— This must only be colored with harmless materials, such as (black) chinese black; (blues) Berlin blue, indigo, litmus, Prussian blue, saffron blue, ultramarine; (brown) caramel; (greens) chlorophyl (as spinach-juice), mixtures of yellow colors with blue (a mixture of Prussian blue, Berlin blue, and Persian berries gives a green rivalling in brilliancy Schweinfurt's green); (reds) annotto, Brazil lac, carmine, carmine lac, cochineal, orseil, the juice of beets and red berries (such as cherries and currants, etc.); (yellows) Avignon berries, curcuma, fustel, marigold, Persian berries, quercitron, safflower, saffron, turmeric; chalk and the ochres. The use of substances known to be injurious to health is forbidden in this and other food commodities. Among these injurious substances are included salts of antimony, arsenic, barium, except the sulphate; bismuth, cadmium, chromium, cobalt, copper, iron, the chloride and sulphate, though most iron salts are harmless; lead, magnesium, nickel, zinc, and some of the potassium and sodium salts; oxalic acid, picric acid, cocculus indicus (Indian berry, Levant nut), picrotoxine, gamboge, aniline, aloes, eosine, fuchsine and its immediate derivatives; coloring-matters containing nitrous vapors, as naphthol yellow, victoria yellow, coloring-matters prepared with di-azo compounds.

3. DISTILLED BEVERAGES.— These (such as kirsch, brandy made from grape residue, from lees, or with juniper berries, gentian, etc.) must only bear the name of "natural" when they are produced by the fermentation and subsequent distillation of the fruit or material of which they bear the name, without any addition whatsoever. The sale of these beverages made artificially with alcohol, or increased by alcohol and other substances, is tolerated, provided the mixture contains nothing injurious to health, and is properly labelled.

4. FLOUR AND BREAD.— The sale of any flour containing ergotized grains is forbidden. The addition of any flour of an inferior value constitutes a fraud if the mixture is not specified. Wheat flour shall be composed entirely of ground wheat, free from bran, perfectly white, or having a faint tinge of yellow; must not show red, gray, or black specks, nor possess a disagreeable odor; must contain no foreign meals, as rye, corn, barley, peas, beans, rice, linseed, buckwheat, and potato-starch; no alum to disguise the presence of damaged flour in mixtures, or to improve the appearance of an inferior grade, etc.

5. FRUITS AND VEGETABLES.— The sale of unripe or of rotten fruits or vegetables is forbidden.

6. HONEY.— Honey must consist of the saccharine substance collected by the bee (*Apis mellifica*) from the nectaries of flowers, and deposited by them in the cells of the comb. It must not contain any added starch-sugar (glucose), cane-sugar, or inverted sugar.

7. LARD.— This must be made exclusively from the rendered fat of the hog, and must not contain any foreign fats.

8. LIQUEURS.— These must be free from unwholesome materials, toxic bitter substances, fuchsine and other coloring-matters, etc.; and, as they are all artificial products, they must be duly labelled.

9. MALT LIQUORS.— These must consist of the fermented alcoholic infusion of malted barley with water, and flavored with hops. The replacement of these substances by others is considered, if these are inoffensive, as a violation of, and, in case they cause injury to health, as an offence against, the law. They must not contain antiseptics, salt (except that derived from the water used in brewing), or alkaline bi-carbonates. The beer-pumps used must be so fitted as not to produce any alteration in the beverage. The pipes must be as short as possible, and formed of pure block tin. They must be washed out every day with boiling water, and every eighth day with a solution of soda. The air used must be drawn from without, and caused to traverse a bed of pounded and sifted charcoal. The whole apparatus must be kept in a state of perfect cleanliness.

10. MEAT.— Every animal, before being slaughtered, must be inspected by a competent veterinarian, who will issue the necessary health certificate. An inspection is again made when the carcass is ready to be cut up, and before the removal of the viscera. The inspector will give a permit of sale if he considers the meat sound. Meat is considered injurious which is derived from animals (a)

dying from internal disease, (b) poisoned, (c) affected by a contagious disease, or (d) by a malady involving the decomposition of the blood; also all meats containing any parasites, as trichinae, capable of developing in the human body, and all meats entering into putrefaction. The sale of all meat derived from a sick animal is forbidden, whether it may or may not be injurious to health. The slaughtering of calves under sixteen days old, as well as the sale of such veal, is forbidden.

11. MILK.— The sale of milk coming from sick cows is prohibited. Persons coming in contact with invalids suffering from contagious diseases should abstain from the handling of milk. The use of vessels of copper, brass, zinc, pottery poorly glazed or made with lead enamel, must be avoided. Places for storing or retailing milk should be clean, airy, and located at a distance from sleeping or sick rooms. The use of carbonate of soda, salicylic and boracic acid or their salts, as well as other materials intended as preservative agents of milk, is prohibited. The removal of cream, the addition of water, foreign fats, or coloring-matter, are considered as adulterations. Milkmen are required to mark upon their cans in an indelible manner the kind of milk they contain: (a) whole (pure) milk; (b) mixed or half-skimmed milk, resulting from the mingling of the skimmed milk with the morning's whole milk; and (c) skimmed milk, i.e., milk entirely without cream. In the two latter cases milkmen must notify their customers of the character of the product. A specific-gravity test at 15.5° C. (60° F.) of 1.03 is generally recognized as the minimum for pure milk, though chemical analysis is depended upon in cases of dispute.

12. SPICES AND COLONIAL PRODUCE.— These must be sold in a pure and unmixd condition.

13. TINNING.— The tinning of all copper and iron utensils used in the preparation or preservation of foods must be made with pure tin, or one containing not more than one per cent of lead. Galvanized (i.e., coated with zinc) vessels are not allowed.

14. VINEGAR.— This must be composed only of acetic acid, and must not contain any other acid, either mineral or organic.

15. WINE.— Nearly every wine-producing country in Europe has special laws on this subject, in which a sharp distinction is drawn between natural and artificial wines. A natural wine is defined as the liquid product which results from the alcoholic fermentation of the juice of fresh grapes without any addition whatsoever. Every wine which has not been made solely from the juice of fresh grapes must be sold under the denomination of "artificial wines." Artificial wines may be divided into two classes,—viz, imitation and demi-wines,—defined as follows: Artificial wines are alcoholic liquids which resemble natural wines, but which are not derived from the fermentation of unaltered grape-juice, and are made with a mixture, such as water, brandy, alcohol, glycerine, sugar, tartaric acid, cyanthic ether, etc., to imitate wines; demi-wines are those resulting from the addition to the must or natural wine of water, sugar, alcohol, and other substances, intended to produce the taste or appearance of wine in such diluted and attenuated liquids, or made in the same manner with grape marc, already used in the preparation of must. Provisions are made for the proper branding and labelling of all vessels and packages containing wine, and for distinctive way-bills, invoices, etc., used in the shipment and the sale of wines. All wines not labelled as artificial are considered as being genuine wines, and severe penalties are imposed for violations of this provision.

Penal Provisions.

The penalties prescribed range from a small fine, to imprisonment in the house of correction or the penitentiary, with or without hard labor, for a term of years or for life, depending on the gravity of the offence.

In occupations requiring a license from the authorities, said license may be rescinded, and the offender may be deprived of the privilege of carrying on such occupation for a longer or shorter period of time, in the discretion of the court. The repetition of an offence within a year is generally punished by doubling the penalty provided for the first offence.

The selling, offering for sale, or otherwise putting on the market, of a product under a name other than that which its nature requires, although the value of the product may be the same, is con-

sidered a fraud, and so punished. Such products may be seized, confiscated, and rendered unfit for use, by the competent authorities.

Executive Provisions.

The police administrations are charged with the supervision and the execution of these laws, having power to make and enforce the necessary regulations.

There is generally a State commission of control, composed of three or more experts, appointed with the necessary police powers, to whom this subject is intrusted. They have under their directions the inspectors, veterinarians, and chemists necessary for the proper execution of the laws and regulations. The co-operation of the local police officials, whenever necessary, is obligatory.

The commission meet at least twice a year for the transaction of business. They must also make at least two inspections a year of all factories and warehouses for food.

The inspection and supervision of all establishments intended for the public preparation, manufacture, or sale of foods must be performed by the inspecting officials employed by the commission. The inspections of these establishments must take place at least twice a year, and without previous notification to the owners. Reports of such inspection are made in writing to the commission.

The inspecting officials have the right to enter any establishment within their jurisdiction during the usual business hours or when such places are open to the public, and to take for examination such samples as are necessary.

When the examination of samples cannot take place on the spot, but demands a chemical, microscopical, or similar examination, two samples must be taken, and placed under seal, by the inspecting official, in the presence of the owners or their representatives, who likewise may affix their own seals thereto. One of these samples is forwarded to the commission with a report, and a request for the proper examination thereof, and the other is retained by the inspecting official. On demand of the owner, another similarly sealed sample may be retained by him.

When there is reason to believe that a food is adulterated or unwholesome, the inspecting official may order it detained until a proper examination can be made.

If the sample proves, on examination, to be adulterated or unwholesome, the cost of said examination is paid by the offender; but otherwise the State pays the cost of the samples taken and of the examination.

All unwholesome foods are to be confiscated and destroyed without compensation to the owner.

Private individuals may have samples of food examined by the experts of the commission on complying with prescribed regulations and by paying a moderate charge, or free of charge in many countries.

EDGAR RICHARDS.

THE ANCIENT ETRUSCANS.¹

THE problem of the ethnologic position of the ancient Etruscans must be considered as yet unsolved. In spite of the prolonged labors of Corssen and Deecke, the theory that attached the Etrusci to the Indo-European stock rests on such feeble foundations that it is rejected by some of the ablest specialists in this branch; while the Turanian or Ugric origin, so vehemently advocated by Dr. Isaac Taylor, Mr. Robert Brown, jun., and others, is now dismissed as untenable by all the continental Etruscologists.

As for those other hypotheses which connect the inhabitants of Etruria with the ancient Copts, with the Israelites, with the Lydians, with the Armenians, with the Hittites, with the Celts, with the Basques, and what not, they never had enough in their favor seriously to attract the attention of scholars.

One defect in these theories has been that they were all based on one ethnic element only. Their authors seem unaware that in the present condition of ethnologic science it is insufficient to deduce conclusions from the language only, or the arts only, or the legends or the physical features only, of a nation: all these must

be taken into account where the problem is complex, and the verdict of each must be carefully weighed.

My attention was especially called to this problem while spending some months in Italy early in the present year, where I had the opportunity of seeing the many museums of Etruscan antiquities which are so intelligently preserved and displayed in that country.

I had reached the Italian shores by the most ancient travelled route from the coast of Africa; that, indeed, which was taken by the pious Æneas himself, sailing from Carthage by way of the Isle of Pantellaria to Marsala, the ancient Lilybœum.

On a clear day one is rarely out of sight of land on this crossing, for no sooner do the bold headlands on either side of ancient Carthage sink in the south-west than the volcanic cone of Pantellaria rises in sight; and when that is lost to view, the mountainous coast of southern Sicily is soon perceived. The distance between the two islands is not quite sixty English miles, — an interval of space which was not enough to offer any serious barrier to even very early ploughmen of the Mediterranean main.

I dwell on these geographic details with a purpose, as you will see later; and I mention the fact of my journey in Africa, as it was the observations I made there which first led me to the conclusions I am about to present in this paper. Part of my time had been passed on the borders of what is called "la Grande Kabylie," — that portion of the province of Algiers which is inhabited by the Kabyles, the most direct descendants of the ancient Libyans.

They are a strange people, these Kabyles, both in customs and physical aspect. Natives of Africa time out of mind, many of them present the purest type of the blonde races, — blue or gray eyes, tawny beard, fair complexion, curly light or reddish hair, muscular in build, and often tall in stature. When I came to look at the many evidently portrait busts on the tombs of the ancient Etruscans, there was something in the features, in the shape of head and face, which reminded me of these Kabyles. Slight as it was, it induced me to compare the two peoples in other details, and it is the result of this comparison which I now submit to be weighed and judged by those competent in such matters.

Etruscan remains are found in Italy from the Gulf of Salerno to the River Po, and from the Tyrrhenian Sea to the Adriatic. One inscription, indeed, has been unearthed at Verona, perhaps one near Chiavenna; and even at Chur I was shown one, in the Rhetian Museum, which the curator averred had been dug up near that city. Certain it is, however, that the right bank of the Po was substantially the northern limit of Etruscan culture.

They were essentially city-builders and city-dwellers; and at the height of their power, which we may put about five or six hundred years before the Christian era, they appear to have had three federations, of twelve cities each, within the limits I have named. This statement might easily lead to an excessive idea of their numbers; but it is well ascertained that the Etruscans constituted by no means the bulk of the population. They were only the ruling class, a slave-holding aristocracy; while the large majority of the inhabitants belonged to native Italian tribes, as the Umbri, the Oscii, the Ligures, and others.

All the ancient writers recognize the Etruscans as intruders on Italian soil, and they themselves are said fully to have acknowledged this, and indeed to have had certain legends as to the time and place of their first permanent settlement on the peninsula. It is only in utter defiance of these semi-historic reports that Virchow and others bring them down from the Alps, across the plains of Lombardy, through the defiles of the Apennines, and at length to the shores of the Tyrrhenian Sea. Neither the classical historians nor the Etruscans themselves knew a vestige of such a tradition. The erudite Otfried Muller, who has collected every thing to be found in Greek and Latin literature concerning them, states that it is the unanimous testimony of antiquity that the earliest Etruscans reached the western shore of Italy, crossing the sea from the south; and he adds that it is undeniable (*unleugbar*) that such was the belief of the Etruscans themselves. We know that by tradition and religious customs they assigned as their first permanent settlement the city of Tarquinii, the modern Corneto, on the shore of the Mediterranean, twelve miles north of Civita Vecchia.

¹ Abstract of a paper by Daniel C. Brinton, M.D., read before the American Philological Society, Oct. 18, 1889.

To this venerable site the priests and soothsayers resorted from all parts of Etruria to perfect themselves in the pure and ancient "Etruscan discipline." Here their hero-god Tages, a wondrous gray-haired boy, sprang into life from a ploughed furrow, and taught their ancestors the mysteries of the diviner's craft and the nobler arts of life. This locality, I say, according to uniform tradition, was where their progenitors first established themselves, crossing the sea from somewhere to the south. Such a tradition, so definitely preserved, cannot be cast aside without sound reasons.

The date of this landing has been given by Müller at about two hundred and ninety years before the founding of Rome, while other writers are inclined to put it earlier by five hundred years. Between a thousand and twelve hundred years before the Christian era is probably as near as we can now fix it.

Now that the extensive excavations in Etruscan sites enable us to have a survey of the whole field of their operations, it is conceded more and more that the line of their migration was from south to north, from cisapennine to transapennine localities. Their settlements at Marzabotto, Bologna, and beyond, were visibly later and of briefer duration than in Etruria proper. The Etruscan alphabet of North Italy also reveals plain marks of degeneration, and the forms of the inscriptions are less archaic.

We do not have to depend upon guess-work for a knowledge of the physical features of the Etruscans: we have a vast realm of mimetic art preserved, much of it unquestionably faithful to the originals; and, in spite of the frequent custom of incineration, hundreds of genuine Etruscan skeletons have come down to us in a good state of preservation.

It surprises me, that in spite of this, and although the anthropometric results I am about to quote have been published for years, Dr. Deecke, in his recent edition of Müller's "Etrusker," takes no note of them, but repeats the old statement that this people was short in stature, heavy-set, obese, and dark. Of course, Dr. Isaac Taylor, in order to give countenance to his theory that the Etruscans were Turanians, is glad to adopt this opinion. He would not have liked to take cognizance of the modern anthropologists who have studied the subject, for nothing more fatal to his theory can be imagined than their results.

The old notion seems to have arisen from expressions in two late Roman poets, Virgil and Catullus, who speak of the Etruscans as fat. *Pinguis Etruscus* and *obesus Etruscus* are their words. It has also been commented on that the Etruscan cinerary urns frequently represent short, stout men, with disproportionately large heads and arms. This, however, was merely a technique of the national artists. They often put all their work on the upper, and effaced the lower portion of the figure, as not presenting individual characteristics. Where the full figure is shown, as in some beautiful specimens in the Museum at Florence, the squat appearance referred to is not apparent.

Fortunately we do not have to rely on the contradictory testimony of art to learn the stature of the Etruscans. The Italian anatomists have measured two hundred of their skeletons, and from these have deduced, in accordance with well-known osteologic rules, the height of the average individual. The result shows them to have been an unusually tall race, the average of the two hundred persons having been 1.75 metres, or very nearly five feet nine inches. This is greater than the average height of our soldiers during the war, which was 1.70 metres, and is rather above the average of the soldiery of any European nation to-day, though less than some of the picked corps, — the French carabiniers, for example. It is a little more than the average stature of the Algerian Kabyles, who, nevertheless, are a tall race, averaging above 1.70 metres.

Dr. Taylor and his followers do not fare better when it comes to cranial measurements. The typical skull of the Turanian stock is short and roundish, — brachycephalic; that of the Etruscan was markedly of the long type, — dolichocephalic. MM. Hovelacque and Hervé quote the results of three extended measurements of the cephalic index by Italian craniologists as showing 75.6, 76, and 77.3. Less than a fourth of the crania can be called brachycephalic.

It is interesting to compare these figures with measurements

from the skulls of the modern descendants of the ancient Libyans, — the Kabyles. According to data furnished by two excellent observers, MM. Topinard and Lagneau, these are respectively 76.7 and 77.3, almost absolutely the same as for the old Etruscans.

There is a current tradition in Italy that the Etruscans were blondes, with light hair and blue eyes. I met a Tuscan wine-merchant who lived near Florence, and he pointed with pride to his handsome blond beard, informing me that his family claimed Etruscan descent, and that his beard was proof of it. There is evidence from ancient art that this piece of folk-lore is correct; and the eminent anthropologist I have just quoted, M. Topinard, sums up, with his usual correctness, our anthropologic knowledge of this people when he says, "From the evidence before us, we may decide that the Etruscans were of large stature, blondes, and dolichocephalous; while their predecessors, the Umbrians, were small and brachycephalous."

In all these physical traits we discover a coincidence with the ancient Libyan or true Berber type, as seen in the Kabyles of the Djurdjura Mountains, the Rifians of Morocco, and the former inhabitants of the Canary Islands, the Guanches. There is no doubt but that the last mentioned were a true branch of the Berber stock. The fragments of their language, which have been collected and critically edited by Sabin Berthelot and others, prove that it was closely allied to the dialect of the Morocco Rifians. Their skeletons show them to have been an unusually tall race, quite a number of individuals ranging from six to six and a half feet in height. Their skulls present the same dolichocephalic index as the Kabyles; and that they were largely blondes, is attested by the early navigators, who speak of their long yellow hair reaching down to below their waists. The presence of these blondes on the Canaries destroys the theory sometimes advanced, that the blond hue of the Kabyles arose from admixture with the Goths at the period of the dissolution of the Western empire; for the Canaries were peopled by the Berbers long before the Christian era, and Dr. Verneau has quite recently discovered Numidian inscriptions there. But, for that matter, this hypothesis is untenable for other reasons. The blond Berbers are referred to on Egyptian monuments; and, as for the Goths in Africa, they had entirely disappeared as early as when Procopius wrote his history.

All this goes to show that the physical type of the ancient Etruscans was the same as that of the ancient Libyans, and entirely distinct from any then existing on the Italian or Hellenic peninsulas. This identity can be traced in other features of importance to the anatomist. The orbital index of the modern Kabyles is 88.1; of the Etruscans, 87.4, a remarkable approximation. The nasal indices of both range between 44 and 49. In both there is a lack of accentuation of the cranial prominences.

Wherever the first settlers of Tarquinii came from, they do not seem to have brought with them the higher arts of life. Most of these were later acquisitions, learned from their neighbors, the Greeks of Sicily and Magna Græcia, and in longer voyages for trading and piracy, which extended to Greece itself, to the coasts of Asia Minor, to Egypt, and to the Semitic cities of Palestine and their colonies at Carthage and elsewhere. Etruscan art yields positive testimony to all these influences, especially that of the Greeks. The Etruscan alphabet appears to me to have been derived directly from the Greek, and not from the Phœnician, as Rawlinson and others have thought. We must carefully exclude all these external borrowings if we would make a correct comparison of real Etruscan culture-traits with those of other nations. When this is done, it will be found that in some characteristics they stood in bold relief from all the nations I have mentioned.

No one of these is more conspicuous than the position assigned to woman in Etruscan civilization. It was in astonishing contrast to her place among the polished Greeks, and still more so to her station in Oriental life. With the Etruscans, evidently a strictly monogamous people, she was the equal and the companion of her husband. She sat by his side at the feasting-board; she was cared for in the most attentive manner; her image was carved with his on their common tomb; and there are a thousand evidences that she was not merely the idol, but the honored help-

mate, of the man. It was from this Etruscan example that early Rome drew the principle of monogamy and of the substantial independence of woman; and, whatever we have of that noble element in modern life, it is a legacy through Rome from ancient Etruria.

This was decidedly neither a Hellenic nor an Eastern principle, but we do find it from the earliest times among the Berbers. Even in spite of the polygamous doctrines of Mohammedanism, the woman still retains her position in Kabyle life as the companion and helpmeet of man. Their *Kanoun*, or ancient code of laws, often in conflict with the Koran, and always respected in preference to it, protects her autonomy in a variety of ways, and the independence of her position has been a frequent theme of comment with travellers.

Another marked and peculiar element in Etruscan life was the recognition of the principle of confederation in politics. Their league of twelve independent cities was the first of its kind in the ancient world. Canon Rawlinson forcibly points out how far it was superior to the temporary and unstable alliances of the Greeks. In this lay the secret of the rapid success of Etruria.

Here, again, is a singular identity with North Libyan governmental features. The very word "Kabyle" (the Arabic *q'ba'il*) means "confederation," and refers to their ancient system of a political union of thoroughly independent communities. Nor is this a recent growth. The name by which the Kabyles were known to the Latin writers was *Quinguentes* ("the five nations"), referring to the coalition which then, as now, existed among them.

The Etruscans were bold navigators. For more than a century (600-500 B.C.) they were the virtual masters of the Mediterranean. It may be objected that in this they were unlike the Libyans; but it must be remembered that the Libyans undoubtedly did at that time venture out into the Atlantic as far as the Canary Islands, and peopled them,—a greater distance from land than the passage of the Mediterranean requires.

I cannot pursue this parallel in other directions, for lack of material. We know something about the Etruscan religion; but Christianity and Mohammedanism have effaced every vestige of the ancient cult of the Berbers. The architecture of the Etruscans was wonderful; but, beyond the fact that the ancient Libyans were builders of megalithic monuments and of dwellings of cut stone, little has come down to us regarding their knowledge of this art.

One of the ablest of ancient historians, Dionysius of Halicarnassus, asserted that the Etruscan language was *sui generis*, without affinity with any other. Such seems to have been also the most recent verdict of modern linguistic research. Dr. C. Pauli, one of the best authorities on it now living, pronounces all attempts to trace its relationship to be failures; and Dennis, the learned English Etruscologist, states his opinion that it is as isolated as the Basque. Dr. Pauli, indeed, decries all attempts to trace, in the present state of our knowledge, its affinities, and himself sets the example of studying it from its own monuments alone.

These monuments are not insignificant. We have preserved to us, more or less complete, over six thousand inscriptions in the Etruscan alphabet and language, a few of them bilingual, usually with the Latin. We know the value of the Etruscan letters, and, up to a certain point, the phonetics of the tongue. Some words have been preserved to us in Greek and Latin writers with their meanings, and the sense of others can be approximately made out from their recurrence in a great many inscriptions of a certain class. We also have the numerals, and a multitude of proper names, personal and geographic.

If, with this apparatus at command, I venture to disregard Pauli's warning, and to institute a comparison between the Etruscan and Libyan languages, it is because I think the material is sufficient at least to be worth the attention of students. So far as I know, no one has attempted any such comparison before; nor do I find that this possible origin of the Etruscans has as yet been advanced, obvious as it seems to be.

One reason of this has doubtless been the extremely little available knowledge of the Libyan tongues, ancient or modern. What we do definitely know may be briefly rehearsed.

The modern Libyan, or Berber, is spoken by hordes scattered from Timbuctoo to the Mediterranean, and from the shores of the Atlantic to the borders of Egypt. It is divided into a number of dialects, which are phonetically grouped into two classes,—the "strong" and the "weak,"—characterized by the regular transformation of certain consonantal sounds, principally *k* to *l*, *t* and *o* to *d'* or *r*, *s* to *ch*, etc. When the action of these phonetic laws is understood and allowed for, the fundamental unity of all the dialects becomes apparent, both in their vocabulary and grammar.

The themes are both nominal and verbal; but the latter are much the more numerous, and form the grammatical characteristic of the group. They are nearly all consonantal, and may be of one, two, three, or four letters, subject to internal vowel change, and modification of the idea by prefixes and suffixes.

The modern Kabyle, which has adopted many Arabic words, is written with the Arabic alphabet; which, however, does not render correctly some of its sounds. The Touareg, the dialect of the desert, has preserved an alphabet of its own, no doubt a form of the ancient Numidian, which in turn was derived from the Semitic Carthaginian. The Tamacek, as this venerable A B C is called, does not express the vowel-sounds nor separate the words. It is said to have been retained principally through the efforts of the women, who are the *litterate* of the tribe.

The ancient Libyan or Numidian was the parent stem of these dialects. Some hundreds of inscriptions in it have been preserved, a few of them bilingual: so there is a possibility that we may recover the grammar of this now lost tongue. Professor Newman, indeed, has made an effort to restore it from modern Berber dialects; but I am surprised that he has made no use of this epigraphy.

These various Libyan dialects form the western branch of a large family of tongues, of which the eastern branches include the modern and ancient Coptic, the Abyssinian, and others. The whole family has been called "Hamitic," or "Cushite," or "Proto-Semitic," of which terms the first is the best, simply because it conveys no preconceived hypothesis. The grammar of all the Hamitic languages shows similar traits. The nouns have a masculine and feminine form; the radical may be of one or more syllables, and, unlike the Semitic tongues, it remains unaltered in the process of word-building; there are plural but not dual forms; relation is expressed by both prefixes and suffixes; and the verb originally had but one form, instead of the two or more found in the Semitic languages.

The general grammatical aspect of these languages, however, leaves no doubt but that at some remote epoch they were derived from the same original form of speech from which the Semitic languages trace their descent; hence they are classified as the "Hamito-Semitic" stock.

Where was the original seat of the tribe who spoke this parent tongue, has not been ascertained. The uniform opinion of scholars has been that it was somewhere in western Asia; and, though the question does not immediately concern the present discussion, I cannot forbear adding that I hold this to be a mistake, and that the original seat of the Semites was on or near the Atlantic coast.

In conclusion, I would submit the following as the results of this inquiry: 1. The uniform testimony of the ancient writers and of their own traditions asserts that the Etruscans came across the sea from the south, and established their first settlement on Italian soil near Tarquinii: this historic testimony is corroborated by the preponderance of archæologic evidence as yet brought forward. 2. Physically the Etruscans were a people of lofty stature, of the blonde type, with dolichocephalic heads. In these traits they corresponded precisely with the blonde type of the ancient Libyans, represented by the modern Berbers and the Guanches, the only blonde people to the south. 3. In the position assigned to woman and in the system of federal government, the Etruscans were totally different from the Greeks, Orientals, and Turanians, but were in entire accord with the Libyans. 4. The phonetics, grammatical plan, vocabulary, numerals, and proper names of the Etruscan tongue present many and close analogies with the Libyan dialects, ancient and modern. 5. Linguistic science, therefore, concurs with tradition, archæology, sociologic traits, and anthropologic evidence, in assigning a genetic relationship of the Etruscans to the Libyan family.

THE USE OF OIL.

As the season of winter storms on the North Atlantic is approaching, navigators should note the many instances where serious danger and damage have been avoided by using oil to prevent heavy seas from breaking on board. It will be remembered that on the "Pilot Chart" for last March a full explanation was published, with diagrams, as to the best methods of using oil. Reprints of this explanation and accompanying diagrams can be obtained at any branch hydrographic office.

There are many other cases where oil may be used to advantage, such as lowering and hoisting boats, riding to a sea-anchor, crossing rollers or surf on a bar and from life-boats and stranded vessels. Thick and heavy oils are the best. Mineral oils are not so effective as animal or vegetable oils. Raw petroleum has given favorable results, but not so good when it is refined. Certain oils, like coconut-oil and some kinds of fish-oil, congeal in cold weather, and are therefore useless, but may be mixed with mineral oils to advantage. The simplest and best method of distributing oil is by means of canvas bags about one foot long, filled with oakum and oil, pierced with holes by means of a coarse sail-needle, and held by a lanyard. The waste-pipes forward are also very useful for this purpose.

In addition to the reports published last month from vessels that used oil during the St. Thomas-Hatteras hurricane of Sept. 3-12, the following have been received by the United States Hydrographic Office from vessels that encountered the same storm:—

The British steamship "Elgiva" (Capt. Berrpohl), Sept. 4, when in latitude 24° north, longitude 65° west, kept oil-bags at bows and channels to prevent seas from coming on board. The oil had a remarkable effect in smoothing the seas, and the vessel sustained no damage whatever. The British brigantine "Victoria" (Capt. Simmons), in a terrific hurricane, Sept. 5, latitude 26° north, longitude 68° 38' west, lost spars, sails, etc. A quantity of cod-oil was used, and it is thought that it saved the ship's hull from damage, and possibly total loss. The American brig "Mary Bartlett" (Capt. Holmes), Sept. 8, latitude 36° 42' north, longitude 74° 22' west, commenced using oil (paint and kerosene mixed). On Sept. 9, the wind north-east and blowing in terrific squalls, oil was used with great success. The British brig "J. A. Horsey" (Capt. Dowling), in a hurricane off capes of the Chesapeake, Sept. 9-12, used kerosene-oil, but without as great success as if it had been a heavier oil, of which there was none on board. The American schooner "Ralph M. Haywood" (Capt. Baxter), in a hurricane off capes of the Chesapeake, Sept. 9-11, used axle-oil in bags hung over the weather bow. The bags were replenished every two hours; in all, about five gallons being used, and with great success. The Italian bark "Biagino" (Capt. Brignati) encountered the hurricane, Sept. 9-12, after leaving the Delaware Breakwater for Cagliari. The cargo was petroleum, and, as the vessel leaked badly, a large amount of the oil was pumped out. As stated above, a thin oil like refined petroleum has but little effect, and such was the case in this instance. The British steamship "Claribel" (Capt. Macknight) encountered the hurricane, Sept. 9-11, between latitude 37° north, longitude 73° west, and latitude 34° north, longitude 71° west. Oil was used with success, and prevented many a heavy sea from breaking over the vessel.

MENTAL SCIENCE.

Experiments in Crystal-Vision.

THERE is a general tendency, whenever a notion is relegated to the rank of superstitions, to regard all interest in the matter as ending there. Such an attitude neglects to distinguish between error founded upon a false observation of facts and error founded upon a false interpretation of facts; it neglects to consider as well that the origin of this superstition also needs explanation. A superstition is rarely a purely fanciful notion spun from the inner consciousness, but usually contains, though often in a scarcely recognizable form, an element of interesting and perhaps important knowledge. It is with a full appreciation of this latter point of view that an anonymous lady writes in the recently issued number of "The Proceedings of the Society for Psychical Research" upon

the phenomena of crystal-vision, and reviews these in the light of cognate experiments of her own. The phenomenon, though simple, has a very ancient and varied history. It consists in gazing into a crystal, a drop of water, polished metal, a gem, or even the finger-nail, and seeing there reflected certain appearances usually to be interpreted as of prophetic significance. The custom is very widespread in the Orient both in the most ancient and in modern times. It has been found among savages, it has been counted as an instrument of the devil, it has received noble treatment at the hands of the learned before the courts of princes. Like most such customs, it has been surrounded with mystic and religious proceedings, and its exercise controlled by elaborate and fanciful directions. The Assyrians, the Hebrews, the Greeks, the Romans, were acquainted with the process, and give evidences of its use. In early Christian times those who read the future by gazing into a mirror received the title of "specularii." They appear in a church council convened by St. Patrick in 450, while we have a list of procedures against them as heretics in the twelfth century. Although Thomas Aquinas attributes this power possessed by some children to the work of the devil, and though a special condemnation of it was made by the theological faculty of Paris in 1398, the art continued, and in the sixteenth century reached its zenith under the auspices of a court physician or a university professor. Catherine de Medic consulted a magician, who showed her in a mirror how long her sons would occupy the throne. The topic was brought into prominence by the work of Dr. Dee, a very entertaining personage, under whom the process was systematized, and produced wonderful results. Dr. Dee and his associate, one Kelly, of dubious repute, see spirit visitors in their crystal or shew-stone who are described in all detail. Moreover, they hold long conversations with them, though what they learn from the "angelical beings" is often mere "sermon-like stuff." The stone is "of that value that no earthly kingdom is of that worthiness as to be compared to the virtue or dignity thereof;" it is brought to him by angels; it is miraculously restored to him; it is placed in a sanctuary, and shown with great ceremony. We read of many other uses of the crystal: we have instructions whereby to have a spirit enclosed in a crystal stone or beryl glass; and from these mediæval notions we have almost a continuous use of the process down to modern times.

Considering the function of the crystal simply as a means of concentrating the gaze, our author attempts to follow the course of these visions by analogy with other hallucinations, and regards them as consisting mainly of (1) "after-images or recrudescent memories, often rising thus, and thus only, from the subconscious strata to which they had sunk;" and (2) "as objectifications of ideas or images consciously or unconsciously in the mind of the percipient." "The tendency of the conscious memory is so strongly in favor of picture-making, that we may naturally assume this habit on the part of that which is latent or subconscious." This, at any rate, is true for the lady in question; for she is gifted with a remarkable power of visualization, that goes far to explain her success at crystal-vision. When desirous of describing a room in a friend's house, she tells us, "I return in recollection to the occasion of my last visit. I once more occupy the same chair. The carpet at my feet becomes visible, the furniture nearest to my seat, gradually the whole contents of the room, till walls and ceiling complete the picture, and I am able to give an inventory which would not disgrace an auctioneer's clerk." The exercise of this faculty, and especially with regard to phenomena of the unconscious, seems to be much aided by fixation of the attention upon the crystal. To quote from the record of experiments, "Here, for example, I find in the crystal a bit of dark wall covered with white jessamine, and I ask myself, 'Where have I walked to-day?' I have no recollection of such a sight, not a common one in the London streets; but to-morrow I will repeat my walk of this morning with a careful regard for creeper-covered walls. To-morrow solves the mystery. I find the very spot, and the sight brings with it the further recollection that at the moment we passed this spot I was engaged in absorbing conversation with my companion, and my voluntary attention was pre-occupied." Or, again, "I had carelessly destroyed a letter without preserving the address of my correspondent. I knew the county, and, searching in a map, recognized the name of the town, one unfamiliar to me, but which I was sure

I should know when I saw it. But I had no clew to the name of house or street, till at last it struck me to test the value of the crystal as a means of recalling forgotten knowledge. A very short inspection supplied me with 'H. House' in gray letters on a white ground, and, having nothing better to suggest from any other source, I risked posting my letter to the address so strangely supplied. A day or two brought me an answer, headed 'H. House' in gray letters on a white ground." Again, "the question of association, as in all cases of memory, plays an active part in this class of crystal-vision. One of my earliest experiences was of a picture perplexing and wholly unexpected, — a quaint oak chair, an old hand, a worn black coat-sleeve resting on the arm of the chair, — slowly recognized as a recollection of a room in a country vicarage, which I had not entered and but seldom recalled since I was a child of ten. But whence came this vision? What association has conjured up this picture? What have I done to-day? . . . At length the clew is found. I have to-day been reading Dante, first enjoyed with the help of our dear old vicar many a year ago." After these instances (and there are many more in some of which the crystal is purposely resorted to, and often successfully, to see if there be any unconscious information regarding the whereabouts of a missing prescription or a lost key), we may agree with the writer, that "one result of crystal-gazing is to teach one to abjure the verb 'to forget' in all its moods and tenses."

Examples of the objectification of recent sensations are given, but the point is clear enough without instances. Although the author regards recent impressions as a less important element of her dream-life and her visualizations than older experiences, she can none the less create a group of figures, and put them in the crystal to see what they will do; "and so far is one's conscious a stranger to one's unconscious Ego, that I sometimes find their little drama so startling and unexpected that I watch the scene with curiosity and surprise." One more instance may be added. The author wanted the date of Ptolemy Philadelphus, felt sure that she knew it and connected it with some important event, but could not recall it. The crystal showed her an old man, "dressed like a Lyceum Shylock," and writing on a big book with massive clasps. Wondering who he was, she decided to carry out a suggestion, and look at the image through a magnifying-glass. The glass revealed the characters as Greek, though the only characters recognized were the numerals "LXX." Then it flashed on my mind that he was one of the Jewish elders at work on the Septuagint, and that its date, 277 B.C., would serve equally well for Ptolemy Philadelphus. It may be worth while to add, though the fact was not in my conscious memory at the moment, that I had once learned a chronology on a mnemonic system which substituted letters for figures, and that the *memoria technica* for this date was, "Now Jewish elders indite a Greek copy."

Our author adds a possible third class of crystal-visions, concerning which she speaks with becoming caution and uncertainty; namely, those that may be connected with telepathy, clairvoyance, and other doubtful faculties. It is true that historically this use of crystal-vision is the most important; and, if we could credit the evidence of wonderful facts revealed by this means, we would indeed have to call in other means of explanation than those science affords. But the methods of using this form of vision for purposes of more or less conscious deception are so various, and lie so close at hand (indeed, our author cites some pertinent cases in which prophetic powers ascribed, alleged to a crystal-seer, were shown to be groundless by the exercise of very ordinary precautions), that we need hardly have recourse to untoward hypotheses as yet. As is well remarked, "it is easy to see how visions of this kind, occurring in the age of superstition, almost irresistibly suggested the theory of spirit-visitation. The percipient, receiving information which he did not recognize as already in his own mind, would inevitably suppose it to be derived from some invisible and unknown source external to himself." A large class of prophecies, too, aid in their own fulfilment; and, in brief, this aspect of the topic presents nothing peculiar to itself, and may be dismissed with the mention of it already made.

We have illustrated in this study the subtlety of the relation between the conscious and the unconscious mental processes. We see what a small proportion of the endless impressions that stream

in upon us through the avenues of sense are consciously added to our mental storehouse, and what a very much larger portion must be at the service of those lower strata of consciousness that at times rise so unexpectedly and so mysteriously into the focus of attention. And finally, just as much of the mystery that surrounded the mesmeric phenomena fell away when men looked for their explanation, not in some peculiar gift of the mesmerist, but in the psychophysic constitution of the subject, so the phenomena connected with crystal-vision become psychologically rational when we seek their explanation, not in the magic properties of the crystal, but in the mind of the seer.

NOTES AND NEWS.

THE American Institute Fair in this city, which will close in a few weeks, is well worth a visit from any person interested in the progress made from year to year in applied science. The electrical and mechanical exhibits are especially good.

— The will of Henry J. Steere, one of the wealthiest men in Providence, who died recently, gives away directly and in trust the sum total of \$1,139,000. The Rhode Island Historical Society gets \$10,000; the Tabor College in Iowa, \$50,000; and Roanoke College at Salem, Va., \$25,000.

— Dr. Frank S. Billings, late in charge of the patho-biological laboratory of the State University of Nebraska, has removed to Chicago, Ill., to resume the study of the non-recurrent diseases of children, — scarlet-fever, mumps, measles, and whooping-cough. Dr. Billings has fitted up a laboratory at 3600 Michigan Avenue, in which he proposes to prepare virus for the inoculation of swine against hog cholera, and to continue the study of that subject. The importance of such a laboratory to the stock-breeders of the country may be great.

— Leo Lesquereux, the Nestor of botanists in the United States and a well-known student of paleontology, died recently at his home in Columbus, O., at the age of eighty-two. Lesquereux was born at Fleurier, near Neufchâtel, in 1806. He was educated in Neufchâtel, and later occupied chairs at several European educational institutions. At twenty-five he became totally deaf. In 1848 he came to this country, influenced to this step by Agassiz. His works on the mosses of North America in conjunction with Mr. James, and on the fossil botany of the same region, are perhaps the best known.

— Mr. Henry O. Avery, in a letter to *Building* on the efflorescence on bricks, says, "During a recent trip abroad, I noticed in several countries a common occurrence of exuding salts on the surface of brick constructions. On questioning several foreign architects about the cause and remedy, there seemed to be a variety of opinions, and from the seeming contradictions I will note down some: 1. Sulphate of magnesia, due to the presence of iron pyrites (sulphide of iron) in the clay. The action of sulphurous acid generated in the combustion of bituminous coal on the magnesia in the clay changes the pyrites to a sulphate of magnesia. 2. Carbonate of soda, probably caused by the lime of the mortar acting upon a silicate of soda in the brick. 3. Carbonate of lime, formed by the leaching of lime from mortar, carbonated by the carbonic acid in the air. 4. Silicate of soda, caused by using salt clay taken near the sea. There is a common theory that the trouble is mostly due to the action of mortar and the brick together; yet the 'Epsom salts' have been known to appear in ornamental parapet walls where there was no mortar, cement, or grouting of any kind. Some say that bricks burned with wood-fire were exempt from the nuisance, but historical architectural records of Boston speak of 'white saline coatings' one hundred years ago, when wood only was used for burning bricks. As to remedies, several are mentioned. The commonest is water and muriatic acid; but this does not always decompose the sulphate of soda, and will not prevent it exuding again. Oil in mortar, carefully laid, is supposed to prevent 'salt-petring,' one gallon to a cask of lime, or two if cement is used; but this has failed as often as it has succeeded. English architects quite frequently employ a solution of fatty matter, quicklime, and cement-powder; and the French and Swiss masons, a mortar

paste of bone or marble dust, with sand and coloring-matter, used sparingly. For surface treatment, a coat of boiled linseed-oil is often effectual, though sometimes insufficient. An impervious oily varnish is used by many. The backs of bricks have been covered with hot pitch; and in England a preparation called 'Duresco' is used, either transparent or colored, and is said not to peel off. An invention patented consists in placing tarred felt between the face pressed brick and the common brick behind, leaving cavities in the top and bottom flat sides of the front bricks, and connecting them to the common brick backing by pieces of galvanized sheet-iron, punctured to roughen them, and laid between the flat joints of the brick; but this, besides being expensive, has failed repeatedly. In the presence of all these theories, as to cause, effect, and remedy, are we not to conclude that there is no remedy but to wait? The coating is soluble, and is washed off by the rains, and will in time disappear."

— President E. Benjamin Andrews of Brown University is desirous of adding a department of law and applied science to Brown. There will hereafter be an elective course in law for the seniors in the second term beginning this year. As to the prospect of establishing a school of applied science, he says it is not so much a prospect as a hope. Half a million of dollars will be required.

— The following report by Mr. C. L. Calloway, chief officer of the American steamship "Santiago" (Capt. Allen), relative to a waterspout off the Bahamas last April, is one of the best that has been received at the United States Hydrographic Office. One feature of special interest is the fact that the water that fell from the spout was salt water. Although it seems probable that such is often the case, yet there are very few, if any, good observations regarding it, and it is a question of considerable importance relative to the formation of a waterspout. Mr. Calloway reports as follows: "On the 29th day of April, 1889, at about 6.30 A.M., Royal Island (one of the Bahamas) bore about south, distant four miles. The wind was light, from the south-south-east, and the weather partly cloudy. I observed a waterspout forming off the starboard bow (ship heading south-west), and moving in the direction of the steamer at an angle of three points. On account of its close proximity, I was about to steer clear of it, when I observed it breaking, about thirty yards from the ship. Immediately afterwards the steamer passed through the outer edge of the whirlpool, the diameter of which I should judge to have been about fifty to seventy yards. On passing through the outer edge, I observed that the centre was hollow, the water circling from west to east, or against the sun. The water that fell on deck was very salt, and the drops as large as a fifty-cent piece. During the few seconds of our passage through it, the wind blew at the rate of about thirty or thirty-five miles per hour. I did not observe any calm in the centre at all, the water arising from it resembling an inverted fountain. After clearing it, the wind resumed its original force, about fifteen miles per hour. Being the officer of the watch, I had little time to observe the barometer, but it fluctuated one or two hundredths, and then resumed its previous reading. The appearance of the clouds above and around the spout were very ragged and much disturbed, similar to those in a thunder-storm. Their motions were very rapid, ascending, descending, and breaking away from each other after the water had been absorbed into them. The water was whirling very rapidly for several minutes after the break, showing what tremendous circular force there must have been. I may mention, that, upon passing through it, the steering of the ship was not affected, so that if there were any current at all it must have been circular, and confined to the centre." Such reports are of very great interest, and, whenever possible, sketches should be made to illustrate the waterspout at various stages of its formation. The blank form issued by the Hydrographic Office contains a full statement of the items of greatest importance in this connection.

— Gen. M. C. Meigs has had a new edition of the population discussion printed, combining in one sheet the two letters to *Science*, and showing all the results, details, and rates or ratios or percentages, in one table. The article has been noticed by a good many papers, generally with the idea, which is natural, that the author is an optimist. The figures are so great as to startle those to

whom they come for the first time. They startled Gen. Meigs. But they are the results of a law of nature and of the environment of the subjects. We may have a great war, but there is no visible occasion for it. Epidemics and pestilences cannot commit such ravage, now that medical and sanitary science are so advanced, as they did in old times of comparative ignorance; and, until the soil is overtaxed for food, about the rate of annual increase of the last two hundred and forty years must, Gen. Meigs thinks, continue without much change. Doubtless a time will come when the causes which have checked the growth of the French will act upon us, but it seems to be distant at present. England doubled her population between 1800 and 1840; Europe added only 77 per cent to hers from 1830 to 1880; we in that time multiplied ourselves by four.

— Professor F. H. Snow has been appointed acting president of Kansas State University. The *American Geologist* points out that four of the Western States have for presidents of their universities men whose professional training and labor had been scientific: Indiana has D. S. Jordan, an ichthyologist; Wisconsin has T. C. Chamberlin, a geologist; Iowa has C. A. Schaeffer, a chemist; and Kansas now has F. H. Snow, a geologist.

— The matter which arouses the Chinaman to pray with most energy, according to the *Missionary Herald*, is drought or the near prospect of famine; but when he so prays, it is not in solemn or thoughtful ways, but by clanging cymbals and the noise of fire-crackers and the utmost confusion. The *Missionary Herald* of the English Baptist Society contains a report from one of their missionaries in Shansi concerning a great assembly held to pray for rain, and of the day of thanksgiving which followed after the rain fell. Buddhist and Taoist priests were together in their robes, and four holy (?) men were drawn from their retreats in the mountains, and were "stripped to the waist, and bore huge spiked iron collars around their necks and carried their arms stretched out before them with knives run through their flesh." The uproar was maddening. This was their mode of thanksgiving. The story is told of a mandarin who felt great responsibility for the drought which was afflicting his district, and came to a certain well at Han Tau; and, prostrating himself, he cried, "If rain does not come, I will jump into the well!" And this he did at once. Afterwards, as the story goes, rain fell, and the people regarded it as the result of the very meritorious suicide of this man. The emperor, in order to celebrate such a glorious deed, ordered a tablet of gold to be placed in a shrine around the well, on which this man's name and heroic act were recorded. The well is famous to this day, and it is believed that prayers offered there are sure of an answer. The place is covered with thank-offerings of the people, and the tablets which testify to the virtues of the shrine quite cover up the tablet originally placed there in honor of the official who killed himself.

— The house of a Hindoo of good position is divided into two parts. The zenana is that portion of it which is occupied by the women. It is generally situated towards the back of the house. In the centre of it there is an open court twenty or thirty feet square. This is surrounded by a veranda. In the inner or back wall of the veranda you see here and there all round small doors. These conduct to the private apartments of the women. As the custom in India is for young men, when they get married, not to leave their father's house and set up separate establishments of their own, but to bring their wives into their father's house, a goodly number of women may sometimes be found in the same family. These may all meet together in the open court. Should the husband of one of the ladies of the zenana wish to enter, says *The Missionary*, he must first give notice of his approach, either by knocking or by a loud cough. The ladies at once draw their chudders over their faces, and make a rush for their separate apartments. This small court is the only place in which a zenana lady is allowed into the open air, if open air it may be called. When she has reason to go beyond the walls of the zenana, she is either carried in a close palki or conveyed in a bullock-cart, which, of course, is curtained all round. Should she require to walk a few steps, a large sheet is thrown over her, so that no one may see her.

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MEETING OF THE INTERNATIONAL CONGRESS OF ZOOLOGISTS AT PARIS, AUG. 5-11, 1889.

THIS was the first general gathering of zoologists from nearly all the countries of the Old and New World, and was one of the many notable congresses called into being on the occasion of the Universal Exposition of 1889. It should be said that the initiative was taken by the Société Zoologique de France. The sessions were held from the 5th to the 11th of August, under the presidency of Professor Alphonse Milne-Edwards. The opening meeting for organization was held on the afternoon of Aug. 5, and was largely attended. Among the more distinguished savants present were the venerable De Quatrefages, Retzius of Stockholm, Topinard, Rüttimeyer of Basel, Hübner of Utrecht, Fritsch of Prague, besides well-known naturalists from Belgium, Moscow, Kiev, Budapest, Prague, Berlin, London, Geneva, Cairo, Malta, Algeria, southern France, Scotland, Ireland, Cape Town, and the United States. Papers were read by scientists of all nationalities; so that the meeting was truly cosmopolitan in its nature, though, naturally enough, French was the language in which the papers were read. Here it might be observed, that, though many of the papers were presented by foreigners, but few of the speakers used notes or manuscript; and we were, on the whole, struck with the fluency, readiness, and elegance of diction, and the lack of hesitation, clumsiness, and verbosity. The audience consisted mainly of experts; and the papers, with the ensuing discussions—in fact, all the work of the congress was performed, as an American would

say, in a thoroughly business-like manner. The session's began promptly at 9 o'clock, and adjourned at noon. The afternoons were devoted to visits to the new and commodious museum building in the Jardin des Plantes, the Ecole des Mines, to portions of the exposition of special interest to the members, where, among other attractions, the Prince of Monaco exhibited his dredging and other apparatus for deep-sea research. Private collections were thrown open to individual members; private hospitality shown at the noon hour for breakfast, in France, as well as at dinner-time; while on three of the evenings the members attended the delightful *soirées* at the houses of Professor Milne-Edwards, of Prince Roland Bonaparte, and M. Certes, inspector-general of finances; and on other evenings they mingled with the host of savants, teachers, and students at the notable *soirées* given by M. Guyot, the minister of public works, and the colossal reception at the Hotel de Ville given by the municipality of Paris.

To return to more prosaic matters: one of the principal topics discussed in the meetings, and which was especially considered in the opening presidential address, was deep-sea explorations, while most of the papers were of a general nature, giving methods and results. The special topics for discussion, and which were announced beforehand, the reports being in print and distributed at the meetings, were the following: 1. The rules to be adopted for the nomenclature of organized beings; the adoption of an international scientific language (reporter, Dr. R. Blanchard). 2. Determination of the regions of the globe of which the fauna is insufficiently known, and which need exploration; indications of the method of research, of the preparation and preservation of animals (reporter, Dr. P. Fischer). 3. The services rendered by embryology to the classification of animals (reporter, Professor E. Perrier). 4. The relations which exist between the existing and fossil faunæ (reporter, Dr. Filhol).

The discussion on nomenclature was not introduced until the last days of the session. The report of Professor Blanchard was conservative, excellent, and generally accepted by those present, and should be widely disseminated; the law of priority was adopted, beginning with the year 1722, the date of publication of Lang's work; while little approbation was given by the congress to trinomial nomenclature, although the report favored it in special cases.

The idea of such congresses, it seems to us, was a happy conception; and so successful were its results, that, we were told by Professor Milne-Edwards, another will be called in three years. The great value of such international gatherings to a foreigner is the stimulus and pleasure resulting from meeting distinguished workers in other than his own narrow specialty, the friendships formed, the solution of the personal equation so to speak, and the examination of private and public collections and libraries in a metropolis. To an American the occasion was one of great interest and lasting value, and one cannot return to his work without pricking in "some flowers of that he hath learned abroad."

A. S. P.

HEALTH MATTERS.

Electrical Injuries.

AT a meeting of the Practitioners' Society, Oct. 4, 1889, Charles L. Dana, A.M., M.D., of New York, read a paper on the above subject. As he pointed out, with the introduction of new industrial methods we are meeting accidents and injuries of all grades of severity; and in time there will be associated with electrical systems, classes of injuries some of which will be perhaps peculiar to them; some will resemble those known as railway brain and railway spine, traumatic hysteria, and other neuroses or psychoses; while a large number will be only of the ordinary surgical character.

The telegraph and telephone produce peculiar neuroses, due to the demand made upon the nervous system of the operator, the results being telegraphers' cramp, aural and mental disorders of telephone transmitters, etc. Most of the observed cases of this electrical injury come from the apparatus carrying electrical currents for lighting and power.

Such currents have varying effects. In some cases they merely

out the victim, and burn the parts in contact with the wire; in others they have been known to produce permanent paralytic effects (of such cases, however, there are only two on record); in still other instances almost instantaneous death results; while sometimes a mental shock is produced, which affects the system just as other shocks do, causing conditions known as traumatic hysteria or neurasthenia.

The number of fatal accidents from electrical currents during the past ten years has been variously estimated at from 100 to 200.

The electrical current burns or not, according to the dryness of the skin and clothes and the consequent degree of resistance. With a dry skin there is more burning, less penetration, less shock, and less danger of death. With a wet skin and good connections there is little burning and more serious internal effect. Dr. Biggs has noted that most of the fatal electrical accidents have occurred on or after rainy days.

Dr. William C. Thompson recently reported a curious case of traumatic hysteria. A man, aged fifty, not long ago saw an Italian killed by an electric wire. Two weeks later, while walking along the street, an electric wire which had just been cut fell, and struck his head. He grasped it in his hand, and fell down. He says that he knew nothing until a few hours later, when he found himself in the hospital. He then had right hemiplegia and hemianæsthesia, including the senses of smell and taste. There was limitation of the visual and auditory fields, bone deafness, pharyngeal anæsthesia, and all the stigmata of typical hysteria. The wire which struck him was a "dead" one; and the blow was slight, and caused no contusion.

The fact is, that the practical introduction of electricity has been attended with much less fatality than that caused by gas, steam, railroads, and many other of the inventions of modern life. For example: in France, among 223,000 railway employees, there is an annual average of 239.5 killed and 1,850.4 wounded; in Germany there are 1.35 per 1,000 of railway-servants killed, and 3.09 per 1,000 wounded; in England the annual mortality is 2.43 per cent; in the United States among 418,957 employees, in 1880, there were 923 killed and 3,617 injured,—a higher rate than anywhere in Europe (United States Census). In coal-mining the ratio in France is 7.56 per 1,000 of killed, 8.87 per 1,000 of wounded.

Some of the points which Dr. Dana wished to make in the article, which is published in full in *The Medical Record*, are, the extraordinary increase now going on in the practical application of electricity, there being already nearly \$100,000,000 invested in lights and power alone; a practically new class of injuries met in connection with the new industries. Such injuries have been heretofore produced only by lightning, and they have been consequently rare. These injuries are not numerous or serious as compared with those met with in connection with other great industries. There have been in ten years only about 100 deaths in the whole world from artificial electrical currents. The railroad kills annually over 2,500 people (2,541 in 1880), and injures about 6,000, in the United States alone. Electrical currents produce three kinds of severe accidents: they kill at once; or they burn severely; or, by the mental and physical shock, they cause traumatic neurosis. Usually if they burn severely they do not kill; hence, practically, the rule is, if contact with electrical wires does not kill, the victim gets only a burn or a harmless shock. In very rare cases the current seems to affect the nerves or nerve-centres, causing paralysis. The minimum current safe to receive is not definitely known. Probably eight hundred to one thousand volts of continuous current, and a third less of alternating current, would not be fatal. The wires for lighting and for power carry the more dangerous currents.

THE BEHAVIOR OF THE GERMS OF CHOLERA, TYPHOID-FEVER, AND TUBERCULOSIS IN MILK, BUTTER, WHEY, AND CHEESE.—Among the numerous labors of the Reichsgesundheitsamt has been that of determining the behavior of certain germs of disease in various articles of food. Milk is one of the most common articles of diet; and one of the health-office collaborators, L. Heim of Würzburg, has lately concluded a lengthened inquiry into the relations of the bacilli of tuberculosis, cholera, and typhoid-fever to it, and its products, whey, butter, and cheese. That milk

is a favorite medium for dissemination of disease is well known; and Koch, among others, has shown that it is peculiarly adapted for this purpose. As regards cholera, the germs of the disease were still viable after remaining for six days in milk that had undergone no antisepticizing processes: in milk of the same character that had been kept in the ice-chest, on the other hand, no living bacteria were found at the end of three days. This part of the inquiry shows that cholera bacteria remain active in fresh milk the whole length of time it is customary to keep it, and that they do not lose their dangerous quality for some days after the milk has become sour. The same germs were found active under some circumstances, even at the end of a month. In ordinary strong cheese they did not retain their viability over a day, neither did they in unripe cheese. The bacilli of typhoid were alive and capable of development in milk at the end of thirty-five days, but no longer so at the end of forty-eight days; in butter they remained active between three and four weeks, in cheese only three days, and in whey only during the first day. Tubercle bacilli remained capable of development for ten days in fresh milk; in milk gradually undergoing decomposition they lost their power in a period varying between ten days and four weeks. In butter, on the other hand, they retained their full power at the end of four weeks; in whey and cheese, after two weeks, but not after four weeks. The practical importance of the investigations is so obvious as scarcely to need pointing out; and their bearing on the use of milk, the preservation, carriage, preparation, and sale of it and its products, is equally obvious. Something has been done, much remains to be done, to stop the ravages of disease; and the labors of Dr. Heim are another step forward.

STERILIZED MILK DELIVERED TO PATIENTS IN THEIR DWELLINGS.—Since Aug. 1, sterilized milk has been furnished to children under treatment at the Philadelphia Polyclinic. The milk, says *Medical News*, is sterilized by the Visiting Nurse Society of Philadelphia, and taken to the child by the nurse in attendance, in the bottles in which it is prepared. Milk and bottles are furnished the parents at cost. The results have been excellent.

HEALTH OF NEW YORK AND LONDON COMPARED.—Some interesting points of comparison between the health of London and that of New York are summarized in *The Boston Medical and Surgical Journal*. The deaths in London last year numbered 78,848, or 18.5 per 1,000; in New York, 40,175, or 26.33; and in Paris, 22.6 per 1,000. The birth returns for New York are incomplete; but the birth-rate in London was 30.7 per 1,000; in Paris, 27.0. The male births in Paris were 30,723; the female births, 29,913. In London the numbers were, males, 66,629; females, 64,451; but in the total population of London there is a majority of 250 females. Premature births in New York numbered 1,155; in London, 2,099. To be equal, the figures referring to New York should only be a third. New York compares unfavorably with London in the matter of suicides. There were 247 in New York, and 400 in London. Between 800 and 900 persons take their own lives in Paris every year. In New York 1,138 were killed by accidents; and in London, 2,516. There were only 1,892 deaths from bronchitis in New York, while in London there were 10,035. But while some hundreds die every year in London as the result of idleness and obesity, 61 deaths were recorded last year from starvation. A decreased death-rate is invariably accompanied by a lower birth-rate. The deaths in London last year were the lowest on record; the births, the lowest since 1811. In the western districts, where the wealthy reside, and where the degree of comfort is high, the deaths fell to 16.4, and the births to 25.5; but in the impoverished and overcrowded east, where the poor never get a breath of fresh air, and are huddled together in unhealthy alleys, the deaths rose to 27.2, and the births to 36.5. The people least able to support children are the most prolific; and the higher the degree of social comfort and well-being, the less the increase of population.

MINERAL WATERS.—The Paris correspondent of the *Boston Medical and Surgical Journal* says, that, of the numerous international congresses that have been held in Paris since the opening of the exhibition in May last, there has been none more important or interesting than the Congress of Hydrology, which has just terminated its meetings. The object of this congress was to eluci-

date a certain number of those obscure problems which concern the nature and therapeutic value of mineral waters. One of the most original memoirs produced at the congress was that of Dr. Schlemmer, on microbes and thermal waters. According to the author, there is found a certain number of microbes in these waters; but, far from offering any danger, the microbes of mineral waters seem, on the contrary, to possess beneficial properties. It is thus that in certain springs of Vichy, Chantemesse and Frémont have isolated a micrococcus possessing a most pronounced digestive power on albuminoid alimentary substances, which it transforms into peptones. With the knowledge of this fact, it will be seen that it is impossible to imitate this natural mineral water by the aid of the bicarbonate of soda. No artificial chemical combination would be capable of conferring on a water this micro-organic life, any more than of conferring upon it the electro-dynamism of telluric elaboration. The origin of the gases contained in the mineral waters was well demonstrated by Dr. Labat. He stated that whether they proceed from the air or from watery vapor, or whether they are manifestations of the soil or of volcanoes, the gases do not ordinarily play a preponderating rôle in the curative action of mineral waters. Nevertheless, nitrogen is an agent distinctly sedative and anti-catarrhal; sulphuretted hydrogen, a modifier of the skin and of mucous membranes; carbonic acid, an excitant of the blood-vessels and nerves. It is capable, for instance, of arousing the languishing functions of the digestive mucous membrane.

BOOK-REVIEWS.

The Life-Work of the Author of Uncle Tom's Cabin. By FLO-
RINE THAYER MCCRAY. New York, Funk & Wagnalls. 12°.
\$2.

THIS book contains both a biography of Mrs. Stowe and an analysis of her principal works. It is written with the approbation of the Stowe family, who have supplied information on certain points. It contains much that is interesting, and, so far as facts go, gives a fair picture of Mrs. Stowe and her work. But it is marred by an overflow of "gush," which is neither pleasing nor improving to the reader. Mrs. McCray is so enthusiastic over her theme that she can hardly write soberly, even in the most commonplace passages, and some of the most ordinary personages assume in her eyes the character of heroes. Thus, she says that certain sermons on intemperance by Lyman Beecher "shook the world," and that Professor Stowe on another occasion "spoke eloquently and with magnetic force," and "stood forth a commanding figure upon the arena of the world's advancement." Of course, Mrs. Stowe herself is still more highly lauded. The book is a handsome one, but is marred by bad punctuation and by frequent misspellings, such as "Arabian Knights," "Thomas Carlisle" for "Thomas Carlyle," "Henrick Heine" for "Heinrich Heine," etc. Still the work has an interest from its subject, and also from the sincerity and earnestness of its author.

Hypnotism: Its History and Present Development. By FREDERIK
BJÖRNSTRÖM, M.D. Tr. by Baron Nils Posse, M.G. New
York, Humboldt Publ. Co. 8°. 75 cents.

THE general aspects and methods of hypnotism may be now regarded as sufficiently well understood to make a detailed review of the contents of a general *résumé* of the subject unnecessary. As, however, the available literature of standard merit in English is small, and much of this is in the way of translations, it may be useful to call attention to the present essay of an eminent Swedish physician, especially as its general accessibility will provide it with a large body of readers. The work is purely expository in character, and offers about as convenient an introduction to the subject as we have in English. The topics are well selected, the points clearly stated, and the whole fairly represents the present status of investigation upon this vexed phenomenon. A general historical introduction is followed by a chapter defining the ordinary hypnotic condition, according to various authorities. The method of hypnotizing and the stages of hypnotism are next interestingly discussed. The so-called "unilateral hypnotism" is needlessly honored with a special chapter, though the physical and the psychical effects of

hypnotism are more satisfactorily treated in succeeding chapters. As is proper, most space is given over to the phenomena of suggestion; in which, however, the selection of cases is not as judicious as it might be, considering the needs of the general reader. The concluding chapters treat of hypnotism as a remedial agent, as a moral remedy, in relation to the law, and, finally, its abuses and dangers. Considering the short space at command, the topics are fairly presented except the last, which concerns itself rather uselessly with Parisian methods of deceiving the credulous. The chief defect of the work, however, lies in its placing too nearly on a par views and theories the evidence for which is still regarded by the most able investigators as very different. This is true of the "hemi-hypnotic" phenomena; but it is still truer of the "mental suggestion," or telepathic experiments, to which entirely too much space is devoted. This somewhat uncritical treatment of the outlying fields of hypnotism is certainly the chief defect of the work. In spite of this, however, the work is a valuable addition to the easily accessible literature of the topic, and can safely be placed in the hands of the general reader, especially if he bring to the reading of it the understanding that the views expressed are partly individual, and partly prematurely positive.

Practical Electric Bell Fitting. By F. C. ALLSOP. London and
New York, Spon. 12°. \$1.25.

THIS treatise on the fitting-up of electric bells and the apparatus necessary therefor supplies just the information on the subject that would naturally be needed by the average workman. Beginning with the proper way to join two pieces of wire, it goes carefully through all the ramifications of the subject, explaining, in a manner not easily misunderstood, each step, by means of well-worded text and a sufficient number of illustrations. The author shows that he not only thoroughly understands his subject, but that he knows how to treat it clearly and exhaustively without saying a word too much. Much of the thoroughness of the treatise is due, no doubt, to the manner in which it first appeared, or, rather, to the way in which it grew from that part of it which first appeared. The work was first published as a series of papers in a technical journal, and their favorable reception induced the author to re-issue it in book form, taking the opportunity to revise it according to the light gained by the comment and criticism accorded it in its serial form. Much additional matter was added also, the result of numerous questions addressed to him on the subject from time to time.

The points treated are grouped as follows. The first chapter is devoted to wiring, soldering, and joining wires, and earth connections. This is followed by a chapter on pushes, pulls, contacts, and switches, and another on bells, relays, and indicators. Batteries and the magneto bell have each a chapter devoted to them, followed by one on connecting-up. The last two chapters treat of the localizing of faults and of portable sets of apparatus. The book contains nearly a hundred and fifty explanatory engravings.

Proceedings of the Society for Psychological Research. Pt. XIV.
June, 1889. London, Soc. Psych. Research. 8°.

THE varied contents of this issue testify to the vigorous activity of the society in the directions inaugurated in former publications. The most interesting and novel contribution is upon the curious phenomena of crystal-vision, an account of which will appear elsewhere in *Science*. The president's address is very brief, and contains hardly more than a report of progress, with renewed protests against misinterpretation of the society's work. A paper by the late Edmund Gurney, completed by F. W. H. Myers, treats of apparitions occurring soon after death, and in part refers the frequency of such apparitions to the emotional disturbances connected with the decease of a friend, and in part considers the matter as of super-normal significance. It cannot be said that any essential advance is made in the present discussion of cases. Mr. Myers also writes suggestively, though with a disproportion of introduction to thesis, upon the Dæmon of Socrates, explaining this vexed question as the appearance of the unconscious mind of Socrates through the medium of spoken language, just as the subconscious "strata of personality" reveal themselves in automatic writing. In the supplement we have an account of some very heterogeneous

and unsatisfactory experiments in various fields of psychic research made at Pesaro, and a review of a recent German work on hypnotism. The society has decided to collect a library in honor of the late Mr. Gurney, to contain works in the special fields of his labors. A catalogue of the library is appended, and contributions are invited.

AMONG THE PUBLISHERS.

THE J. B. Lippincott Company will soon publish "As You Like It," forming the eighth volume of the new variorum Shakespeare edition, edited by Dr. Horace Howard Furness. This edition of Shakespeare throws much light on these dramas, and gives an interesting compendium of what has been written about them.

— Houghton, Mifflin, & Co. will publish shortly "Standish of Standish," a story of the Plymouth Colony, by Mrs. Jane G. Austin.

— D. Appleton & Co. have nearly ready "Five Thousand Miles in a Sledge—Midwinter's Journey across Siberia," by Lovel F. Gowing; and David A. Wells's new work, "Recent Economic Changes, and their Effect on the Production and Distribution of Wealth and the Well-being of Society."

— Fleming H. Revell, Chicago and New York, publishes this week a series of thirty maps and plans of the entire world as known in Scripture. The series is entitled "Revell's Biblical Wall Atlas," and was prepared by T. Ruddiman Johnson, who has availed himself of the results of the latest geographical research, including the recent surveys of the Palestine Exploration Fund, together with every benefit of the most accurate modern scholarship.

— The next edition of the "Naturalists' Directory" (Boston, S. E. Cassino) will be issued early in 1890. Any list of the names of scientific men that are not already represented in the work will be thankfully received. While the new edition will be as complete as possible in American names, it has been thought best to exclude from the lists of foreign countries the names of all persons who do not reply to the blanks or letters sent them, thus making it a more useful exchange list. Unless a sufficient number of subscribers is received to meet the expense of publication, the book will not be issued.

— The September *Bulletin of the Ohio Agricultural Experiment Station* contains five articles discussing the results of experiments in preventing the injuries of the plum curculio, striped cucumber-beetle, currant-worm, and various other injurious insects, and also an important experiment with remedies for potato-rot. These experiments were carried on by the entomologist and botanist of the station, Clarence M. Weed, and the bulletin is illustrated with numerous original engravings. It will be sent free to any Ohio farmer who requests it. The address of the experiment station is Columbus, O.

— *Babyhood* for November opens up the question of how to meet the increasing demand for intelligent nursery-maids. It is a subject in which all mothers of young children are interested, and the methods proposed by *Babyhood* for raising the standard of nurse-

girls deserves careful consideration. No less important to parents is the warning as to growing pains given by Dr. J. Lewis Smith. "Nursery Cookery," "Nursery Helps and Novelties," may be mentioned among the topics discussed in the current number.

— "Origin and Formation of the Hebrew Scriptures," to be published soon by Lee & Shepard, Boston, is the indicative title of Lorenzo Burge's third volume bearing upon the human family in its origin, and in the general trend of the purposes of its creation, and its relation to the Creator, at the same time interpreting the Scriptures, and explaining their relation with mankind. Mr. Burge's previous works in this line of investigation are "Pre-Glacial Man and the Aryan Race;" and "Aryas, Semites, and Jews; Jehovah and the Christ." In his "Origin and Formation of the Hebrew Scriptures," the author presents the arguments as to when, where, under what circumstances, for what purpose, and by whom, were these Scriptures written, from the records of the eminent Persian nobleman and historian, Nehemiah, for many years governor of Palestine, from B.C. 445. The work includes an appendix containing prophecy sustained in the histories of Egypt, Assyria, and Babylon, and a review of what the author terms "radical views of the Bible." "The Heroes of the Crusades," by Amanda M. Douglas, announced by Lee & Shepard, is a history of the Crusades, and a story of the personal incidents and efforts of the Crusaders themselves.

— The *Harvard Monthly* (Cambridge, Mass.) enters on its fifth year with an appeal for increased support outside the college, because the editors believe that they can give graduates their money's worth. The purely literary side of the magazine is sufficiently known. In addition to this, events have led it more and more into the practical discussion of college questions. The editors purpose henceforth to recognize decisively this part of their field in the two following ways. Heretofore they have accepted nothing shorter than formal articles. In the future, upon any subject which would concern a Harvard graduate or undergraduate as such, they will regularly open their columns to matter such as the *Century* might print under "Open Letters," or the *Nation* under "Correspondence." They will also begin to publish each month, with brief comment, a record of recent events deserving note; not a chronicle of the daily routine, but of whatever changes the daily routine, of college life, including in the latter word every thing from the broader aspects of athletics to the A.B. degree. In gathering the facts, the editors have been promised the aid of President Eliot, so that what information the paper gives will be authentic. All comment will be entirely the editors' own. These two changes will enable graduates at a distance to keep track of developments at Harvard, and so to do intelligent missionary work, and will also give them a better means than in the past of expressing their own views both on student life and on the college government. The editors wish eventually to make the *Monthly* the recognized organ of communication between alumni, members of the governing boards, and undergraduates. The value to the college of such a medium, it seems to them, would be very great. It depends on graduate support, both in subscriptions and in contributions, how quickly and how thoroughly they can accomplish this end.

Publications received at Editor's Office,

Oct. 28.-Nov. 2.

BELL, A. M. Popular Manual of Vocal Physiology and Visible Speech. New York, N. D. C. Hodges and E. S. Werner; London, Trübner. 59 p. 16^s. 50 cents.

CORSON, H. An Introduction to the Study of Shakespeare. Boston, Heath. 377 p. 12^s.

JURY, Th. Vol. I. No. 1. W. Rochester, N.Y. W. M. Butler. 18 p. 4^s. \$2 per year.

MCCRAY, Florine Thayer. The Life-Work of the Author of Uncle Tom's Cabin. New York and London, Funk & Wagnalls. 440 p. 12^s. \$2.

MYERS, P. V. N. Ancient History for Colleges and High Schools. Part I. The Eastern Nations and Greece. Boston, Ginn. 369 p. 12^s. \$1.10.

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THE CENTURY MAGAZINE



JOSEPH JEFFERSON.

Enters upon a new volume with the issue of November, which contains the opening parts of several leading features of the year. In this number are the first chapters of the "Autobiography of Joseph Jefferson." In it the author relates the story of his life, from his first appearance on the stage as "property" baby, to within the past few years. His reminiscences and the portraits of actors and actresses with whom he has been associated — among them the elder Booth, the Wallacks, Forrest, and Charlotte Cushman — are especially interesting. His own experiences in the pioneer West, in Mexico, Australia, South America, England, France, and the Southern and Eastern States, are related in a frank and charming manner. Mr. Jefferson writes as naturally as he acts. Serial stories by Frank R. Stockton and Amelia E. Barr also begin in the November number. Mr. Stockton humorously describes the extraordinary cruise of *The Merry Chanter*. Mrs. Barr, the author of "Jan Vedder's Wife," etc., has written for THE CENTURY a story of love in the days of Cromwell and the Merry Monarch, entitled "Friend Olivia." During the year there will be printed other serials and a number of short stores by such well-known writers as Arlo Bates, H. S. Edwards, Sarah Orne Jewett, Richard M. Johnston, Octave Thanet, H. H. Boyesen, and others. The first of the "Present-Day Papers" is printed in the November CENTURY. These are a series of discussions of timely social questions by prominent men who have associated for this purpose, among them Bishop Potter and the Hon. Seth Low, the new President of Columbia College. In December will begin the series by Prof. Fisher, of Yale, on the "Nature and Method of Revelation." During the year will be published popular science papers by Prof. Holden, describing the latest discoveries in astronomy at the Lick Observatory and illustrated articles on "Pre-historic America," by Prof. Putnam, of Harvard. A number of papers on Art will also be printed. In the November number will be found "A Connecticut Yankee at King Arthur's Court," a new story by Mark Twain; a description of the Grolier Club, by Brander Matthews; poems by Walt. Whitman, T. W. Higginson, Margaret Deland, and others.

THE CENTURY costs \$4.00 a year. Subscriptions are taken by booksellers and postmasters, or remittance may be made by check, money-order, or in registered letter, direct to the publishers, THE CENTURY CO., 33 East 17th Street, New York.

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NO INCREASE IN PRICE.

Subscription price as heretofore, \$3.00 a year; 25 cents a number. November begins the volume. New subscribers should commence with that issue. Booksellers and postmasters take subscriptions, or remittance may be made, by check, draft, money or express-order, or in registered letter, to the publishers,

THE CENTURY CO., 33 East 17th St., New York.

—E. & F. N. Spon announce as in preparation, "Practical Electrics," a universal handbook on every-day electrical matters, including connections, alarms, batteries, coils, dynamo-machines, motors, phonographs, telephones, etc., reprinted from the third series of "Workshop Receipts"; "Treatise on Evaporation by the Multiple System in Vacuum, its Construction and Working in Sugar Factories," by James Fo-ter; "Experimental Science: Treatise on the Various Topics of Physics in a Popular and Practical Way," by George M. Hopkins; "The Steam Engine and the Indicator," by William B. Le Van; and "A Practical Treatise on Mine Engineering," by G. C. Greenwell, F.G.S., third edition, reprinted from the second.

—The eighth edition is in preparation, to be ready in January, of "The Electrician," electrical trades' directory and handbook for 1890 (corrected to December, 1889). This will contain a carefully compiled list of British, colonial, and foreign electricians, electrical engineers, electric-light engineers and contractors, electrical-apparatus makers, electric-bell makers and fitters, electric-light, telegraph, and telephone companies, electric-light, telegraph, and telephone engineers, wire makers and drawers, and of all persons engaged in electrical pursuits throughout the world; useful tables relating to dynamos, arc and incandescent lamps, batteries, etc.; and a biographical section, giving interesting particulars concerning eminent men connected with electricity in all its applications, with portraits. Full particulars will be sent immediately on application to "The Electrician" Office, 1 Salisbury Court, Fleet Street, London, E.C.

—D. C. Heath & Co. of Boston have issued "An Introduction to the Study of Shakespeare," by Hiram Corson. It does not cover all the ground that an introduction ought to cover, for it gives no account of the dramatist's life, nor of the state of the English drama in his time; and many other points necessary to a thorough understanding of Shakespeare are left unnoticed. Still it presents a good deal of matter in a concise though not very artistic style. There is quite an elaborate discussion of Shakespeare's verse, and many pages of textual criticism, the latter of which seems hardly appropriate in an introductory work. But the greater part of the book is taken up with literary criticisms on certain of the plays,—"Romeo and Juliet," "Macbeth," "Hamlet," and others. In these criticisms Professor Corson expresses strong dissent on certain points from the views of Coleridge and the German critics; but we have no space to discuss the questions thus raised, and must refer the interested reader to the book itself.

—The division of ornithology and mammalogy of the United States Department of Agriculture is engaged in mapping the geographical distribution of birds and mammals, in addition to the study of their economic relations. The purpose of this work is to ascertain the boundaries of the natural faunal areas of North America. The original information on which the maps are based is collected mainly by the special field agents employed by the division. A smaller portion is contributed by voluntary observers. In the progress of the work many new facts are obtained which ought to be put on record for the benefit of other workers in this department of science. It is not unusual to find new species in the collections made by the field agents of the division, and such species must be named and assigned their proper systematic position before they can be discussed intelligently. It is evident that the results of the investigations of the division are of importance to two distinct classes of readers,—farmers and naturalists. It is deemed desirable, therefore, to publish such of the results as are of use mainly to those engaged in scientific research separately from those of a more purely economic character. The publication of the economic material being already provided for (and appearing as bulletins and reports), it has been decided to publish a series of faunal papers, under the title "North American Fauna." This publication will contain, in addition to the faunal papers proper, such technical matter as results from the study of the material collected, or as may be necessary to an intelligent understanding of the reports which follow. No attempt will be made to issue the separate numbers at regular intervals, but each number will bear date of actual publication. The first of the series is "A Preliminary Revision of

the North American Pocket Mice" (genera *Perognathus* et *Crice-todipus* auct.), with descriptions of new species and subspecies, and a key to the known forms, by Dr. C. Hart Merriam. This contribution toward a revision of the North American pocket-mice is the outgrowth of a recent attempt to identify a large number of specimens for the purpose of mapping their geographical distribution. The results are wholly unexpected. Only six species were previously recognized. This number is here increased to eighteen. Three subspecies also are described, and several well-known names are shifted to forms other than those to which they have been heretofore commonly applied. The present revision of the group is by no means exhaustive: it is intended merely as a foundation for future study.

LETTERS TO THE EDITOR.

*Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

The Various Discoveries of Lake Mistassini.

IN being persistently discovered, the now unmythical Lake Mistassini has a record not surpassed by the "true" source of the Mississippi. If the lake in question were some recent upstart, grovelling in quaternary detritus, one might pardon such unseemly conduct; but a severed body of water, quietly slumbering in Archæan rocks, has a right to resent such intrusions on its privacy. Furthermore, it is a sacred lake, dedicated to the Great Spirit; for on its bank, one historian informs us, there were found "*autre curieux de marbre d'environ 30 à 35 pieds en quarè; sa route est de 8 à 9 pieds de haut. Les sauvages l'appellent Tchichi Manitou Quitchonap, la maison du Grand Esprit*" (sic).

Its first discovery, more than two hundred years ago, is forgotten except to the dusty pigeon-holes of the Department of Crown Lands. Its last gestation required the combined services of half a score of explorers and a great metropolitan journal to exploit it. In the mean time, still another journal which is daily read by more than a quarter of a million of people was frantically demanding to be informed whether the lake had an actual existence, or whether, like the fountain of perpetual youth, it lay just beyond the end of the rainbow.

Briefly stated, Lake Mistassini was discovered by Father Abanel, a Jesuit, in 1672. It appears on Franquelin's map of New France ("Carte de l'Amerique Septentrionale") under the name of "Lac Timagaming." On this map the shape of the lake is fairly shown, and the long peninsula at the southern end is clearly recognizable. Generally the outlines of the lake, though roughly charted, are tolerable accurate. Franquelin seems to have been a competent topographer, and the slopes and drainage of the country surrounding the lake are reasonably correct. The Heights of Land (*Hauteurs des Terres*), or divide between the St. Lawrence and the Arctic basin, are correctly charted. The outlet of the lake, Rupert River, is followed to Baye du Nord, now called "James Bay." On his map there appears a lake much larger than Lake Mistassini lying to the south-west. This, in all probability, is Lac St. Jean of Père Laure's map; it is, however, greatly exaggerated.

Père Laure, a Jesuit missionary who explored the region about fifty years afterwards, was a man of far more than ordinary ability. He may not have been a trained surveyor, but his keen perception and faithful work more than balance any lacking in that direction. He explored and mapped a large part of the region between the Gulf of St. Lawrence and James Bay, and his manuscript map is now in the archives of the minister of marine, in Paris. The map herewith presented is reproduced from a tracing of a portion of the original. As late as 1866, a reproduction of this map appears in a work by Father Charlevoix. Still more recently, the "Atlas de Géographie Militaire," compiled for the Military Academy at San Cyr, contains a map of a part of the Dominion of Canada, evidently edited from Father Laure's map.

Less than ten years since, Lake Mistassini was again ruthlessly disturbed by a discovery. This time its dimensions were enlarged

until it surpassed Lake Superior in size. In 1884 Mr. John Bignall of the Geological and Natural History Survey was ordered to complete an unfinished survey of the lake; and his work, essentially finished, appears in the report of Mr. A. P. Low, also of the Geological Survey. A carefully reduced copy of Mr. Bignall's map is herewith presented; and some of the details, however, having been omitted for want of space. A casual inspection shows that not only is Lake Mistassini insignificant compared to Lake Superior, but also that it is not comparable even to Lake Ontario in size. In examining the maps of Mr. Bignall and Father Laure side by side, the differences are not so great as one might imagine. The salient features are alike in both, and the one is easily reducible to the other. The foreshortening in the latter probably arose from placing too much reliance on the appearance to the eye. Every topographer who has plotted a similarly shaped object, guided by the eye only, knows that it is extremely difficult to avoid such distortion.

The axis of the lake in Father Laure's map is certainly out of its proper angle; but, if we allow about 30° for variation of the compass, this objection disappears. It is hardly probable that at that early date Father Laure should have any means of estimating the



Extrait de la Carte du Domaine du Roi en Canada, du Reverend Père Laure, Jésuite, 1731.

Ptomaines and Leucomaines, and their Relation to Disease.

SEEING the article in *Science* of Oct. 18 induces me to send you this. It was published in a local medical journal (*Pacific Medical Journal*, September, 1889), but I should be glad to give it wider circulation.

Some recent notices in regard to the composition of leucomaines, and suggestions as to their probable relation to disease (*American Microscopical Journal*, vii. p. 216, 1888; *Science*, xii. p. 335, 1888; *Revue Scientifique*, xliii. p. 187, 1889), have induced me to embody some reflections of my own on this subject.

There is no longer any doubt that the announcement and general acceptance of the germ theory of disease constitute one of the greatest epochs in the history of medicine. But as in the case of all great truths, so in this, the first ideas on the subject have had to be greatly modified: the first extravagant hopes have been disappointed or deferred, and the first claims of its advocates found to be too sweeping.

At first it was imagined that all the grave symptoms of a germ disease, and the death of the patient, were due directly to the presence and multiplication of a specific microbe in the same sense as



Map of Lake Mistassini reproduced from the official surveys of Mr. A. P. Low, Geological Survey of the Dominion of Canada, 1886.

REDUCED COPIES OF THE MAPS OF MR. BIGNALL AND FATHER LAURE.

variation of the compass, or that such a factor should enter into his calculations; so that, on the whole, there are but very few discrepancies between the two maps that cannot be reconciled.

Furthermore, except the direction of the axis, there are no differences between the outlines as shown by the two maps that might not have resulted from the natural erosion of the basin and the corrosion of its outlet. "Rivers," as Gilbert aptly remarks, "are the mortal enemies of lakes;" and it is not reasonable to suppose that Rupert River is an exception to the rule. "Le grand percé" of Father Laure's map has been degraded to a narrow gash, and it is by no means improbable that the level of the water has been considerably lowered by drainage. Indeed, the fall between the adjacent lakes renders such an hypothesis highly probable, for a feature of such importance would not likely have passed Father Laure's notice. Lac Dauphin has disappeared, — possibly from having been drained, — and the long chain of islands traversing the centre of the lake bears further testimony to the lowering of the water in recent times. Unfortunately, Father Laure gives no estimate either of the depth or of the area of the lake, beyond the allusion "d'environ 300 lieues de tour;" so that a comparison of these elements at the two different dates is impossible.

It goes without saying that the lake bears every indication of glacial origin, and the severe winters of the present age cannot fail to leave their traces on the outlines of the lake, even from year to year.

JACQUES W. REDWAY.

the destruction of fruit trees and field-crops is sometimes due to the ravages of insect-pests. The first great modification of this original idea was, that the disease and death in these cases are not due directly to the microbes, but to the accumulation in the blood (or on the mucous surfaces to be absorbed into the blood) of a poisonous chemical substance, a by-product of microbial multiplication. These by-products of albuminoid fermentation (for there are many kinds) have now been isolated from their microbial culture-fluids and analyzed. They may be regarded as alkaloids of albuminoid decompositions, and are called ptomaines. They are most of them deadly poisons. Septic poison, which is the by-product of putrefactive fermentation, i. e., of the multiplication of putrefactive bacillus, is the most familiar example.

The fact of a poisonous by-product of disease-germ multiplication ought to have been anticipated; for every form of fermentation has its peculiar chemical by-product, and many of these are poisonous. The different kinds of alcohol, ethylic, amylic, etc., and different kinds of organic acids, such as lactic, acetic, butyric, etc., are familiar examples. It would be strange indeed if the same were not true of albuminoid fermentations determined by the growth and multiplication of disease germs. As already said, some of these chemical by-products of disease germs have been separated from their generating microbes (as alcohol may be separated from the yeast-plant); and, by the inoculation of these pure chemical products, the corresponding diseases have been produced.

All the symptoms of typhoid-fever and of diphtheria have been thus produced without the presence of any pathogenic microbes. These pure chemical substances have also been successfully used as a vaccine against the corresponding disease, precisely as alcohol is used as a preventive of alcoholic fermentation.

This was indeed a great modification of the original form of the germ theory, but one which only confirmed its truth. We are now probably on the eve of another modification equally important and sweeping. I must explain.

We have seen that ptomaines are alkaloids of albuminoid decomposition generated in the presence and under the guidance of microbian life. Now, there is going on continually in the animal body, as a strictly physiological process, albuminoid decomposition (wasting of the tissues) in the presence and under the guidance of cell life. This also, as might be expected, produces poisonous products. These products also have been isolated and analyzed, and are found to belong to the same class of chemical bodies as the ptomaines. They are alkaloids of albuminoid decomposition, and are therefore in the highest degree poisonous. They are called leucomaines. If they are not also usually deadly to the animal body, it is only because they are continually being eliminated by appropriate organs.

But suppose there should be some change in the process of tissue-waste, and therefore of the composition of the leucomaines, rendering these more poisonous; or suppose, what is still more probable, there be some failure in the function of the organs by which these poisons are normally eliminated: evidently the result would be disease. And not only so, but (mark this) disease similar to those produced by disease germs, except that they would lack the property of contagiousness, because not due to the presence of microbes. Here, then, we would have diseases similar to so-called germ diseases produced without germs. Can we point out any such? Perhaps not yet with any certainty. It is hardly probable that any strongly marked specific and clearly contagious diseases, like small-pox, measles, scarlet-fever, whooping-cough, diphtheria, etc., are ever produced otherwise than by microbes. But it is possible that some of those obscure, sporadic, and apparently non-contagious forms of fever which often run so insensibly into each other, and so puzzle the physician to classify, such as some forms of typhoid, malarial, typho-malarial, continued fever, etc., may be produced in this way. Perhaps, also, countless unclassified, slight fevers and indispositions may come under the same head.

As thus modified, it seems to me that the last remaining objection to the germ theory is removed. But observe: this modification is an abatement of the arrogance of that theory, — is equivalent to an abandonment of its former claims as a universal theory of the cause of disease.

We have said that leucomaines are not usually deadly in their effects on the animal body, only because they are continually eliminated by appropriate organs. What organs? I answer, there may be more than one, but undoubtedly by far the most important is the liver. By careful experiments on animals, Schiff has shown that the liver has the remarkable property of eliminating, or else of decomposing and rendering innocuous to a greater or less degree, all kinds of organic alkaloid poisons, but especially alkaloids of albuminoid decomposition produced by wasting of tissues; i.e., leucomaines. If the vessels of the liver of a dog be ligated so that the venous blood containing these leucomaines cannot pass through that organ, the animal quickly falls into deep lethargy, and in a half-hour dies of blood-poisoning. That death is not the result of mere mutilation, is proved by the fact that a single drop of the blood of a dog dead of ligated liver injected into the veins of a frog will immediately kill the animal if his liver be ligated, but is innocuous if his liver be free (*Archives des Sciences*, lviii. p. 293, 1877).

But the question still remains, "How does the liver eliminate these poisons?" Not directly as such, for they do not appear in the bile. The answer to this weighty question is, I am persuaded, to be found in my interpretation of the glyco-genic function of the liver. In my article on this subject, published in 1878 (*American Journal of Science*, xv. p. 99, 1878; also *Western Lancet* for the same year, but I do not remember the number), I maintain that the liver has the power of splitting albuminoids, whether of food or of

waste tissue, into glycogen (which is immediately changed into liver sugar and burned) and a nitrogenous incombustible residue, which is eliminated by the kidneys as urea. Thus leucomaines are rendered innocuous, and at the same time utilized as fuel to maintain vital heat and force by the liver.

But if leucomaines, then also probably ptomaines, produced by microbes may also be disposed of by the liver in the same way, and the patient often saved. If this view be true, then the belief in the pre-eminent importance of the functions of the liver, and the practice based thereon, of clearing the bowels and stimulating the action of the liver in the onset or in the early stages of disease, — a practice reached empirically, and often ridiculed as savoring of routine, — receives ample justification.

JOS. LECONTE.

INDUSTRIAL NOTES.

Storage-Battery Litigation.

THE Electrical Accumulator Company of New York have issued a circular under date of Nov. 1, in which they state that the litigation involving a patent monopoly of the secondary-battery industry has been so prolonged, and is so technical, that it is believed a few words of explanation are appropriate, in order to enable the public to have a clear understanding of the situation.

In March, 1887, suit in equity was commenced in New York by the above-mentioned company, owning the Faure patent, against the Julien Electric Company, designed to stop further infringement of that patent, covering improvements in secondary batteries. During the progress of the suit it became evident that the Faure patent would be sustained, and early in 1888 the Julien Company modified their method of applying the active material to the battery-plates. In March, 1889, Judge Coxé rendered his decision sustaining the Faure patent, and holding that it could be construed to cover any secondary battery having the active material applied to a plate or support in the form of a "paint, paste, or cement." The modified method of the Julien Company accordingly came within the scope of the Faure patent. On April 11, 1889, an injunction was issued restraining the defendants from further acts of infringement. In June the Julien Company petitioned the court for a rehearing of the case; and their factory, which had shut down in April after the injunction was issued, again resumed operations, the method of manufacturing the batteries being again slightly modified; which second modification, it was claimed, did not infringe the Faure patent. Apparently becoming alarmed at the probability that this second modification was also an infringement, the Julien Company devised a third form, and subsequently a fourth form was employed.

In August a new suit in equity was brought against the New York and Harlem Railroad Company and the Julien Electric Traction Company as co-defendants. These parties were using large numbers of these so-called new forms of battery. Motion was made for a preliminary injunction, and in October Judge Lacombe rendered his decision, which, as will be seen after careful perusal, virtually gave the Electrical Accumulator Company all that they asked or claimed. An injunction was issued on Oct. 28, operating to stop the use of all of their four modifications as well as the original form. This decision of judge Lacombe has been printed for the information of interested parties. It is concise, accurate, and clearly defines what Brush is said to have done in anticipation of Faure's patent.

Quoting from the decision on this point, "What Brush did was to immerse a plate coated with dry material not only into fluid, but into the very fluid in which it was forthwith, and *without removal therefrom*, put to use as a battery plate." It is to be noted, that, under this decision, the manufacture of secondary batteries in any quantity will, if at all possible, be utterly impracticable without infringing Faure's patent.

It has yet to be demonstrated that such form of battery will work outside of the laboratory. It has never been done, although ten years have elapsed since Brush is said to have made the experiment; while manufacturers, both in this country and Europe, have been studying the problem with the strongest incentives to attain success.

CALENDAR OF SOCIETIES.

Biological Society, Washington.

Nov. 2.—C. V. Riley, The Remarkable Increase of *Vedolia cardinalis* in California; W. H. Dall, Notes on the Genus *Gemma*; Deshayes; George Marx, On a New Spider and its Influence on Classification; C. Hart Merriam, Remarks on the Spotted Skunks (Genus *Spilogale*), with Descriptions of New Forms.

Boston Society of Natural History.

Nov. 6.—Thomas Dwight, The Joints and Muscles of Contortionists.

Engineers' Club, St. Louis.

Oct. 23.—The secretary read a letter from the chairman of the board of managers of the Association of Engineering Societies, proposing a meeting of the board to consider the question of proposed affiliation with the American Society of Civil Engineers. Professor Johnson stated that this announcement was made for the club's information, in order that an opportunity might be given the club to instruct its members of the board regarding some plan of united action. Mr. H. A. Wheeler then presented some notes regarding the recent European trip of the American engineers. Some three hundred members of the American Society of Civil Engineers, the American Society of Mechan-

ical Engineers, and the Institute of Mining Engineers, took part. Professor Johnson exhibited a test piece of iron which had been welded by the electrical process at the exposition.

Minnesota Academy of Natural Sciences, Minneapolis.

October.—N. H. Winchell, The so-called Huronian Rocks in the Vicinity of Sudbury, Can.; H. V. Winchell, The Iron-bearing Formations of Minnesota; Professor Chayne, Some Remarkable Forms supposed to be of Cryptozoon in the Shakopee Limestone at Northfield; Warren Upham, A Recent Visit to Itasca Lake.

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Morris's "British Butterflies," Morris's "Nests and Eggs of British Birds," Bree's "Birds of Europe" (all colored plates), and other natural history, in exchange for Shakespeareana; either books, pamphlets, engravings, or cuttings.—J. D. Barnett, Box 735, Stratford, Canada.

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Will exchange "Princeton Review" for 1883, Hugh Miller's works on geology and other scientific works, for back numbers of "The Auk," "American Naturalist," or other scientific periodicals or books. Write.—J. M. Keck, Chardon, Ohio.

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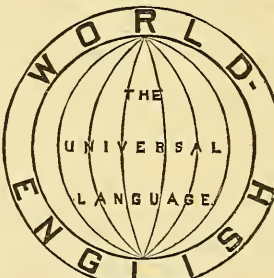
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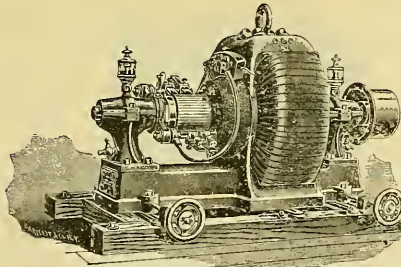
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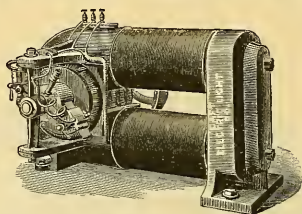
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SEVENTH YEAR.
VOL. XIV. No. 354.

NEW YORK, NOVEMBER 15, 1889

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ELECTRIC ACCUMULATORS.

THE world moves slowly, — faster, perhaps, than formerly, — but still the movement is well ordered and regular, new things not jumping into existence fully developed and ready for their most advantageous use.

All this is true of the accumulators or storage-batteries for electricity, about which the public has heard for a number of years. The principle on which they are based is an old one. That an electric current, in passing through many chemical solutions, would decompose them, is a fact shown in every school in the land. That

store up its electricity? The answer to these questions is well given in a paper by George B. Prescott, jun., read at a meeting of the American Institute of Electrical Engineers on Oct. 29.

There are in use electrical systems for lighting purposes; and, as every one knows, these are mainly of service after the sun goes down, and then they are called on for a maximum service for a short time, which is followed by a smaller demand during the rest of the night. It is patent that such a method of production cannot be economical, for the plant must be idle, or working to but a fraction of its capacity, most of the time. The accumulator comes in as a storehouse; so that the dynamo may be run at an even

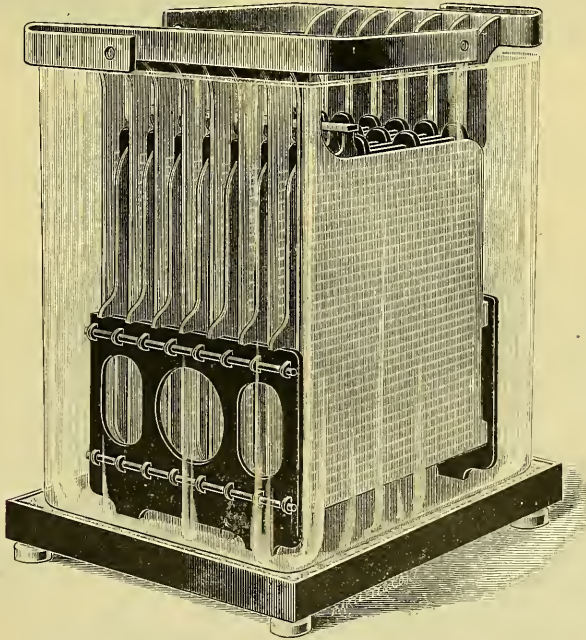


FIG. 1.—ELECTRICAL ACCUMULATOR COMPANY'S STORAGE-BATTERY.

when the battery sending the current is removed, and the wires entering the solution joined, a current can be detected in these wires opposite in direction to the original current, is also known. The decomposing apparatus shows itself as a storage-battery from which, to all intents and purposes, electricity runs out again when the experiment of electrolysis is over. What those interested in storage-batteries have been doing is to make this effect of commercial value.

But why should this effect be of commercial value at all? Why not use the current from the primary battery itself, and not first

rate of production, and any spare electricity stored till the extra demand has to be met.

There is a field, then, in which accumulators may play an important part, not in competition with the direct application of the current from the dynamo, but standing to the electric-light systems very much as gasometers do to gas-works. The demand for light during the day is not *nil*, yet it is so small that few electric-light companies are justified in running their dynamos the twenty-four hours through. But it is calculated that there will be ample surplus of current to charge the necessary storage-batteries if the

dynamos are started at 2 P.M. and work till midnight, — a working day of ten hours, — thus rendering the ordinary electric-light plant efficient the whole day.

There is another field in which accumulators take an active part, — that of long-distance lighting, now so successfully occupied by the alternating converter system, in which the high-potential cur-

rent, is proportional to the number and size of its plates; its rate of discharge depending upon the number of plates and the effective surface of each, while the time of such discharge varies with their thickness. Although there are no obvious theoretical reasons why a single cell of accumulator should not be made sufficiently large to possess any desired capacity, there are mechanical con-

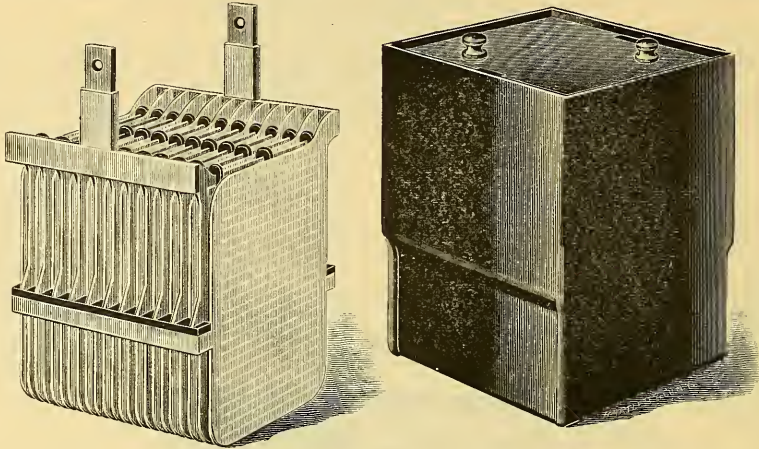


FIG. 2.

rents on the main lines are converted into those of lower potential before entering buildings for use. An accumulator is a chemical converter; and, now that the questions of cost and durability are practically solved, the accumulator is likely to find an application for this converting process.

There is, of course, a practical loss every time energy is trans-

considerations which make it advisable to limit the dimensions of a cell to the extent that it may be conveniently portable. Therefore, when higher rates or longer discharges than an ordinary cell will give are demanded, two or more cells must be connected in parallel.

When two or more series of cells connected in parallel are to be

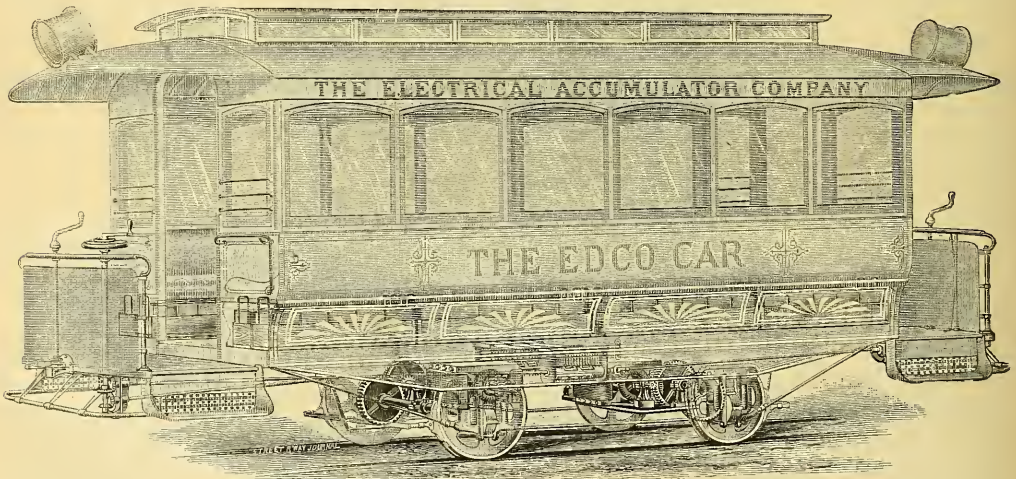


FIG. 3.

formed from one form to another, and this loss is greater the more rapid the rate of charge and discharge of a storage-battery; but this loss, added to the cost of the accumulators, is not believed to be enough to counterbalance the advantages already mentioned.

Generally speaking, the total current capacity, expressed in ampère hours, of a single cell of accumulator of the lead lead-oxide

charged at the same potential, it is evident, that, unless each series is in precisely the same state in respect to residual charge, there will be a difference in their electro-motive forces, and in consequence less current will flow in those series having higher potentials than in others. While the larger current flowing into the less charged cells will have a tendency to bring up their potentials

to the average, it is found in practice that some series will become fully charged sooner than others.

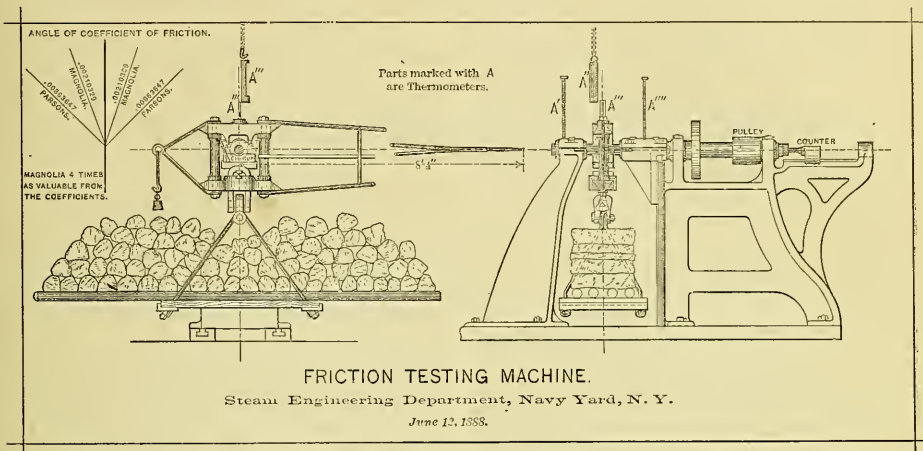
The details of the methods of use we hope to publish later. Our illustrations show the battery and street-car of the Electric Accumulator Company; this car, as is well known, calling for no street wires.

MAGNOLIA-METAL.

For the last fifty years the soft metal made of copper, regulus of antimony, and tin, invented by Isaac Babbitt of Boston, and named for him, has been in use for the bearings in machinery, as the friction was much reduced by its use.

posed to be the best of their class. The machine used was a 5-inch shaft keyed on a 3-inch shaft lubricated with sperm-oil, 5-inch shaft running in the oil. With light pressure and slow revolutions of shaft, the metals showed little difference, but, with rapid revolutions and heavy pressures, magnolia-metal showed great superiority. The foregoing table shows a detailed statement of the tests, which occupied an hour's time.

The testing-machine consists of a shaft revolving in suitable bearings, between two of which is a steel journal on which the test-piece is placed; the top half only of the bearing being used, which was lined with the metals tested. The brass sets in a frame, to the under side of which is suspended a platform. On



FRICITION TESTING MACHINE.
Steam Engineering Department, Navy Yard, N. Y.
June 12, 1888.

FIG. 1. — APPARATUS USED IN TESTING MAGNOLIA-METAL.

In these days of demand for high speed on railways and in ocean steamers, a diminution of the friction is imperative, and magnolia-metal is offered as furnishing a material for bearings much superior to any thing that has gone before.

This platform the weights are placed for producing the pressure. There are two knife-edges, allowing freedom of the frame, and the weighted platform. A pan beneath the test journal, carrying oil, lubricated the bearing. Thermometers were inserted in the oil-bath and in a recess in the top of the metal. In this machine the co-efficient of friction is obtained by the angle of deviation of the knife-edge from a vertical line passing through the centre of the journal in terms of the radius of the journal, and is independent of the weight entering directly into this calculation.

Other satisfactory tests have been made by the United States Government at the Brooklyn Navy Yard, and by Professor R. H.

Time in Minutes.	Temperature.			Pounds Pressure per Square Inch.	Revolutions of Shaft per Minute.	Speed of Rubbing Surface per Minute.
	Magnolia Anti-Friction Metal.	Hoyt's Genuine Babbitt.	De-Oxidized Genuine Babbitt.			
0	65° F.	90° F.	90° F.	2 gen. Babbs. 300 Magnolia 300	1,600	2,095 ft.
10	115°	150°	140°	300	1,550	2,030 "
20	150°	180°	170°	500	1,550	2,030 "
30	160°	230°	230°	800	1,100	1,965 "
40	180°	345°	320°	1,000	1,500	1,965 "
45		397°		1,000	1,500	1,965 "
50	270°		360°	1,000	1,500	1,965 "
55			375°	1,000	1,500	1,965 "
60	400°			1,000	1,500	1,965 "

Magnolia ran full time free without melting out or stopping machinery; Hoyt's melted and stuck to shaft at end of 45 minutes; de-oxidized genuine Babbitt melted and stuck to shaft at end of 55 minutes.

Mr. H. G. Torrey, who has been assayer at the United States Mint, New York, for thirty years, has made several friction tests of journal-bearing metals, the results of which have just been made known. Those selected were magnolia-metal, and Hoyt's genuine Babbitt and the de-oxidized genuine Babbitt, the latter two sup-

posed to be the best of their class. The machine used was a 5-inch shaft keyed on a 3-inch shaft lubricated with sperm-oil, 5-inch shaft running in the oil. With light pressure and slow revolutions of shaft, the metals showed little difference, but, with rapid revolutions and heavy pressures, magnolia-metal showed great superiority. The foregoing table shows a detailed statement of the tests, which occupied an hour's time.

Recently this new metal has been introduced in the "City of Paris" and the "Angusta Victoria," contributing its share in the speed developed by these ocean racers.

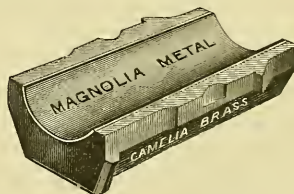


FIG. 2. — MAGNOLIA-METAL BEARING.

ATMOSPHERIC NITROGEN AS PLANT-FOOD.

FARMERS in all older portions of the country buy large quantities of nitrogen in artificial fertilizers. Nitrate of soda, sulphate of ammonia, dried blood, cottonseed-meal, and fish-scrapings owe their fertilizing value mainly, and Peruvian guano and tankage largely, to nitrogen; and the same element is one of the chief ingredients of bone manures, ammoniated phosphates, and many other fertilizers. According to an estimate by the Connecticut Experiment Station, not less than five hundred thousand dollars are expended annually for commercial fertilizers in Connecticut. A large amount of this goes for nitrogen, which is one of the dearest of the ingredients of fertilizers, and costs at retail from eight or ten to eighteen cents or more a pound.

The Storrs School Agricultural Experiment Station, Mansfield, Conn., in its October bulletin, reports a continuation of an investigation of atmospheric nitrogen as plant-food, begun some years ago at Wesleyan University, Middletown, where the chemical work of the station has been carried on since the establishment of the latter in 1838. The details of the experiments there reported were conducted by Mr. C. D. Woods, formerly assistant in chemistry in Wesleyan University, and now chemist of the station.

The quantities of nitrogen in ordinary crops, and the cost of the same in the better commercial fertilizers, vary from 31.5 pounds for potatoes, to 80.3 pounds for clover-hay, costing from \$4.73 to \$12.05.

The plants must have this nitrogen, or they cannot grow. They obtain part of it from the soil, and the rest from the air. The nitrogen of the soil has either been accumulated in the past or is supplied in manures. A small quantity, in the form of ammonia and other compounds of nitrogen, is continually brought to the soil by rain or snow. Late research implies that soils acquire nitrogen from the air by the aid of microbes or electricity, or probably both. The nitrogen in the soil is being continually leached away by drainage-waters, and more or less of it escapes into the air. Soils which are not cultivated, and from which the produce is not removed, accumulate more nitrogen than they lose, so that many virgin soils have a large stock. By ordinary cultivation and cropping, the nitrogen is gradually exhausted, unless it is returned by manures or otherwise.

The main questions have been, first, Can plants make use of atmospheric nitrogen to any considerable extent? second, If they do, is it the free nitrogen of the air that they acquire? There are certain kinds of plants, like clover, beans, and others belonging to the family of the legumes or *Papilionaceae*, which generally get on very well without nitrogenous fertilizers in worn-out soils; and it would seem as though these plants, at any rate, must in some way be able to make use of the nitrogen of the air. But the classic experiments of Boussingault in France, of Lawes and Gilbert in England, and others, have been widely accepted as proving that plants cannot use the free nitrogen of the air, and that they get practically very little combined nitrogen from the air, so that they are dependent upon that previously stored in the soil or supplied in manures. Still many experimenters have not regarded the question as definitely settled.

While the experiments of Boussingault, and Lawes and Gilbert, differ in their details, they agree in this, that the plants were under conditions widely different from those in ordinary culture. The especial object was to find whether plants acquire free nitrogen; and the plants were for the most part grown under cover, to exclude combined nitrogen, and in artificial soil containing little or no nitrogen. The growth was generally stunted and abnormal.

Later experiments on more or less similar plans have brought similar results. Investigations by Ville in France, however, implied that plants can acquire nitrogen from the air, but his conclusions were not generally accepted.

Some years ago a series of experiments was conducted by Mr. C. D. Woods, in which the conditions were more like those in which plants commonly grow. The method used was that of sand-culture. By proper management, feeding, and watering, plants may be grown as large, as healthy, and in every way as well developed, in pure sand as in the richest soil. For these experiments sea-sand was used. To remove all traces of material containing nitrogen

(except, of course, air), the sand was carefully sifted, then washed, and finally heated in iron pots in a furnace, so hot that the pots nearly melted. It was then put in glass jars, and water was added in which were dissolved salts containing the mineral elements of plant-food, potash, lime, iron, sulphuric acid, phosphoric acid, etc., and in some cases nitrogen in the form of nitrate of potash or lime. The seeds were then sown, and the plants grew. They were kept in the open air in a building erected for the purpose. The arrangement was such that the plants were exposed in the day-time in pleasant weather, but put under cover when it rained and at night. They had enough plant-food to enable them to make more or less growth independently of the nitrogen of the air, but were free to get the nitrogen from the air in case they were able to do so. They grew well. Many of them were as well or better developed than those in a rich garden-soil near by.

The amount of nitrogen in the seeds and in the nutritive solutions was determined by analyses at the beginning of the experiments. The same was done with the nitrogen in the plants at the end of the experiments, and with that left in the nutritive solutions. The quantities of nitrogen supplied to the plants at the beginning, and contained in them at the end, of the experiment were thus determined. The plants were found to contain more nitrogen than had been supplied by the nutritive solutions and the seeds. For this gain there was but one possible source, the atmosphere. The peas had in some way acquired nitrogen from the air, and in some cases the quantities of atmospheric nitrogen, thus obtained were very large.

Since that time a number of investigators have obtained similar and even more striking results, and much light has been thrown upon the ways by which the plants are enabled to obtain the nitrogen from the air.

Professor Hellriegel in Germany has found from a large number of experiments that pea, lupine, and serradella plants obtain large quantities of nitrogen from the air, while oats, barley, and buckwheat seem to be restricted to that supplied to them in the soil and obtained through the roots. He has furthermore brought out the very important fact that there is a connection between the nitrogen acquired and the tubercles which are found on the roots of leguminous plants. The root-tubercles are the bulb-like enlargements, from the size of a pin-head to that of a pea or larger, sometimes called "warts," which are found on the roots of beans, peas, clover, cow-peas, and other leguminous plants. They are often thought by persons not botanists to be indications of disease. This suggests that minute organisms, termed "microbes," which are in some way connected with these tubercles, may be the agents by which the plants obtain nitrogen from the air.

To test the influence of the microbes in the soil, Professor Hellriegel prepared soil-infusions by putting small quantities of soil in water, shaking the mixture thoroughly, and letting it settle. The water was then assumed to contain the microbes. The infusions thus prepared were put into the sand in which the plants grew. In a very remarkable series of trials it was found that where leguminous plants were supplied with mineral but no nitrogenous food, and received these infusions, they grew well, had tubercles upon their roots, and contained large quantities of nitrogen when mature. Those which received no infusions, or infusions which had been sterilized, i.e., in which the microbes had been killed, made very little growth, had few or no tubercles, and showed no gain of nitrogen. In another experiment Professor Hellriegel grew peas and buckwheat inside a large glass globe, as Boussingault had done, except that soil-infusions were added. In both Hellriegel's and Boussingault's experiments the plants had practically no nitrogen except that in the seed and the free nitrogen of the air. Boussingault's plants made very little growth, and showed no gain of nitrogen. The same was true of Hellriegel's buckwheat; but his peas grew well, and gained considerable nitrogen. In other words, where the microbes were present, the peas evidently utilized the free nitrogen of the air.

Professor Wolff in Germany has reported experiments with clover which imply acquisition of atmospheric nitrogen. Numerous other late experiments indicate that both plants and soil obtain nitrogen from the air.

The experiments now described in this bulletin may be divided

into the following series: 1888, Champion of England peas, 25 trials; 1888-89, alfalfa, 5; 1889, East Hartford Early peas, first series, 33; 1889, Champion of England peas, 16; 1889, oats, 10. Other series with other plants are begun, but are not yet ready to be reported upon. The following questions were proposed for study: 1. May plants grown under normal conditions acquire any considerable amount of nitrogen, free or combined, from the surrounding atmosphere? 2. What effect has the addition of soil-infusions upon the formation of root-tubercles? 3. Is there a definite relation between the formation of root-tubercles and the acquisition of atmospheric nitrogen?

The method was essentially the same as in the previous experiments by Mr. Wood above described. The plants were grown in glass jars containing sand, purified by washing and igniting. Nutritive solutions, either free from or containing known quantities of combined nitrogen in the form of nitrate of potash or lime, were applied to the sand. The amounts of nitrogen supplied in nutritive solutions and seed were compared with the amounts found at the end of the experiments in residual solutions and plants. The difference between these two amounts must show the loss or gain in nitrogen. A loss must indicate decomposition of either the organic nitrogen of the seed or plants or the nitric acid of the nitrates fed, or both. A gain must represent the nitrogen acquired from the air in excess of any lost either from organic matter of seed or plant or from nitrate of the food.

The conditions of growth were varied by varying the amounts of nitrogen supplied in nutritive solutions. The minerals needed for the growth of the plants were added in amounts to make one part or less by weight of dissolved salts in one thousand parts of the solution. Some of the plants received no combined nitrogen except that in the seed; to others nitrates were added, but in such small quantities that the minerals were relatively in excess; to others enough nitrogen was added to make the mixture of plant-food correspond more nearly to the composition of the plants.

The answer to the question, "May plants grown under normal conditions acquire any considerable amount of nitrogen from the atmosphere?" coincides with the earlier experiments at Mansfield, and is plain and unmistakable. Peas of small, early variety (Early Hartford) planted in sand, with no nitrogenous food except that in the seed, grew to a height of over five feet. With nitrogen supplied in the solutions, they sometimes reached a height of over eight feet. Many of the peas and alfalfa plants accumulated large quantities of nitrogen from the air. In one case a single plant thus obtained more than one-third of a gram (54.6 grains) of nitrogen.

In a number of experiments with peas in which the roots had few or no tubercles, instead of gain, there was a decided loss of nitrogen. This gives added force to the suggestion that if nitrogen escaped in some of the trials, it may have escaped to some extent in other cases also. If so, the results are all inaccurate as indications of the actual atmospheric nitrogen acquired, and the plants must have really obtained more than the figures imply.

It may be that the loss of nitrogen is greater in some classes of plants than in others. The apparent loss in the experiments with peas was about as large when they were not fed combined nitrogen, other than that in the seed, as when they were fed considerable quantities of nitrates. In the experiment with oats the results were very different. Without the addition of nitrates, there was no loss, but a slight gain. When nitrates were fed, there was loss; and the larger the amount of nitrates added, the greater was the loss of nitrogen.

These experiments do not tell to what extent the loss observed with the oats, and with the peas which had no root-tubercles, was from the seed, and to what extent from the nitrates; whether, as seems most likely, it was due to the action of microbes; or what connection there may be between plants of different species and the loss of nitrogen. These and kindred questions must remain for future research to decide. But one can hardly help coupling this observation of the large loss of nitrogen in the oat experiments with the common observation of practical farmers that oats are an exhaustive crop. The power of leguminous plants to acquire nitrogen from the air evidently explains in part why they are such valuable "renovating crops."

Experiments by Berthelot and others imply that nitrogen is being continually gathered from the air by soils, and that microbes, and probably electricity, aid the process. A large amount of late research tends to show that nitrogen compounds in the soil are being constantly decomposed by the action of microbes, and that the nitrogen thus set free escapes into the air.

In Hellriegel's experiments the development of the root-tubercles on the plants seemed to be dependent upon the addition of soil-infusions: in those of the Storrs School Station, although the sand and water were sterilized, root-tubercles were often abundant where no soil-infusions were added. This was especially the case where the plants had some nitrogenous food. Indeed, where the plants were reasonably well fed, so far as the root-tubercles were concerned, it made no apparent difference whether they had soil-infusions or not; nor was there much difference where the plants had no nitrogen in their food. The plants were grown near a garden in which the soil was rich; and the microbes, which seem to be connected with the root-tubercles, were probably abundant. The most natural explanation is, that the organisms or their germs (spores) were floating in the air; found their way to the pots in which the plants were cultivated, and grew there; and that the growth of the microbes was especially favored where the plants had nitrates, i.e., had food enough to keep them vigorous until the tubercles were formed.

These experiments, like those of Hellriegel, reveal a remarkable relation between root-tubercles and the acquisition of nitrogen from the air by plants. Leguminous plants thus far experimented with have root-tubercles, and acquire atmospheric nitrogen. Other plants have been found to be without root-tubercles, and to gain little or no nitrogen; while in some experiments, as in those with oats, above cited, there is a large loss. There is an evident connection between root-tubercles and microbes, though the exact nature of the microbes and their connection with the tubercles remain to be explained.

While there is as yet no positive proof that the root-tubercles or the microbes are the cause of the gain of nitrogen, the fact that there is a connection between the root-tubercles and the amount of nitrogen acquired by the plants from the air is unmistakable. In every case, without exception, where there were no root-tubercles, there was loss of nitrogen; where there were "few" tubercles, there was sometimes a slight loss of nitrogen, at other times a slight gain; with a "fair number" of tubercles, there was a decided gain; where there was a "large number" of tubercles, the gain of nitrogen was very large.

It may be that this relation holds in fields as well as in pot-culture. The past season the station grew a half-acre of cow-peas, which yielded at the rate of about eight tons of green fodder per acre. In some ten different places in the field the roots were examined, and found to be covered with tubercles of large size. At one end of the field, where the yield was relatively light, the roots had less tubercles than elsewhere, and in general where the growth was heaviest the tubercles seemed to be most abundant.

As to whether the nitrogen which the plants obtain is the free or the combined nitrogen of the air, these experiments do not bring absolute proof, but the quantities of nitrogen obtained are so very large as to leave little doubt that it is free nitrogen; and the experiments of Hellriegel above cited would seem to prove that the uncombined nitrogen can thus be used. This and the cognate question as to how the nitrogen is acquired, demand further study. Investigations in this line are being planned for at the station.

This subject has a wider significance than what has been said above implies. The future welfare of our race, material, intellectual, and moral, depends upon the food-supply, or, in other words, upon the product of the soil. This, in turn, reduces itself essentially to a question of phosphoric acid, potash, and nitrogen. Enough of the first two for indefinite time to come is assured in the deposits of phosphates and potash salts already discovered, but the probability of a sufficient supply of nitrogen has been questioned. This costliest of the fertilizing elements escapes from our soils into the air and into the sea, and is taken away by crops, and not completely returned. Artificial fertilizers promise to meet but

a small fraction of the coming demand. If, as has been urged, the exhaustless stores of the atmosphere are not available to plants, the outlook is dark enough; but if the farmer may use his crops to gather it, without money and without price, we may dismiss our solicitude. With the assurance that plants obtain nitrogen from the air, the fear of starvation for the over-populated earth of the future may be ignored. That research is bringing the brighter answer to this problem, there seems to be most excellent ground to hope.

WARM AND COLD WATER FOR MILCH COWS IN WINTER.

WHETHER or not it is desirable in Wisconsin to warm water for domestic animals, has been experimented upon by F. H. King at the Agricultural Experiment Station at Madison.

On the night of Jan. 21, 1889, six cows were placed in stanchions side by side, in two groups of three each, upon a daily ration of five pounds of bran mixed with two pounds of ground oats and six pounds of hay, together with what dry cut corn-fodder they would eat up clean; and this ration was not changed until after the close of the experiment, March 25. During this time the cows were fed twice and watered once daily. They were allowed the freedom of the barnyard during the middle of each pleasant day, and in every way received similar treatment, except that, when one group of cows was getting water at 32° F., the other group took it at 70° F. The time of the experiment was divided into three periods of sixteen days each, having intervals between them. At the close of the first and second periods the temperatures of the water were reversed for each of the cows in order to eliminate, so far as might be, the individual differences of the two groups.

In plan this experiment contemplated as its chief object ascertaining whether it is true, as many farmers believe, that warm water for milch cows produces a measurable increase in the yield of milk over that of cold water, and, if so, whether this increase affected the volume simply, or the weight of the solids contained, to an extent which would make it remunerative in general practice to warm the water for cows.

The discussion of the results obtained has shown for these six cows, while under experiment, the following facts:—

1. While on warm water, they gave, on the average, 1,002 pounds of milk per cow per day more than while on cold water, or 6.23 per cent of the general average daily yield of 16.06 pounds.
2. They drank on the average, daily, while on cold water, 63 pounds; but while on warm, 73 pounds, or 10 pounds per cow more.
3. They ate more while on warm water than while on cold, and at the rate of .74 of a pound of corn-fodder per cow per day.
4. An increase in the amount of water drank was coincident with an increase in the quantity of milk given; and this was true irrespective of whether the water was warm or cold, an increase of 10 pounds in every 100 pounds of water drank being accompanied by an increase of 1 pound in every 100 pounds of milk given, nearly.
5. They consumed solid food, while on warm water, at the rate of 1.44 pounds for each pound of milk produced; and while on cold water, at the rate of 1.54 pounds for each pound of milk given.
6. An increase in the amount of water drank, when the temperature of the water remained the same, was associated with an increase in the amount of water in the milk without a notable increase in the total solids contained.
7. An increase in the temperature of the water drank, rather than an increase in the quantity of it, was associated with an increase in the total amount of solids produced.
8. There was a daily fluctuation in the percentage of water in the milk associated with a fluctuation in the amount of water drank.
9. Five cows manifested a strong preference for water at 70° over that of 32°, but one of the cows showed an even stronger liking for the iced water.
10. With but one exception, the cows, while they ate less and drank less during the cold-water periods, weighed more at their

close, and, with but three exceptions, they weighed less at the close of the warm-water periods.

11. With butter at 20 cents per pound, skimmed milk at 25 cents per hundredweight, corn-fodder at \$5 per ton, and the cost of warming water for forty cows 120 days at \$15, the results obtained from the cows on the experiment indicate that a net gain of \$21.36 would be realized on a herd of forty cows averaging sixteen pounds of milk per cow per day, and at least \$10 on a herd of twenty, and \$5 on a herd of ten cows. Counting corn-fodder at \$10 per ton, the net gain on a herd of forty cows would still be \$12.48.

THE ETHNOLOGICAL SIGNIFICANCE OF THE BEECH.

THE new science of linguistic paleontology has thrown a flood of light on several obscure problems of ethnology. It has, for instance, been proved that the names of the ass and the camel in Aryan languages are not primitive, but merely loan-words from the Semitic. This fact by itself goes far to disprove the hypothesis which placed the cradle of the Aryans in Central Asia, a region of which these animals are natives.

According to an article on the above subject by Canon Isaac Taylor, published in a recent number of *Knowledge*, in no case have more valuable results been obtained than in the case of the beech. This tree, which flourishes only in temperate climates, and is a lover of chalk subsoils, is confined to a definite and restricted area. It grows in the extreme south of Norway and Sweden, but is not found east of a line which strikes across Europe from the Frische Haft on the Baltic coast, near Königsberg, through Poland to the Crimea, ending finally in the Caucasus.

In former times the limit was more narrowly restricted. In Cæsar's time the beech had not reached Britain or Holland, while at the close of the bronze age, or the beginning of the iron age, it was only just beginning to replace the oak in Denmark. Early in the neolithic age its range was probably confined to France, northern Italy, and northern Greece; while in Germany, as Dr. Schrader believes, it did not extend north of the Thuringian forest. It flourishes in Macedonia, and clothes the north-eastern slopes of the Thessalian coast chain, while in the south of Epirus the ilex or evergreen oak replaces it as the characteristic forest-tree.

Within these ancient limits of the beech we must place the cradle of four Aryan languages,—German, Latin, Celtic, and Greek. We draw this conclusion from the following philological facts: the word for beech is, in Gothic, *boka*; in Latin, *fagus*; in Celtic, *faidhbéile*; while the corresponding word, *φηγός*, denotes the oak in Greek.

With regard to other members of the Aryan family, the names for the beech—*buky* in old Slavonic, *bukas* in Lithuanian, and *buk* in Russian—are manifestly loan-words from the German. This would go to prove that the Slavs, in the prehistoric period, must have dwelt east of the beech line, though they have since advanced within it. Johannes Schmidt has shown reason for believing in the unbroken geographical continuity of the European Aryans, previous to the linguistic separation: hence they must be placed astride, so to speak, of the beech line,—the Slavs and Lithuanians in European Russia; and the Celts, Latins, Hellenes, and Teutons, farther to the west.

We have now to account for the fact that the word denoting the beech in Latin, German, and Celtic, has come in Greek to denote, not the beech, but the oak. A well-known explanation of the difficulty has been offered by Professor Max Müller in the second series of his lectures. He contends that the word originally denoted the oak, but that it was transferred to the beech at the time when the oak-forests of Jutland were replaced by beech-forests. But this does not account for the fact that the Latin word *fagus* means the beech, for Helbig has shown that the Umbrians had already reached Italy before the commencement of the age of bronze. The bronze age began in Italy earlier than in Denmark, and in the bronze age the oak was still the prevailing tree in Denmark, and was quite unknown in the neolithic age, when the Umbrians, whose language was a dialect of Latin, were already settled in Italy. The word *fagus*, therefore, must have denoted the beech in Latin at a period prior to the change in the forest-growth to

which Professor Max Müller attributes the alteration in the meaning of the word.

Moreover, a great change in the vegetation of a country, such as the replacement of the Danish oak-forests by forests of beech, must have occupied many centuries. At what moment, then, was the name transferred from one tree to the other? Were the people of Denmark content to have no name for the beech when it first appeared, and what did they call the oak after having deprived it of its original title, in the prolonged period during which the two trees must have been growing side by side?

Another hypothesis, less beset with difficulties, has been advanced by Geiger and Fick, who suppose that the word originally signified the beech, and received among the Greeks the changed signification of the oak. If the Greeks had migrated from a land of beeches to a land of oaks, there is no difficulty in understanding that they may have transferred the name of one tree to the other. The word meaning the food-tree (*φῶγ ἰν*, "to eat") would be as applicable to the evergreen oak, with its acorns, as to the beech, the mast of which was the staple food for their swine. The beech, as has been said, is not found south of Dodona, which lies in the centre of Epirus. It is noticeable that the most ancient Greek legends are connected with Dodona, where the Greeks made their first halt in their progress to the south, and where the earliest prophetic utterances were obtained from the rustling of the leaves of the sacred tree,—the *φῶγ ἰν*. Hence we may believe that the Greeks entered the peninsula, not from Asia Minor, but from the north-west, through the valleys of Epirus. This route would explain how the old Aryan word denoting the beech came to be applied by the immigrants to designate the tree which flourished on the hillslopes of their new territory. In modern times we have similar instances of transferred names in the United States, where such English names as "the robin," "the hemlock," and "the maple" are used to denote wholly different species.

But with regard to the Greeks, it may be urged that before they entered the peninsula they must have been already acquainted with the deciduous oak which flourishes in the region whence they emigrated. This objection is met by the fact that the Greeks had a second name for the oak, *δρῦς*, which corresponds to the old Irish *daur* oak, as well as to the Gothic *triu*, and the Sanscrit *aru*, which mean simply a tree. Both of the Greek words for the oak are used by Sophocles in speaking of the sacred oak at Dodona.

The Greek word for the deciduous oak agrees with the Celtic word, while the Greek word for the evergreen oak was the word which in their former home had denoted the beech.

The question as to whether the original Aryan word denoted the beech or the oak is not important, as from it may be drawn an inference as to the primitive seat of the Aryan race.

According to Professor Max Müller, the Aryans migrated from Central Asia, where the beech is unknown. If this had been the case, it is extremely difficult to explain how the ancestors of the Latins, Celts, and Teutons, migrating, as Pictet maintains, at different times and by different routes, to lands where the beech abounds, should all have chanced to call it by the same primitive name, merely modified according to the fundamental phonetic laws of Latin and German. But, on the other hand, all such difficulties disappear if we assume that the cradle of the Aryans was in the original beech region; that is, roughly speaking, in the valleys of the Rhine, the Main, and the Danube; and that it was here that the differentiation of the Greek, Latin, Celtic, and German languages took place.

The name of the beech bears also on the solution of the question as to which of the neolithic races has the best claim to represent the primitive Aryans. The choice probably lies between the brachycephalic Celto-Latin race, some of whose earliest settlements may be discovered in the pile-dwellings of Bavaria, Switzerland, and northern Italy, and the dolichocephalic Scandinavian race, whose remains are found in the Danish kitchen-middens. That one of these races constituted the primitive Aryan race, and imposed its language on the other, is highly probable.

Now, as we have already seen, in the neolithic age the beech had not yet reached Denmark, the fir being at that time the predominant tree. In the bronze age the fir was succeeded by the oak, which gave place in the iron period to the beech: hence the beech

region was at that time inhabited by the Celto-Latin people, while the Scandinavian race in all probability dwelt to the north of its limit.

The beech has therefore a threefold ethnological significance. 1. It proves that the Greeks entered Hellas from the north, probably through Epirus, and not, as has been contended, from Asia Minor. 2. It proves that the differentiation of the Aryan languages took place not in Asia, but in Central Europe, on either side of the beech line; the Slavs and Lithuanians being to the east of it, the Greeks, Celts, and Latins, farther to the west. 3. It makes it probable that the primitive Aryans belonged to the brachycephalic Celto-Latin race, and not the dolichocephalic Scandinavians.

ENGLAND'S COAL-RESOURCES.

A PAPER on this subject was read by Professor Edward Hull at the recent meeting of the British Association. To at once set at rest any alarm that may be felt as to Professor Hull unfurling the old banner of "Exhaustion of English Coal-Fields," *Engineering* states that he estimates there is enough coal in Northumberland and Durham to last, at the present rate of consumption, for three hundred years; supposing, of course, one goes deep enough for it. Before that period has elapsed, however, it is to be hoped, on behalf of posterity, that the petroleum-engine, the sun-motor, or some other force, will have promoted steam and gas engines to the serener atmosphere of the antiquarian museum.

Professor Hull is the director of the Geological Survey in Ireland, and he naturally turns to coal as a refreshing subject, which has not become hackneyed to him by his official labors. By a diagram shown on the walls, the output of coal since the beginning of the century was given. The figures have often been quoted, but may be given once again in brief. In the year 1800 the output of coal probably did not exceed 10,000,000 tons, a very large proportion of which was drawn from the Newcastle district. In the year 1830 the quantity raised in the British Islands was about 29,000,000 tons, it 1860 it had reached 80,042,698, and in 1888 the quantity had reached about 170,000,000 tons, as shown by the returns issued by the Board of Trade. There was reason for believing that between the beginning of the century and the year 1875 the output of coal had more than doubled itself for each successive quarter of a century. Since the year 1860, in which the author had estimated that sufficient coal existed to a limiting depth of 4,000 feet to last, at the rate of production for that year, for one thousand years, the available quantity of coal had been reduced by 3,650,000,000 tons; but this amount, great as it was, had not very materially affected the coal-resources. The production of the South Wales coal-field had doubled in the quarter of a century between 1854 and 1879, and in 1888 amounted to the enormous total of 27,355,000 tons, largely owing to the demand for steam-coal in the Cardiff district. The resources of this great basin are enormous, and render it capable of maintaining or increasing its present output for a long period of years. The Lancashire and Cheshire and the great Yorkshire and Nottingham coal-fields are highly progressive, as is also the Northumberland and Durham. This great northern coal-field, notwithstanding the long period over which it has been worked, shows no signs of falling off in its output. The discovery of the liassic ironstone of the Cleveland district, and the great exports from the northern ports, have given a vast impetus to northern coal-mining during the last quarter of a century; and the enormous drain upon this coal-field, the limits of which have been definitely determined, cannot fail to cause a serious falling-off in its output during the twentieth century, although there is sufficient to maintain the present rate of consumption for three hundred years. The relation between coal-production and the development of the iron trade since the discovery of the ironstone deposits of the North Riding of Yorkshire, and the richer hematites of North Lancashire and Cumberland, was then considered; and the different coal-fields of the British Isles were passed in review in order to show those which are in a progressive condition, and which are stationary or retrogressive. The author concluded his subject by expressing an opinion, that, while the enormous output of coal during the past few years had not actually crippled England's resources, a general rise in the value of coal must ensue in the near future, owing to

the greater depth at which the mines will have to be worked, and the increased cost of coal-mining. Reference was then made to the great expansion of coal-mining in America, and the author agreed with the late Professor Jevons that future British manufacturers must not expect to derive any help from the import of coal from the United States when coal shall have become dear or scarce at home.

A good discussion followed the reading of this paper. Mr. Bourne pointed out that the opening of the Canadian route to the East would ease the demand on English product, as coal had been discovered in the Dominion. Thus the Peninsular and Oriental ships, instead of filling with English coal at foreign stations, would probably be running from Vancouver to China and Japan, and use Canadian coal. The speaker looked to petroleum to lessen the demand for coal in many instances, as it had already done in many cases. He did not consider the electric light had done much in this direction, but, if water-power could be more largely used, some relief might be hoped for in that direction.

Mr. G. W. Hastings, M.P., spoke on the aspect of the question from the political economist's standpoint, and pointed out that coal-owners had been making very little profit from their exports.

Mr. John Marley, president of the Northern Institute of Mining and Mechanical Engineers (Darlington), said it would be well if Professor Hull had taken into consideration one or two facts in connection with the coal-trade. One was that thirty years ago the amount of coal required for the production of every ton of pig-iron and its detailed manufacture was double the quantity it is now. That would, therefore, form an element in future calculations. Also the manufacture of steel only required about half the number of tons of coal which was required for each ton of manufactured iron. Another point which the professor had named was his differing from the Royal Coal Commission in not taking into account the coal-seams between 12 inches and 24 inches in thickness. The professor evidently thought that these seams will not come into play so much as he (Mr. Marley) would venture to submit they will, on account of the great depth to which shafts will have to be sunk to work them. He would call Professor Hull's attention to the fact that these shafts have to be sunk, and are sunk, to the thicker seams; and when these thicker seams are exhausted, then the thin seams, between 1 foot and 2 feet in thickness, come into play. He spoke of what was an actual fact, for he knew many instances where seams of 14, 16, and 18 inches were at this moment being worked profitably in the county of Durham from shafts sunk from the thicker seams. Professor Hull would therefore see that his objection to the expensive shafts for these thin seams did not really apply.

Professor Hull, in reply, did not anticipate that petroleum, however largely it was likely to come into use in England, would make very much difference in the demand for coal. As to Mr. Marley's remarks on the greater economy of fuel in the manufacture of iron, he himself could remember when eight tons of coal were required in the Midlands for the production of one ton of iron, while now only $1\frac{1}{2}$ tons of coke were required in Cleveland per ton of pig-iron. At the same time, the economy in the use of coal was more than counterbalanced by the enormous increase in the production of iron.

HEALTH MATTERS.

Insanity following Surgical Operations.

In a recent letter to the *British Medical Journal*, Dr. Tait writes, —

"I have now performed, so far as I can estimate, between seven thousand and eight thousand operations requiring the use of anaesthetics, and I have had anaesthetics administered in my practice for purposes not involving traumatism probably in three thousand more instances, and I know of seven cases of sequent — not necessarily consequent — insanity. Of course, there may have been others not known to me, and I shall say fourteen cases to cover that margin of error. My own practice, therefore, does not yield a proportion of cases of insanity following operations larger than the general proportion of insanity in the adult female population; and,

if I include the cases of anæsthesia, it is probably considerably smaller.

"Dr. Denis, in his book on this subject, says, 'En moyenne, on observe 2.5 cas d'aliénation mentale sur 100 opérations.' But if this had been the case, all of us engaged in active operating practice would have felt the influence of the fact long ago. Personally I have been struck by the occurrence of insanity after operations as being like the occurrence of tetanus, — something to be met with occasionally, but not a matter to calculate upon. If I saw an insanity rate of 2.5 in my operations, it would be more striking than any death-rate in every thing but my hysterectomies, and in that class I have already said I have never seen insanity follow in a single instance; and Dr. Bantock's experience amounts to practically the same result, for his exception cannot really be called one of insanity following an operation. As a *per contra*, I can point to at least thirteen cases where operations have cured insanity."

TRANSPLANTATION OF SKIN FROM A CORPSE TO A LIVING PERSON. — Dr. Bartens has successfully transplanted the skin of a corpse to a living person who had been severely burned. His method of procedure, as described in the *Brooklyn Medical Journal*, was as follows: On Dec. 13 a lunatic died in the hospital of pyæmia following a compound fracture of the arm, and about twenty minutes after his death two large, good-conditioned flaps were removed from the legs of the corpse. These were laid in warm water to which a little salt had been added, and then were taken to the division of the hospital (two or three hundred yards away) in which the scalded boy lay. These flaps were then carefully washed, and cleansed of their subjacent fatty pannus; that done, they were divided into smaller pieces of from one centimetre wide to about one to two centimetres long (the ulcerated surfaces of the boy's legs had been cleansed in the same manner as the flaps in the mean time); then these pieces were laid on to fit as nearly as might be, dusted over with iodoform and covered with batting, and compresses applied. This whole proceeding took about one hour and a half from the time of the death of the old man. There were twenty-eight pieces applied in all; as it happened, too, fourteen on each limb. On the 19th of December the bandages were removed for the first time, and it was found that there was union of twenty-four of these grafts.

COCAINE HALLUCINATIONS. — MM. Magnan and Saury report three cases of hallucination due to the cocaine habit. According to the *British Medical Journal*, one patient was always scraping his tongue, and thought he was extracting from it little black worms; another made his skin raw in the endeavor to draw out cholera microbes; and a third, a physician, is perpetually looking for cocaine crystals under his skin. Two patients suffered from epileptic attacks, and a third from cramps. It is important to notice that two of these patients were persons who had resorted to cocaine in the hope of being able to cure themselves thereby of the morphine habit, — an expectation which had been disappointed. For more than a year they had daily injected from one to two grams of cocaine under the skin; without, however, giving up the morphine injections, which were only reduced in quantity. The possibility of substituting cocaineism in the endeavor to cure morphinomania is a danger, therefore, which must be carefully held in view.

NOTES AND NEWS.

THE officers for the coming year of the Society for the Promotion of Agricultural Science are Professor C. E. Bessey of the University of Nebraska, for president; Professor W. R. Lazenby of Ohio University, for secretary and treasurer; and professor T. J. Burrill of Illinois University, for third member of the council.

— The thirty-third annual convention of the Association of College Presidents in New England began Nov. 7, in New Haven, Conn., at the residence of President Dwight. Delegates were present from eleven colleges, including President Eliot of Harvard, President Warren of the University of Boston, Professor Richardson of Dartmouth, President Smith of Trinity, President Carter of

Williams, President Dwight, Professors Newton and Wright of Yale, President Capen of Tufts, President Raymond of Wesleyan, President Hyde of Bowdoin, and President Andrews of Brown. The discussions were on these subjects: First, "What should be the Minimum of Mathematical Studies for the Degree of Bachelor of Arts?" Second, "Ought not our Courses of Study, both Prescribed and Elective, be so arranged that any Given Candidate for the Degree of Bachelor of Arts should be compelled to confine his Time to a Smaller Number of Subjects?" Third, "The Expediency of requiring Somewhat of Natural Science for Admission to College." Fourth, "The Means of inducing Secondary Schools to teach Science by Laboratory Methods." The convention continued through Nov. 8. Among the subjects discussed were, "The expediency of reducing the College Course to Three Years," "Limitation of Society Conventions in Term Time," "The Advantage of College Training for Teachers," and "The College Pastorate."

— Peter Graff of Worthington has announced the gift of twenty-five thousand dollars out of the estate of his son, Charles H. Graff, M.D., to endow a professorship of hygiene and physical culture in Pennsylvania College at Gettysburg. Dr. George D. Staley of Lebanon, formerly of Harrisburg, has been chosen to fill the chair.

— The leading ship-builders in England have just submitted to the Canadian Pacific Company offers for the construction of three first-class passenger-steamers for the Atlantic service in connection with the new route to the East. It will be remembered, says *Engineering*, that a week or two ago the Naval Construction and Armament Company, whose works are at Barrow, were commissioned to build three twin-screw steamers of 7,000 tons, being 440 feet long, to attain a speed of 18 knots an hour, for service between Vancouver and Yokohama, the other sea-passage of the route; the Canadian Pacific Railroad carrying the passengers from the Atlantic seaboard in Canada to the Pacific. The new Atlantic steamers will be faster than the Pacific vessels, having a maximum speed of 20 knots, with the engines indicating about 10,000 horsepower, and the boilers, of which there will be ten, working at a pressure of 165 pounds to the square inch. The intention is that the voyage from the south of England to Halifax in the winter, and Quebec in the summer, should be accomplished in at most five days and a half. Unlike the Pacific steamers, they will be propelled by a single screw, but it is quite possible that before the contract is ultimately fixed this may be altered. In the case of the Pacific steamers the first idea was to have a single screw; and, as negotiations proceeded, the builders were asked to tender for twin-screw boats, and the beam and depth of the hulls were considerably increased. The Atlantic vessels will, according to present design, be 480 feet long by 54 feet beam by 25 feet draught. The first of the new vessels, according to the mail contract with the government, must be ready to sail in February, 1891, so that the order for the steamers will likely be placed before long. It is expected that the passage from the south of England to Japan will be made in twenty-three days without any difficulty. The distance is about 9,250 miles, as against 13,750 by the Suez Canal, and 15,500 by the Cape. To Shanghai, also, the route is shorter *via* Canada, being 10,500 miles, as against 12,500 and 14,500 respectively by Suez and the Cape.

— An imperial Chinese edict, dated Aug. 27, 1889, states that "the sovereign is of opinion that to make a country powerful, railways are essential." What a wonderful change this represents in Celestial opinion since the time of the Chinese war! The great trunk line between Peking and Hankow is to be immediately commenced in two places,—in the south, from Hankow to Sing-Yang Chow; in the north, from Lu-Kow K'iao to Cheng-Ting Fu,—leaving the intervening sections for a future period. Lu-kow is five miles south of Peking. The construction of the line, according to *Engineering*, is to be under the management of Chow Fu and Taoti Pan Chün-teh, under the general superintendence of Li Hung Chang and the Admiralty. Li has transferred the whole of the foreign staff of the existing Maiping-Tientsin line to the new railway, although one of his colleagues advises that Chinese capital and labor should be relied upon solely. There is still a very strong opposition to railways in China; and the emperor, out of compassion for those who, in pulpit phraseology, may be called his "weaker

brethren," has ordered the viceroys and governors of Chihli, Hupeh, and Honan to issue explanatory proclamations, exhorting and commanding all people to throw no impediment in the way. "It is the imperial desire that all shall work together to make this great work a success." This will be the first railway openly constructed in China. The existing line commenced as a tramway from the coal-mines to a canal. Then a locomotive was put upon it, and little by little it was extended until it reached Tientsin. If the Chinese would only commence to build railways in good earnest, the effect would soon be felt in England.

— At the recent meeting of the Congress of German Men of Science and Physicians at Heidelberg, Herr O. Ammon submitted to the Anthropological Section some interesting results of observations he had made in Baden. These observations, says *Nature*, related to five thousand soldiers. The tall men had generally long skulls, or skulls of medium length, whereas the short men had round skulls. Most of the round-skulled men came from the Black Forest; the long-skulled usually belonged to the valley of the Rhine, and were especially numerous in towns and in the neighborhood of the castles of ancient families. From this fact Herr Ammon concluded that the round-skulled men had been the original inhabitants of the Rhine valley, that they had been driven from it by long-skulled invaders, and that the latter had established themselves near the settlements of their victorious leaders. Having shown that there is a certain relation between the height of the figure and the shape of the skull, Herr Ammon went on to indicate the relation between fair hair and blue eyes. No fewer than 80 per cent of the men with blue eyes had fair hair. He found also that physical growth is generally quicker in the case of the brown-eyed than in that of the blue-eyed type.

— In a paper read before the Royal Danish Academy in February, M. Adam Paulsen gave some interesting particulars of observations made with the object of determining the height of the aurora. *Nature* states that two theodolites were used, the observing telescopes of which were replaced by short tubes having small holes at the eye ends, and metallic cross-wires at the other ends. Two of the stations were situated in the same magnetic meridian, on opposite banks of the Fiord of Godthaab, at a distance apart of 5800.4 metres. The vertical circles of the two theodolites were placed in a common plane by means of observations of "blue-fire" signals given at each station. Signals were also exchanged on the appearance of an aurora which it was thought possible to measure, so that simultaneous observations were secured; and it was previously agreed to direct the instruments to the base of the auroral arc. The observations at Godthaab gave heights for different auroræ ranging from 0.6 of a kilometre to 67.8 kilometres. A second series of observations with the same apparatus and methods was made in 1885 by MM. Garde and Eberlin at Nanortalik, near Cape Farewell, the base-line in this case being 1247.8 metres; and the values determined here were 1.6 to 15.5 kilometres. The results obtained by the staff of the Swedish International Expedition at Spitzbergen, with a base of 572.6 metres, range from 0.6 to 29.2 kilometres. These observations, therefore, lead to the conclusion that auroræ are by no means confined to the highest parts of our atmosphere, but that they occur almost indifferently at all altitudes. In support of this view, M. Paulsen gives accounts of several appearances of auroræ beneath the clouds and the summits of mountains. It is interesting to compare the new values with those given by previous observers. M. Flögel calculated the heights of several auroræ which appeared in the autumn of 1870, and concluded that only the very lowest parts of the aurora came at all within the limits of our atmosphere; he gave the actual limits as 150 to 500 kilometres. For an aurora on Oct. 25, 1870, M. Reimann found a height of from 800 to 900 kilometres, and Norden-sköld came to the conclusion that the mean height of auroræ was about 200 kilometres. On the other hand, Lemström has observed auroræ as low as 300 metres, and M. Hildebrandsson has seen auroræ in a completely clouded sky. Considering all the facts of the case, M. Paulsen inclines to believe that in the temperate zone, auroræ only appear in the higher layers of the atmosphere; whereas in the auroral zone, properly speaking, the phenomenon is generally produced in the lower layers.

SCIENCE:

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Communications will be welcomed from any quarter. Abstracts of scientific papers are solicited, and twenty copies of the issue containing such will be mailed the author on request in advance. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents.

Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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WHEN JOHNS HOPKINS UNIVERSITY was first opened, it was feared by some that it would have to depend for support on the funds left it by Johns Hopkins, and that others who might give freely to any of the older educational institutions would hesitate about aiding an institution which is so young as Johns Hopkins University, and whose prosperity is yet a credit to the memory of the founder. The events of the last few months show, however, that Johns Hopkins University has entered on a second stage in its development. It is known to all that when, on the stopping of the dividends on Baltimore and Ohio stock, it became imperative that funds be raised to supplement the income from other sources, enough admirers of the stand the university has taken among American educational institutions were found willing and able to give one hundred thousand dollars to enable the university to maintain the high grade of teaching and investigation so characteristic of it from the start. This was well enough, so far as it went; but this seems now to have been merely No. 1 in the list of generous gifts to the university this year. There followed the gift of twenty thousand dollars by Mr. Eugene Levering to the Christian Association, which has been used in erecting a building, now nearly completed. Mr. John W. McCoy gave the university, upon his death, more than one hundred thousand dollars, a magnificent library, and made the university the residuary legatee of a large estate, from which it will realize another considerable sum. The gift of twenty thousand dollars to found the Turnbull lectureship

of English poetry preceded the bequest of Mr. McCoy, and filled a long-felt want in the English department. In all, during the last six months, the university has been the recipient of more than four hundred thousand dollars, including the amount that will probably be realized from the residuum of the McCoy estate. This does not include the McCoy library.

A most satisfactory gift, as showing approval of the work done by Johns Hopkins University, is that of Mrs. Caroline Donovan, which we chronicle this week. Mrs. Donovan in her letter stated she had observed with satisfaction the work at the university, and as an evidence of her appreciation she asked the trustees to accept a gift of one hundred thousand dollars, provided that the income thereof should be used in the endowment of a chair in the university. Mayor Latrobe of Baltimore, the legal adviser of Mrs. Donovan, through whom the gift was announced to the university trustees, said, in his presentation address, "My friend, Mrs. Caroline Donovan, directs me to say in this connection, first, that she has written two letters, — one of them designating English literature, the other not naming any particular branch of instruction for which the chair is to be established. Her preference is thus shown for the study of English literature, but at the same time she does not wish to encumber the gift with this condition, and therefore leaves it to be decided by the university, she desiring to found such a chair as may be of the most practical service. From her conversations with me on the subject, I can say, however, that Mrs. Donovan would greatly prefer if the decision of the university in this connection was not for instruction in any of the so-called 'dead languages.' Second, Mrs. Donovan desires me to say that the money she gives is her own, made by herself, and not by gift or devise. Third, She also instructs me to say that before making this gift she has liberally provided for all those having any claim upon her through blood relationship or otherwise. No just complaint can therefore be made by any one, that he or she has been wronged by her thus disposing of her own money." Mrs. Donovan is the widow of William Donovan, who died several years ago. She is about eighty-six years of age, and resides in Baltimore County, a few miles from Catonsville, and is a liberal giver to many worthy charities, all of which she does secretly, in a very unostentatious manner. Her greatest fear was of having the matter mentioned in the newspapers, but Mr. Latrobe told her that it was impossible to keep any thing from them. When Mayor Latrobe suggested the gift should be called "The Caroline Donovan Chair," she objected on the ground that a chair bearing a woman's name was unusual. This succession of gifts marks the advent of a growing prosperity in the life of this university, of which all Americans are proud.

WILL SCHOOLS AND COLLEGES take advantage of the opportunities we offer them to make known, free of all cost, their needs as to additional teachers? We want to publish such items as news, and news of very great interest to many of our readers, but we find it next to impossible to rouse the school owners and managers to use what we offer. So far, in the several months that our "Want" column has been open, but one, "M. H.," has availed himself of it to advertise for a teacher. That he did so to good purpose may be judged by the following extract from his letter: "I have to thank you and your admirable paper for securing a most competent man as teacher of natural science in Ogdén College. I have had, I suppose, thirty or more applications, and they are still coming." This feature has been urged on us occasionally; but, to make it of due value, there is need of a great waking-up on the part of those most interested. The backbone of any of the numerous engineering papers published in this country is the weekly list of new engineering undertakings, showing manufacturers and others where they can place their goods. The goods of some of our readers are their teaching capacities, and we hope that both

teachers of science and employers of such teachers will use the columns of this weekly to make public their needs, that they may be the better filled. We appreciate that the commercial spirit is weak in the class to which we are appealing, but it is hard to believe that it is so weak as not to lead them to write us a postal the contents of which when published may lead to an improvement in their position.

COL. M. H. CRUMP of Bowling Green, Ky., is carrying on experiments to see whether the air from the so-called Grand Avenue Cave cannot be used for regulating the temperature of a proposed hotel at that point. We have already called attention to these experiments, and Col. Crump has advertised in *Science* constantly for some weeks for information on the use of cave air for such purposes, but none of the readers of *Science* have much to offer. The scheme is novel, and the prominent geologists of the country who have been consulted have expressed considerable interest in the outcome.

THE HORN-FLY.

THE knowledge of this pest now in the possession of the division of entomology of the United States Agricultural Department is sufficiently far advanced to enable it to present a preliminary article in the last number of *Insect Life*, giving the main facts ascertained. A more complete article will be published in the annual report.

Attention was first called to this pest in September, 1887, when Mr. I. W. Nicholson of Camden, N.J., wrote to the department, under date of Sept. 22, as follows: "Herewith I send some specimens of flies which appear to have made their first appearance about the middle of August. They are very annoying to cattle, but rarely settle upon the horses or mules. They gather in patches or clusters, particularly upon the legs, and are very active. I should like to know if they are common in other parts of the United States. They appear to be very numerous in all the counties near Philadelphia, yet I have seen no person who has observed them before this season."

Later letters the same season from Mr. Nicholson mentioned the common habit of clustering upon the horns, and the fact that after a severe frost in the middle of October the fly disappeared.

May 15, 1888, the same gentleman wrote that the flies had promptly made their appearance May 10, or a little before, in great numbers. A few days later the same insect was heard of in Harford County, Md., through Mr. George R. Stephenson, who reported its occurrence in that locality the previous summer.

By the summer of 1889 the pest had extended in numbers much farther to the southward, and the department was early informed of its occurrence in Harford and Howard Counties, Md., and Prince William, Fauquier, Stafford, Culpeper, Louisa, Augusta, Buckingham, and Bedford Counties, Va. The alarm became great. Considerable time has therefore been devoted to the study of the habits and life-history of the insect. This was done mainly by Mr. Howard, who made a number of short trips to The Plains, Warrenton, and Calverton during June and July. Later in the season Mr. Marlatt assisted in the work, which had been greatly facilitated by Mr. G. M. Bastable, Mr. David Whittaker, Mr. M. M. Green, and Mr. William Johnson, and particularly by Col. Robert Beverly. Aug. 20, Mr. Howard found the flies practically in Washington, — in Georgetown, — and the next day Mr. Marlatt found them in Rosslyn, at the Virginia end of the Aqueduct Bridge, so that further trips for material were not necessary.

The result of the summer's observations by these two gentlemen is that the life-history of the insect has been accurately made out from the egg to the fly through several consecutive generations, and that substances can be recommended which, from their experience, will keep the flies away for from five to six days; while from the life-history a suggestion as to preventives is made, which, under certain circumstances, will prove undoubtedly of great benefit.

Since this insect was first brought to notice, it has been felt that it was an imported pest. Its first appearance in the neighborhood of Philadelphia, and its gradual spread southward, have favored this idea. The fact that in this country it has spread with much greater rapidity towards the south than towards the north would seem to indicate that it is a south European species.

The exact time and place of the introduction, it is impossible to ascertain. Upon its first importation in small numbers, it was probably for some time unnoticed, and its first noticeable appearance may not have been at the point of importation.

All imported cattle from Europe pass through the quarantine stations of the Agricultural Department at either Littleton, Mass., Garfield, N.J., or Patapsco, Md., and an examination of the records develops one or two points of interest. Since 1884 only ten head of cattle have been imported into the country direct from France. All of these have passed through the New Jersey station, but their ultimate destinations have in no cases been within the regions now infested with the fly. The other importations have been from points like Antwerp, London, Amsterdam, Hamburg, Glasgow, Liverpool, Southampton, Hull, Rotterdam, and Bristol. The year 1886, immediately preceding the appearance of the fly, was marked by quite an extensive importation of Holsteins from Amsterdam and Rotterdam and London, through the Garfield station, mainly for parties in New York City. Over three hundred were imported, and an interesting point to investigate will therefore be the occurrence or non-occurrence of this fly in Holland.

The popular name which is here adopted — the "horn-fly" — has the sanction of popular use. It is sufficiently distinctive. The names of "Texas fly" and "Buffalo fly" and "Buffalo gnat" are also in use in some sections, and indicate an impression that the insect came from the West. Dr. Lintner uses the term "cow-horn fly."

The most prominent of the popular errors is the belief that the fly damages the horn, eats into its substance, causes it to rot, and even lays eggs in it, which hatch into maggots and may penetrate to the brain. There is no foundation for these beliefs. As will be shown later, the flies congregate on the bases of the horns only to rest where they are not liable to be disturbed. While they are there, they are always found in the characteristic resting position. Where they have been clustering thickly on the horns, the latter become fly-specked, and appear at a little distance as though they might be damaged; and it is doubtless this fact which has given rise to the erroneous opinions cited.

Mr. Howard's first impression upon entering the field, that the eggs would be found to be laid in freshly dropped dung, proved to be correct. He brought to Washington with him from Calverton dung dropped on the night of July 28, and exposed in the field during the 29th; and from this dung the first adult flies, five in number, issued Aug. 7, only ten days from the laying of the eggs. This settled the point of place of oviposition and breeding. It seemed probable that this was the only substance in which the species breeds, as indeed it is the only likely substance which exists in sufficient quantity through the pastures to harbor the multitudes of flies which are constantly issuing through the summer. However, many living females were captured, and placed in breeding-cages with horse-dung and decaying animal and vegetable material of different kinds, each isolated; and it resulted that a few oviposited in the horse-dung, and four flies were reared from this substance. There is no evidence, however, that in a state of nature the flies will lay their eggs in any thing but cow-dung.

The time and manner of oviposition were puzzling at first. After hours of close watching of fresh dung in pastures close to grazing cattle, not a single *Hematobia* was seen to visit the dung, much less to lay an egg. This close observation was made at all times of the day from dawn till dusk without result, while breeding-cage experiments were all the time proving that nearly all fresh droppings contained many eggs. With some hesitation, therefore, the inference was made that the eggs were presumably laid at night.

The question was, however, considered by no means settled; and, on the discovery of the fly at Rosslyn, Mr. Marlatt was directed to make especial observations upon this point. The first result was, that careful examination of dung dropped in the early

morning (prior to 7 A.M.) showed very few eggs, not more than eight or ten to a single dropping, while that dropped between 4 P.M. and later in the night contained still fewer. On a dung dropped between 10 and 11.30 A.M. in the hot sunshine, however, examination a few minutes after showed a large number of eggs, estimated at three hundred and fifty. Other very fresh droppings were examined, and the eggs were found to range from none at all to over three hundred. One animal was then fortunately observed, from close quarters, in the act of passing her dung. As the operation commenced, forty or fifty of the flies moved from the flank to the back of the thigh, near the "milk mirror;" and at the close of the operation they were seen to dart instantly to the dung, and to move quickly over its surface, stopping but an instant to deposit an egg. The abdomen and ovipositor were fully extended, and the wings were held in a resting position. Most of them had left the dung at the expiration of thirty seconds, while a few still remained at the expiration of a minute. Every individual had returned to the cow, however, in little more than a minute. This explains the previous non-success in observing the act of oviposition; for the Virginia cattle on the large stock-farms are comparatively wild, and, although the dung was examined as speedily as possible after dropping, the flies had already left.

The results, therefore, indicate that the eggs are deposited during daylight, chiefly during the warmer time of the day, between 9 and 4, and mainly between 9 in the morning and noon. They are laid singly, and never in clusters, and usually on their sides on the surface of the wet dung, seldom inserted in cracks.

After the eggs hatch, the larvæ descend into the dung, remaining, however, rather near the surface. When ready to transform, the larvæ evidently descend from the dung into the ground below from a half to three-quarters of an inch. Actual observations were made on larvæ in dung in breeding-cages where the soil was fine sand, affording ready entrance to the larvæ. Where the dung has been dropped upon hard ground, the probabilities are that they will not enter so deeply, and may indeed transform upon the surface of the ground at the bottom of the dung.

From the records it appears that from ten to seventeen days, say two weeks, is about the average time from the laying of the egg to the appearance of the flies; and with four active breeding months, from May 15 to Sept. 15, there will be eight generations. The flies will undoubtedly breed later than Sept. 15, but this time may be allowed to make up for the time occupied in the development of the eggs in the abdomen of the female. With seven or eight annual generations, the numbers of the flies are not surprising.

The flies were observed in the greatest abundance during July. They make their first noticeable appearance in Virginia early in May, and, from hearsay evidence, remain until "late in the fall" or until "right cold weather." Sept. 28, they were still as abundant as ever around Washington. The characteristic habit of clustering about the base of the horn seems to exist only when the flies are quite abundant. When they average only a hundred or so to a single animal, comparatively few will be found on the horns. Moreover, as a general thing, the horn-clustering habit seems to be more predominant earlier in the season than later, although the flies may seem to be nearly as numerous. The clustering upon the horns, although it has excited considerable alarm, is not productive of the slightest harm to the animal. Careful study of the insects in the field show that they assume two characteristic positions,—one while feeding, and the other while resting. It is the resting position in which they are always found when upon the horns. In this position the wings are held nearly flat down the back, overlapping at the base, and diverging only moderately at the tip. The beak is held in a nearly horizontal position, and the legs are not widely spread. In the active sucking position, however, the wings are slightly elevated, and are held out from the body, not at right angles, but approaching it,—approximately an angle of sixty degrees from the abdomen. The legs are spread out widely; and the beak, inserted beneath the skin of the animal, is held in nearly a perpendicular position. The fly, before inserting its beak, has worked its way through the hairs close to the skin. While feeding, however, the hairs which can be seen over its body do not seem to interfere with its speedy flight when alarmed; for at a fling of the tail, or an impatient turn of the head, the flies rise instantly in

a cloud for a foot or two, returning again as quickly, and resuming their former positions.

The horns are not the only resting-places; for, with the horns black for two inches above their base, we have seen the flies towards nightfall settle in vast numbers upon the back between the head and fore-shoulders, where they can be reached by neither tail nor head. When feeding, they are found over the back and flanks, and on the legs. During a rain-storm they flock beneath the belly. When the animal is lying down, a favorite place of attack seems to be under the thigh and back belly, around the bag. With certain animals the dewlap seems to be badly attacked, while with others this portion of the body is about exempt. Certain cattle, again, will be covered with flies, and will lose condition rapidly, while others are but slightly troubled.

On the horns the flies settle thickly near the base, often forming a complete band for a distance of two inches or more. They seem to prefer the concave side to the convex side of the curve of the horn, probably for the reason that the cow cannot scrape them off so readily; and one cow was noticed in which they reached nearly to the tip of the horn on the concave side of the curve only.

The amount of damage done by the fly has been exaggerated by some, and underestimated by others. Many rumors have been heard of the death of animals from its attacks, but not a single case as yet has been substantiated. It is believed that the flies alone will never cause the death of an animal. They reduce the condition of stock to a considerable extent, and in the case of milch cows the yield of milk is reduced from one-fourth to one-half. Their bites seldom even produce sores by themselves, although a number of cases have been seen where large sores had been made by the cattle rubbing themselves against trees and fences in an endeavor to allay the irritation caused by the bites; or, in spots where they could not rub, by licking constantly with the tongue, as about the bag and on the inside of the hind-thighs. A sore once started in this way will increase with the continued irritation by the flies, and will be difficult to heal. Those who underestimate the damage believe that the flies do not suck blood; but such persons have doubtless watched the flies only upon the horns or elsewhere in their resting position, when the beak is not inserted, or have caught them and crushed them when their bodies contained little blood. In reality, the flies suck a considerable amount of blood, however, and it is their only nourishment. If captured and crushed at the right time, the most sceptical individual will be convinced.

Almost any greasy substance will keep the flies away for several days. A number of experiments were tried in the field, with the result that train-oil alone, and train-oil with a little sulphur or carbolic acid added, will keep the flies away for from five to six days, while with a small proportion of carbolic acid it will have a healing effect upon sores which may have formed. Train-oil should not cost more than from fifty to seventy-five cents per gallon, and a gallon will anoint a number of animals. Common axle-grease, costing ten cents per box, will answer nearly as well; and this substance has been extensively and successfully used by Mr. William Johnson, a large stock-dealer at Warrenton, Va. Tallow has also been used to good advantage. The practice of smearing the horns with pine or coal-tar simply repels them from these parts. Train-oil or fish-oil seems to be more lasting in its effects than any other of the substances used.

A great deal has been said during the summer concerning the merits of a proprietary substance, consisting mainly of tobacco-dust and creosote, known as "X. O. dust," and manufactured by a Baltimore firm, as an application to cattle: and it has received an indorsement from Professor J. B. Smith, entomologist to the New Jersey Experiment Station. This substance has considerable merit as an insecticide, and will kill many of the flies when it touches them, although they die slowly, and a few may recover. The substance costs twenty-five cents per pound, and is not lasting in its effects. Where it is dusted through the hair, the flies, on alighting, will not remain long enough to bite; but two days later they are again present in as great numbers as before. A spray of kerosene emulsion directed upon a cow would kill the flies quite as surely, and would be cheaper; but it is not advisable to attempt to reduce the numbers of the pest by actually killing the flies.

Throwing a spadeful of lime upon a cow-dung will destroy the larvæ which are living in it; and, as in almost every pasture there are some one or two spots where the cattle preferably congregate during the heat of the day, the dung which contains most of the larvæ will consequently be more or less together, and easy to treat at once. If the evil should increase, therefore, it will well pay a stock-raiser to start a load of lime through his field occasionally, particularly in May or June, as every larva killed then represents the death of very many flies during August. Dr. C. V. Riley feels certain that this course will be found in many cases practical and of great avail, and will often be an advantage to the pasture besides.

THE KANSAS ACADEMY OF SCIENCE.

The annual meeting of this society was held at Wichita. Among the papers read was the following: "On Monstrosities in Flowering Plants," by W. A. Kellerman. The author illustrated what may be called extreme variations in the development of certain parts of plants. These are looked upon as interesting phenomena in botany, and deserve greater attention.

E. A. Papenoe discussed oviposition in *Tragidion*, and showed that this beetle places its egg within an elliptical case on the surface or bark of the chestnut, oak, and other trees. The egg is oblong, smooth, and dull white. The bark is not punctured, as is commonly the case with this class of beetles. Robert Hay read a paper on artesian wells, in which he showed by diagrams how such wells are possible, and what progress had been made in the West with these wells. The relation of artesian wells to irrigation in arid regions was discussed. J. T. Willard gave a brief description of devices and methods used in the analysis of agricultural products. He described a desiccating apparatus, a method of purifying ether, and a method to prevent foaming in boiling liquids. G. H. Failyer communicated the results of his work on nitric acid and ammonia in rain-water. These observations have extended through more than three years. The per cent is usually greater in smaller rains. About three pounds and a half of nitrogen are annually added to an acre of soil by the rains. But little continuous work has been done in this line in this country. F. H. Snow gave the results of his attempts at artificial spreading of contagious disease among chinch-bugs. It has been observed that a certain fungus is present where the bugs are dying in large numbers. The attempt was made to propagate this disease by sending the infected bugs to different parts of the State and to several other States. The result has been thus far successful, and the war will be pushed next season with the help of a lot of infected material which is being kept over. The same author showed the curve of mean daily temperature for twenty-one years at Lawrence, Kan. Among the interesting facts brought out, it may be noted that the average coldest day is Jan. 6; and the hottest day, July 15. There seems to be a remarkable rise in temperature during the first ten days of April, and a corresponding fall of temperature in November, thus showing a more sudden change of seasons than has been observed in some other States. Professor Snow has also made a discovery on the method of respiration of the salamander. In its final or air-breathing stage, a stream of water was observed passing into the mouth through each nostril, the mouth being opened eight or nine times a minute to allow the water to escape. Folds of mucous membrane in the posterior part of the mouth appear to perform the function of removing the oxygen from the inspired water. E. C. Murphy gave some tests of cements manufactured in Kansas. From these tests it was shown that the native cements are inferior in tensile strength, compressive strength, and transverse strength, to Portland cement. L. I. Blake gave the result of tests made in the physical laboratory on the insulation resistance of electric wires exposed to moisture. The wires were immersed in water, and daily tests were made for three months. The results were shown by a series of curves, and a remarkable difference in quality was observed. The underwriter's wire was especially condemned. The same author gave the results of experiments in telephonic communication between vessels at sea. W. S. Franklin presented a paper on classification of the sense of smell. D. B. Jennings gave the result of his observations on hot winds. Though the paper is too long to

be successfully abstracted, many interesting points were brought out. This is simply a preliminary paper on the subject.

F. O. Marvin exhibited an isogonic chart of the State of Kansas. There is shown to be an irregularity in the action of the needle in several contiguous counties. E. H. S. Bailey and E. E. Slosson presented a paper on the occurrence of celestite and associated minerals in concretionary formations in eastern Kansas. Complete analyses of the minerals will be published. E. H. S. Bailey also called the attention of the academy to the analyses of some Kansas mineral waters. Their occurrence and constituents were discussed. J. R. Mead gave a *résumé* of his observations on the occurrence of gold in Montana. L. E. Sayre gave the history and process of manufacturing binding-twine. In the discussion which followed, W. A. Kellerman suggested that perhaps some common weeds, like the velvet-leaf or the dogbane, might be used as a substitute for the more expensive fibres now in use. F. O. Marvin gave the result of a series of experiments on the second setting of cements. L. E. Sayre gave some notes on albuminoids, and also exhibited a novel and ingenious microscope attachment to be used to facilitate field-work in botany.

At the close of the meetings an excursion was made to the salt-fields of Kingman, where an opportunity was afforded to examine the practical work of salt-manufacture and salt-mining.

BOOK-REVIEWS.

Studies in Pedagogy. By THOMAS J. MORGAN. Boston, Silver, Burdett, & Co. 12°. \$1.75.

THE author of this work, who is the principal of the Rhode Island State Normal School, here gives the public a statement of the views on education to which his experience and reflection have led him. We cannot say, however, that there is much that is new or valuable in them; on the contrary, they are mostly of a commonplace order. Mr. Morgan rightly lays stress on training, or discipline, as of more importance than mere instruction; but there is nothing new in this idea, and we cannot see that he has any thing striking to offer in regard to methods of training. He lays great stress on the education of the senses and the imagination, and even proposes to have a special series of exercises for training the nose, which he characterizes as an organ of "neglected merit and overlooked modesty." He points out the importance to the teacher of a thorough knowledge of psychology, and also of a preliminary training in methods of teaching. He has a high conception of the function of the teacher, and of the qualifications necessary for their perfect performance. Mr. Morgan's views appear to us in the main sound and true; but they are so familiar that there seems to be no good reason for writing a whole volume for the purpose of setting them forth.

Seven Thousand Words often Mispronounced. By WILLIAM HENRY P. PHYFE. New York and London, Putnam. 12°. \$1.25.

THE editor of this book has produced already two books on pronunciation, — one "The School Pronouncer," and the other "How Should I Pronounce?"

That every one cares to pronounce correctly goes without saying. That every one, even if he may be reckoned among the well educated, does not necessarily know the accepted or most acceptable pronunciation of our mysteriously spelled English words, is equally true. But it is not always true that one seeking the recognized pronunciation of a word in dispute is willing to handle his big dictionary, even if he is so fortunate as to possess such; and, again, it not infrequently happens that the word may be a proper name, and proper names are sparingly treated in even the big quartos.

"Seven Thousand Words often Mispronounced" includes fully that number of words which, through inherent difficulty or carelessness on the part of the speaker, are liable to be mispronounced, with twenty-five hundred proper names.

There are the necessary introductory chapters on the sounds of the English language, — sounds both native and adopted or imported, as it were, from foreign tongues; it being the editor's idea that the adoption of so considerable a number of foreign words into

frequent use in English conversation calls for an appreciation, on the part of English speakers, of the sounds peculiar to these imported words. There are also the helps and suggestions as to the way of using the book. But the suggestion to use the book will be willingly accepted by all to whom it may be available, it is so well suited to its purpose.

The State. Elements of Historical and Practical Politics. By WOODROW WILSON. Boston, Heath. 12°.

THIS is one of the most ambitious books that we remember to have met with, but we are sorry to say that the execution is by no means adequate to the design. The work is mainly descriptive and historical, and attempts to give an account of all the more important constitutional governments on record, including those of Athens, Sparta, Rome, France, Germany, Switzerland, England, the United States, and several others. In the case of the United States, not only is the Federal Government described, but also those of the States, of the Colonies before the Revolution, and even of the counties, cities, and towns. But this is by no means all. The author has undertaken not only to describe these various governments as they now are or as they were at some particular epoch, but also to give a history of them all from the days of Homer to the present time. He has, besides, several chapters on the origin of government and on its nature and functions, on the nature and development of law, and so forth; and all this is crowded into one duodecimo volume. The necessary result is that the work is so condensed and so crammed with facts that it is almost impossible to read it through; and the broad outlines of the subjects treated are obscured by the mass of insignificant detail.

We are obliged to add that the author's conception of politics and political history seems to us defective. He confines his attention mainly to the mere machinery of government, the details of organization and administration, and has little or nothing to say on the all-important subject of the relations between the government and the people. The main question about any government is as to what rights it guarantees to the people, and how these rights are secured; but on these points Professor Wilson gives scarcely any information. His remarks, too, on the nature and functions of government are slight and superficial, and the philosophy of the book generally is very thin.

After finding so much fault, we are glad to add that the facts recorded seem to have been carefully and conscientiously collected; and, though we have not undertaken to verify them, we have no doubt they are trustworthy, and they also are pretty well arranged. The book has an elaborate table of contents, as well as an index; and it will, no doubt, be of considerable value as a book of reference, but it can hardly be used for any other purpose.

AMONG THE PUBLISHERS.

THE J. B. Lippincott Company have published a new edition, revised, of Professor Joseph P. Remington's text-book on the "Practice of Pharmacy."

— Sidney S. Rider, Providence, R.I., has in preparation for the series of Rhode Island Historical Tracts a "History of Privateering," as connected with Rhode Island during the Revolution (1776-83).

— D. Appleton & Co. have published a volume on the land question, entitled "The Land and the Community," by the Rev. S. W. Thackeray, with an introduction by Henry George; and a new edition of Bellamy's "Dr. Heidenhoff's Process."

— Beginning with the coming year, the *North American Review* will be printed on a larger page. Among the attractions of the year is announced a "Duel between Free Trade and Protection; a Great Discussion between Two Prime-Ministers, the Right Hon. W. E. Gladstone and the Hon. James G. Blaine."

— In view of the unceasing efforts for the suppression of the African slave-trade, interest will be taken in the announcement that Longmans, Green, & Co. are about to publish an authorized life of Cardinal Lavigerie, the primate of Africa, which will contain a full statement of the means by which he proposes to check this infamous traffic.

— "The Descendants of Palæolithic Man in America" is the subject of an article, by Dr. Charles C. Abbott, which will open the December *Popular Science Monthly*. It describes the surroundings and occupations of the men who made the rough pottery and the implements of slaty rock which Dr. Abbott has found so abundantly in the Delaware valley. Another of Professor C. H. Henderson's illustrated articles on "Glass-making" will appear in the same number. In this one the evolution of a glass bottle is picturesquely described. Some new phases in the Chinese problem will also be presented by Willard B. Farwell. The writer asks, in view of the wretchedness of millions of the Chinese at home, whether exclusion will exclude, and invites more thoughtful consideration of the Chinese problem, which is made especially serious by the peculiar constitution of the Chinese mind. Col. Garrick Mallery's American Association address on "Israelite and Indian" will be concluded in this number. This portion of the essay deals especially with the similarity in the myths and social institutions of the two peoples.

— One of the most accurate pictures ever given of the slums of New York will appear in *Scribner's* for December under the title "How the Other Half Lives." The author is Jacob A. Riis, for many years police reporter of the Associated Press, who has had every facility during his very active career to collect definite information on the subject. The illustrations are from flash-light photographs taken by the author. Edward J. Phelps, ex-minister to England, in his article in the same number, says, "Never since the creation has there come upon the earth such a deluge of talk as the latter half of the nineteenth century has heard. The orator is everywhere, and has all subjects for his own. The writer stayeth not his hand by day or by night. Every successive day brings forth in the English tongue more discourse than all the great speakers of the past have left behind them, and more printed matter, such as it is, than the contents of an ordinary library. . . . We certainly seem to be approaching the time when hardly any thing will be left to be said on any subject that has not been said before — perhaps many times over; when all known topics will begin to be exhausted."

— Professor Paul Haupt of the Johns Hopkins University is editing, in connection with Professor Friedrich Delitzsch of the University of Leipzig, a new periodical, *Beiträge zur Assyriologie und vergleichenden semitischen Sprachwissenschaft* ("Contributions to Assyriology and Comparative Semitic Philology"). The plan of such a series was conceived by Professor Haupt as early as 1878, but various circumstances prevented its realization. This new series will form a *pendant* to the quarto volumes of the Assyriological Library, edited by Friedrich Delitzsch and Paul Haupt, which now includes Haupt's "Akkadian and Sumerian Texts" and his "Babylonian Nimrod Epic," Bezold's "Achaemenian Inscriptions, with the Cuneiform Text of the Smaller Achaemenian Inscriptions," autographed by Professor Haupt, Strassmaier's "Alphabetical List of Assyrian and Akkadian Words," Lyon's "Sargon," Zimmern's "Babylonian Penitential Psalms," Delitzsch's "Assyrian Dictionary," Lehmann's "Samassumukin," Weisbach's "Second Species of the Achaemenian Inscriptions," and Bang's "Old Persian Texts." Due regard will be given to the principles of comparative philology, and this will be a distinctive feature of the contributions published in the *Beiträge*. Naturally the *Beiträge* will chiefly contain the work of the German Semitic School; though articles in other languages, especially in English, French, or Latin, will not be excluded. The editors do not propose to issue the journal at fixed intervals, but from time to time, as sufficient satisfactory material is at hand. Part I. of Vol. I. is now ready. Subscription and orders may be addressed to the Publication Agency of the Johns Hopkins University, Baltimore, Md.

— G. P. Putnam's Sons announce a new edition (the nineteenth) of "Haydn's Dictionary of Dates," brought down to the fall of 1889; a revised edition of Edward L. Anderson's treatise on "Modern Horsemanship;" the first volume of Charles Booth's "Labor and Life of the People," describing East London; "A History of Austro-Hungary from the Earliest Time to the Year 1889," by Louis Leger, translated from the French by Mrs. Birkbeck Hill, with a preface by Edward A. Freeman; "The First In-

ternational Railway and the Early Colonization of New England," a history of the railway system which opened Canada to the United States, together with an account of the settlement which established the English title to New England, both subjects being presented in a study of the life and writings of John Alfred Poor, edited by Laura E. Poor; "A Handbook of Precious Stones," by M. D. Rothschild; "The Sayings of Poor Richard," a collection of the wit and wisdom of Benjamin Franklin, edited by Paul Leicester Ford, in The Knickerbocker Nuggets Series; and "Thomas Jefferson's Views on Public Education," by John C. Henderson.

—J. B. Lippincott Company have in preparation George W. Child's reminiscences, a portion of which have been given in *Lippincott's Magazine*.

—Dulau & Co., 37 Soho Square, London, W., announce to be ready early in December "A Catalogue of British Fossil Vertebrata," by Arthur Smith Woodward, F.G.S., and Charles Davies Sherborn, F.G.S. The earliest list of British fossil *Vertebrata* was published by Samuel Woodward, in his "Synoptical Table of British Organic Remains," in 1830, and occupied two pages of the volume; while thirty-five years ago the late John Morris published a "Catalogue of British Fossils," of which fifty pages were devoted to this group. The present volume will consist of about three hundred and fifty pages, and will deal with the *Vertebrata* alone, tabulating the results of researches upon the British fossil forms of this group since the time of Linnæus. In the synonymy, the latest authorities have, for the most part, been followed, though a critical study of some genera has led to the adoption of certain modifications. The nature of the type specimen in each case is stated, and, whenever traceable, the museum or collection in which it is now preserved is mentioned. The type species of each genus, when founded upon a British fossil, is also distinctly marked. In order to render the work as complete as possible, the authors have consulted the publications of all provincial societies; most of the principal collections of British fossil *Vertebrata*, both public and pri-

vate, have been visited; and it is therefore hoped that all essential references to each genus and species are included. Special attention has been given to the distribution of the pleistocene *Mammalia*, every well-authenticated locality for each species being recorded. The work will be prefaced by a general introduction, giving particulars of the principal collections available to the student, and a table of the stratigraphical distribution of the genera. The published price will be 12s. 6d.; subscriptions (if received before Dec. 1), 10s. 6d.

—The author of "An Honest Hypocrite," a theological novel in the sense that its hero is a young clergyman who is troubled with doubts and fears after he has taken orders, is the Rev. Edward Staats de Grote Tompkins, who is the rector of a church in Troy, N.Y. Mr. Tompkins is a graduate of Yale College, and is of Dutch ancestry; his family having come from Holland, and settled in Westchester County, N.Y., in 1620, which refutes the charge that the story is autobiographical. A young Englishman in New York with whom Mr. Tompkins is acquainted, and whose waverings and doubts form the basis of the plot, gave him his leading motive. The book is really the author's own beliefs put into the form of a story instead of into a sermon. The point that is at once raised by this story is, "Is Christianity a sham, or is it not?" The question is not as to its theological, historical, or liturgical truth, but as to its actual practical workings. Mr. Tompkins denies the portraits he is said to have painted. The fashionable "Dr. Grady" is not the well-known clergyman he is supposed to be, nor is "Adrienne" intended for the Duchess of Marlborough. To be sure, the Duchess of Marlborough came from Troy, where the scene of the story is laid, but the author did not know her when she was a young woman. Her character was formed before he had the pleasure of meeting her. Such, in brief, is the idea of one of the most striking novels of the day, the readers of which may be interested to know that Mr. Tompkins is a young man and unmarried.

MACMILLAN & CO'S NEW BOOKS.

THE CRITICAL PHILOSOPHY OF IMMANUEL KANT.

By EDWARD CAIRD, LL.D., Professor of Moral Philosophy in the University of Glasgow, late Fellow and Tutor of Merton College, Oxford. 2 Vols. 8vo, \$7.50.

The object of this book is to give a connected view of the Critical Philosophy, showing the relation of the three "Critiques" to each other and to the other works of Kant, which may be regarded as illustration or developments of the main arguments. The first part, on the "Critique of Pure Reason," deals with the same subject as my former work entitled, "The Philosophy of Kant," but, except in a few passages, it is not a reproduction of it.—*Extract from Preface.*

Just Published, Volume Two, Completing Dr. McKendrick's work on Physiology.

A TEXT-BOOK OF PHYSIOLOGY. By JOHN GRAY MCKENDRICK, M.D., LL.D., F.R.S. Including Histology, by PHILIPP STÖHR. In two volumes.

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"It is in all respects an ideal text-book. It is only the physiologist who has devoted time to the study of some branch of the great science who can read between the lines of this wonderfully generalized account, and can see upon what an intimate and extensive knowledge these generalizations are founded. It is only the teacher who can appreciate the judicious balancing of evidence and the power of presenting the conclusions in such clear and lucid forms. But by every one the rare modesty of the author in keeping the element of self so entirely in the background must be appreciated. Reviewing this volume as a whole, we are justified in saying that it is the only thoroughly good text-book of physiology in the English language, and that it is probably the best text-book in any language."—*Edinburgh Medical Journal.*

HANDBOOK OF PRACTICAL BOTANY for the Botanical Laboratory and Private Student. By E. STRASBURGER, Professor of Botany in the University of Bonn. Edited from the German by W. HILLHOUSE, M.A., F.L.S. Revised by the author, and with many additional notes by author and editor. Second edition, revised and enlarged. With 116 original and 33 additional illustrations. 8vo, \$2.50.

HYDROSTATICS FOR BEGINNERS. By F. W. SANDERSON, M.A. 16mo, \$1.10.

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MODERN VIEWS OF ELECTRICITY. By OLIVER J. LODGE, D.Sc., LL.D., F.R.S. With illustrations. 12mo, \$2.00.

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TIMBER AND SOME OF ITS DISEASES. By H. MARSHALL WARD, F.R.S., F.L.S. With illustrations. 12mo, \$1.75.

MACMILLAN & CO., 112 Fourth Avenue, New York.

— Estes and Lauriat have published the "Salon of 1889," containing 100 photogravures of prize paintings, prepared by Goupil & Co. of Paris.

— Harper & Brothers publish "The Political Problem," by Albert Stickney, brought out by the discontent that can be observed in Europe and in this country with the practical working of existing forms of democratic government; "Winter in Algeria," written and illustrated by Frederick A. Bridgman; "A Little Journey in the World," a satire upon modern social life in America, by Charles Dudley Warner; "Cradle and Nursery," by Christine Terhune Herrick, advocating the treatment of "the baby" as a reasonable being.

— The publishing committee of the Appalachian Mountain Club announces the appearance, from the press of John Wilson & Son, of a volume with the title "Mountaineering in Colorado: the Peaks about Estes Park," by Frederick H. Chapin, one of the club's most widely known members. The book contains one hundred and sixty-eight pages. The work will be embellished with eleven full-page heliotype plates, besides other illustrations; all from photographs taken by the author upon expeditions described in the text. The work will have an interest for lovers of mountain scenery.

— P. Blakiston, Son, & Co., Philadelphia, make the important announcement of a "Chemical Technology; or, Chemistry in its Application to Arts and Manufactures," to be edited by Charles Edward Groves and William Thorp. Vol. I. is now ready, entitled "Fuel and its Applications," by E. J. Mills and F. J. Rowan, assisted by others, including Mr. F. P. Dewey of the Smithsonian Institute, Washington, D.C. This new edition of "Chemical Technology" is founded on that written by Richardson and Ronalds, and subsequently enlarged and rewritten by Richardson and Watts. As the German technology of Dr. Knapp was taken as the basis of the original, Richardson and Watts's work has long been familiarly known as "Knapp's Technology." The historical portions of the original have been retained, but supplemented by a full account of the methods and appliances introduced of late years in the application of chemistry to the arts. This work will be divided into sections, of which the most important are, "Fuel and its Applications;" "Lighting;" "Acids and Alkalies;" "Glass and Pottery;" "Metallurgy;" "Textile Fabrics;" "Leather, Paper, etc.;" "Coloring Matters and Dyes;" "Oils and Varnishes;" "Brewing and Distilling;" "Sugar, Starch, Flour, etc." The first volume treats of fuel and its applications generally; its special employment in various branches of chemical manufacture being reserved for detailed consideration in the volumes devoted to the special subjects enumerated above.

LETTERS TO THE EDITOR.

A Precocious Botanist.

ACCORDING to the "English Annals of Botany," vol. ii. p. 418, Jean Baptiste Lieury appears to have been unusually precocious, having published a paper in 1874 on Polyperous. He was born, it is affirmed, on Dec. 14, 1838; so his researches were perpetrated fourteen years before his birth, which was subsequent to his death, that having occurred on Sept. 3, 1883. For these unusual biographical data, the editors state, they are indebted to M. Eugène Niel of Rouen. Such cases of posthumous rejuvenation are fortunately very rare in this country. C. S. M.

The Champlain Period in the Susquehanna Valley.

I HAVE lately made some observations on the drift along the river at this point, — Harrisburg, — which I wish to report. This district, being only eighty-five miles from the Terminal Moraine, was consequently much influenced by the post-glacial floods.

The stream is very shallow; and its bed, composed for five or six miles of Hudson slates, is laid bare almost every summer, offering exceptional advantages for observing the overlying drifts. The deposit consists, for the most part, of clay variously intermixed with gravel. At one point I noted a bottom layer of gravel one foot thick, overlaid by twenty feet of fine clay. Scattered through the deposit are boulders of various sizes — the largest be-

ing from six to ten tons in weight — composed of conglomerate and sandstone from the mountains beyond.

The height of the drift varies, of course, with the local topography. From one hundred feet in the mountain-gorges, to thirty feet in the lowlands opposite Harrisburg, is a fair general average.

The width of the deposit is not very great, owing to the narrowness of the valley; still it has furnished ground for most of the towns in the neighborhood, Harrisburg itself being built to a great extent on a level flood-plain thirty feet above the present water-level.

At no place in this locality has the terrace formation been noted. One level flood-plain, of equal height on both sides of the stream, is all that marks the limit of the great post-glacial river.

HARVEY B. BASHORE.

West Fairview, Penn., Nov. 7.

INDUSTRIAL NOTES.

Microscopes and Photographic Supplies.

MR. MORRIS EARLE, of the late firm of Morris Earle & Co., 1016 Chestnut Street, Philadelphia, informs his friends and former customers that he is now a member of the firm of Williams, Brown, & Earle, 33, 35, and 39 South Tenth Street, corner of Chestnut. The new firm has been appointed sole agents in the United States for Messrs. R. & J. Beck of London, the well-known manufacturers of microscopes and "Autograph" photographic lenses. In addition to the manufactures of the latter firm, there will be a complete stock of goods of foreign or domestic manufacture pertaining to the business. Mr. Earle will give his personal attention to the photographic supplies, photographic printing, and microscopical branches of the business.

Sanitary Ventilation.

ONE of the most important sanitary problems of the day is that of the adequate ventilation of our schoolrooms, factories, churches, theatres, and other buildings in which many people are gathered together for any considerable time. Even in the best of modern dwelling-houses the atmosphere is none too good, while in crowded places, such as those mentioned, the air is positively poisonous unless proper means of ventilation are employed. The air exhaled in breathing contains, besides the vapor given off by the lungs, from four to five per cent of carbonic-acid gas, at least a hundred times the normal proportion found in pure air. This gas, though not poisonous in itself, is to some extent a measure of other impurities in the air which are poisonous, and, taking the place of the oxygen, obstructs respiration by preventing that necessary gas from being absorbed by the lungs.

Careful observations and experiments show that the air of a room designed to be occupied for any length of time should not be allowed to become vitiated to an extent indicated by the presence of six or eight parts of carbonic-acid gas in ten thousand. Yet careful analyses made some years ago showed that the average atmosphere in sixty schools in this city and Boston contained, in ten thousand parts, fifteen parts, the air in one of the schools containing thirty-one parts. The mean of the air in the New York theatres had twenty-six parts of carbonic-acid gas in ten thousand, one of them being vitiated to the extent of seventy-six parts.

For healthful ventilation it has been found that different quantities of air are required under different circumstances. One authority gives as the proper quantity of fresh air per hour for each person, in ordinary hospitals, 2,400 cubic feet; epidemic hospitals, 5,000; workshops for ordinary trades, 2,100, for unhealthy trades, 3,600; halls for long meetings, 2,000; schools for youths, 1,000.

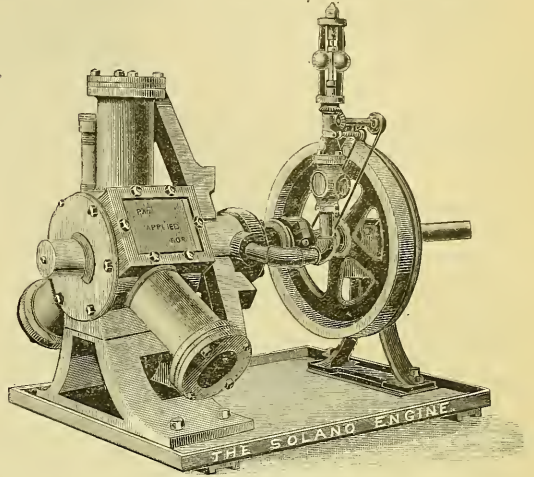
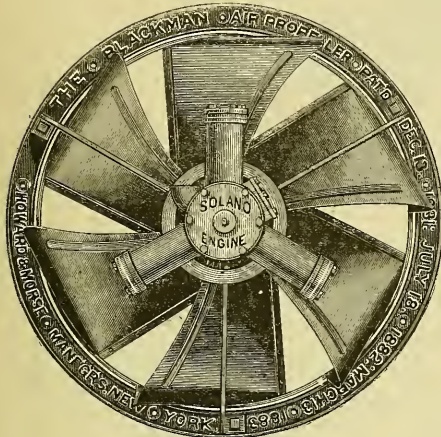
The problem of introducing this large quantity of fresh air into a building has been attacked from various directions, and with varying degrees of success. One method, much in use in this city, is that of positive ventilation, by means of a ventilator-wheel or air-propeller. One of these devices, the Blackman power ventilator-wheel, is now on exhibition at the American Institute Fair in this city, where it attracts much attention from persons interested in sanitary matters as well as from architects and builders. This wheel, and one of the means for actuating it, a high-speed steam-engine, are shown in the accompanying illustrations.

There are certain peculiar features about the Blackman wheel which entitle it to more than passing notice. It is said to be the only exhaust or blast fan made which takes in air at right angles to, as well as parallel with, its shaft, the peripheral flange increasing its supply area by about sixty-six per cent. As the amount of air removed and power required depend upon the area of the feed and delivery surfaces of air-moving machines, this wheel must necessarily give a maximum delivery with a minimum absorption

The fan, of course, may be driven by belt or electric motor, being adapted to any desired motive power.

The Merritt Type-Writer.

The little writing-machine shown in the accompanying illustration belongs to the class of type-writers referred to in these columns last week, and known as lever or single-key machines. The paper being placed in position on the rubber roll or platen, and the latter set at the proper point for beginning a sentence, the finger-key or

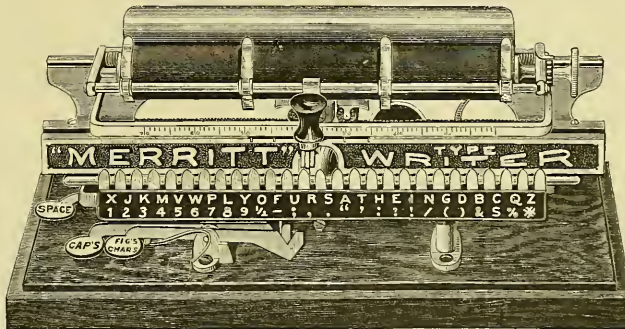


THE BLACKMAN AIR-PROPELLER AND SOLANO HIGH-SPEED STEAM-ENGINE.

of power. The actual air-propelling capacity of the wheel, as given by the manufacturers, is one million cubic feet per hour for each horse-power used. These wheels are giving satisfactory results in public halls, schools, theatres, mines, and other places, where they are used to remove vitiated air or to supply fresh air. They range in diameter from twelve inches to ten feet.

The Solano high-speed engine also possesses some features peculiar to itself. It has no dead centre, and can therefore be

lever is moved to the letter it is desired to print, and pressed down into a notch in the guide-rack. The types, which are the same as ordinary printer's types, are carried in a type-holder attached to and moved by the finger-key, and correspond in relative position with the letters on the index-plate. The movement of the finger-key to any desired letter, therefore, brings the corresponding type to the printing-point; and the depression of the key into the notch both locks the type-holder in position and forces the proper type up



started with the crank in any position; and the working parts are entirely enclosed and protected from dust. The pistons, of which there are three, are light and deep, and guide themselves in the cylinders. The valve motion is very simple, a single rotary valve being steam, exhaust, and relief valve all in one. The lubrication is entirely automatic, and, up to a speed of four hundred revolutions per minute, the only lubricator required is that on the steam-pipe, whence the oil is forced to all the parts needing it. This engine and the wheel or fan described, to the shaft of which it is attached, make a self-contained, compact, and efficient ventilating-machine.

into contact with the paper. Accurate alignment is secured by means of a type-guide.

This machine prints capitals, small letters, punctuation-marks, figures, etc., and its work is as clear and legible as that of the expensive key-board machines. It uses 78 ordinary printing-types, which are inexpensive to replace when worn out. The types are inked automatically, and no ribbon is used. A speed of sixty words a minute is claimed for it; the speed-test, of course, being made by the frequent repetition of a short sentence with short words, as in all type-writer tests of the kind.

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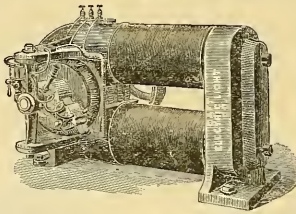
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CALENDAR OF SOCIETIES.

Anthropological Society, Washington.
 Nov. 5. — Romyn Hitchcock, The Shinto Faith; O. T. Mason, Anthropology at the Paris Exposition.
Philosophical Society, Washington.
 Nov. 9. — Asaph Hall, Saturn and its Ring; C. E. Dutton, Remarks on Irrigation in the Arid Region.

Appalachian Mountain Club, Boston.
 Nov. 11. — C. W. M. Black, Stony Mountain, the Pride of Blue Ridge; Frank O. Carpenter, The Great Smoky Mountains and Thunderhead Peak.

Engineers' Club, St. Louis.
 Nov. 6. — Mr. Winthrop Bartlett presented an informal paper on the "Olive Street Cable Road." The total length is 9.6 miles. The conduit is 39 inches deep. The Johnson rail, weighing 65 pounds to the yard, is used. The speaker gave the particulars of numerous details of construction. The road was built at the rate of 274.2 feet per day, counting every day between the time of starting and finishing. Interesting information on the subject of the horse-power required under varying conditions of service was given. The enormous fluctuations of power were shown by an indicator card, in which the power varied from 136 horse-power to 609 horse-power within one minute. The percentage of power required to drive the cable only, as compared with the total power used, was about 50 per cent, much lower than on other roads. A number of practical points of experience were explained, with details of improvements that had been made. Messrs. Russell, Johnson, Seddon, and Hubbard took part in the discussion of this paper. The hour being late, it was ordered that Professor Potter's paper on "Fuel Gas" be made the special order of the next meeting, Nov. 20.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

Morris's "British Butterflies," Morris's "Nests and Eggs of British Birds," Bree's "Birds of Europe" (all colored plates), and other natural history, in exchange for Shakespeareana; either books, pamphlets, engravings, or cuttings. — J. D. Barnett, Box 735, Stratford, Canada.
 I have *Anadonta opalina* (Weatherly), and many other species of shells from the noted Koshkonong Lake and vicinity, also from Western New York, and fossils from the Marcellus shale of New York, which I would be

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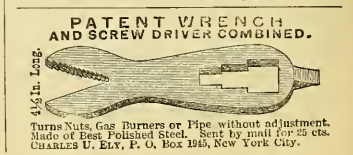
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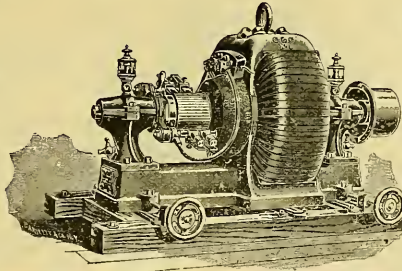
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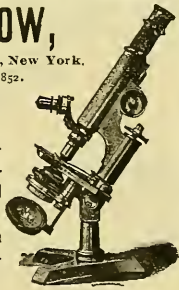
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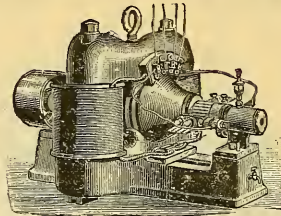
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VOL. XIV. No. 355.

NEW YORK, NOVEMBER 22, 1889

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LEATHER LINK BELTING.

THE first impression on seeing a piece of linked belting such as we show illustrations of in this week's *Science* is that the inventor has gone far astray to make a complicated arrangement to take the place of the simple band of leather we are all so familiar with as

the contacts of the older form of linked belting, and of that with this so-called American joint, on a curved faced pulley.

The last illustration given (Fig. 4) shows the belting as used in driving a dynamo, the slack side of the belt being on top. In this way the amount of contact with the pulleys is considerably increased and the slip correspondingly diminished. At one time it

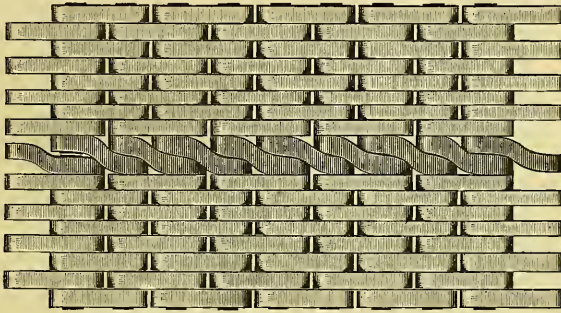


FIG. 1.

used in transmitting power. It is only a few years since such belts were first introduced into this country, and till recently they have been looked on as more novel than useful. But as now made they are said to have proved their capabilities of doing all that the old solid belts would, and more. Their great flexibility is one of the

was supposed that this new belting would give the best results with slow-running machinery; but the actual tests, it is claimed, show it to be well adapted to the fast work called for in driving dynamos.

It will be readily seen that the making of an endless belt is a

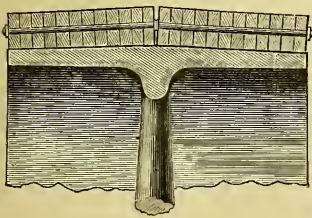


FIG. 2.

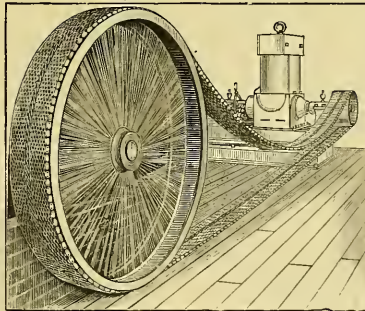


FIG. 4.

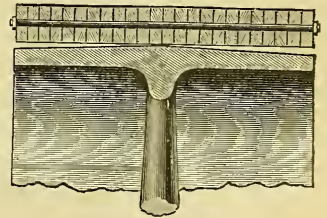


FIG. 3.

LINKED LEATHER BELTING.

strong points in their favor, as they can adjust themselves to almost any angle, so that they can be used in positions where the shafts are out of line with each other, and the belt needs to be twisted.

In the centre of the belt, as shown in Fig. 1, is a series of twisted links. These enable the belt to bend transversely, so that it can adjust itself to the rounded face of a pulley. Figs. 2 and 3 show

matter of passing rivets through the links at the point of union, and that such a belt can be made longer or shorter with but little difficulty.

It has thus resulted that a most eccentric invention has apparently found its place among those that make modern machinery more effective.

NYASSA-LAND AND ITS COMMERCIAL POSSIBILITIES.¹

THE rapidity with which the geography of Africa — the New World of the nineteenth century — has been opened up to the knowledge of Western civilization during the last forty years, has left very little to be filled in on our charts of the Dark Continent. As a natural sequence to the delineation of the strictly geographic features of the country comes the desire to know something of its climate, products, inhabitants, and resources. Added to the ever-increasing pressure caused by the increase in population, is that love of adventure which marks us as a nation, and leads the upper classes to speculate in travel, and the lower in emigration. Is Africa a suitable field for immigration? Does its vast area produce such articles as European civilization requires? Will its peoples and tribes buy our calicoes and manufactures, and have they any thing to offer us in return? These are the questions which have usurped the place of the vague wonder as to what lay in the unknown interior. We are concerned only with one comparatively small portion of this vast continent; and we deprecate criticism, *ab initio*, by saying that even of this portion we must speak largely by inference, analogy, and report.

By "Nyassa-Land" we include that country discovered by Livingstone, and the scene of his last wanderings and death. Roughly speaking, it is bounded on the north by the southern shores of Tanganyika and the borders of the Kongo Free State; on the west, by Lakes Bangweolo and Moero, and the Kongo Free State; on the south, by the Zambezi; and on the east, by the Shiré River, Lakes Shirwa, Nyassa, and Leopold.

Nyassa-Land has during the last year and a half come prominently into notice. Certain influential exponents of British thought and feeling have taken up once more the question of the slave-trade. The consensus of evidence of men so different in character and thought as Livingstone, Lavigerie, Cameron, Elton, Stanley, and Johnston, is not to be gainsaid, and British national feeling has once more proved itself on the side of the oppressed. It was generally agreed that Nyassa was one of the centres of the slave-trade. It had been, moreover, for many years the sphere of perhaps the strongest missionary effort in all Central Africa. Here for over twenty years the Universities' Mission had worked, and spent many thousands of pounds and many noble lives. Here for the last fourteen years the Scotch churches had been working with untiring zeal, founding some dozen stations; and closely following on these a trading company, in its origin largely philanthropic, and founded at first as a lay mission society, had established trading-centres along all the area occupied by the missions; while even private philanthropy had expended large sums in the construction of the "Stevenson" road, between Tanganyika and Nyassa. No wonder that those interested in the suppression of the slave-trade turned their attention to Nyassa-Land, discovered and exploited by British, and the centre of so many and such successful efforts by our countrymen for its good. By a strange coincidence, at the moment that the question of Nyassa began to assume such prominence as a centre of the slave-trade, and on account of the action of Portugal towards our missionaries and traders, and their hardly concealed threats of annexation, — at this same time a new prominence was given to the country by the news that the slave-traders had attacked one of the trading-stations on the lake, and that the British were fighting for their lives. The history of that siege, of which Consul O'Neill was the hero, reads like a page of fiction, — six white men, holding their own against an army of Arabs, utterly cut off from assistance, voluntarily remaining rather than haul down the British flag, slowly firing their last rounds of ammunition one by one! Had that story been told as was the story of Rorke's Drift, England would be aware that she had six new heroes.

It is our firm belief, that, for a country to be developed and civilized, any scheme set on foot must have a sound commercial and practical basis. This is the keynote of Sir John Kirk's creed, than whom no man has been more practically successful in Africa.

What, then, are the inducements offering for commercial enterprise in Nyassa-Land? Let us first view it from the standpoint we have already taken, the development of what has been already initiated in the past. The carrying-trade for the missions alone is

sufficient, in our opinion, to pay dividends to a small company. Undoubtedly the route to Central Africa, the quickest, far the cheapest, the easiest, and healthiest, is by the waterway of the Zambezi, Shiré, and Nyassa, to Tanganyika. All the necessary supplies for the missions along this route, together with calico for their payments, should pass through the hands of the company on Nyassa, including the supplies of food and calico for those settled immediately around Tanganyika, both in the Kongo Free State on the west, and the numerous Arab settlements on the east; for around each mission station there grows up rapidly a desire for some of the rudimentary necessities of civilization. The ideas of decency and of cleanliness are encouraged by mission settlements, and thus the two first wants of calico and soap are rapidly developed. These, together with salt, a chronic savage want, and metal wire and beads for personal adornment, are essentially the pioneering elements, and indeed constitute the money of the country, for which the natives are willing not only to bring their produce, but to work by the week or month. These things, too, are largely required by the Arabs, and to a less degree by their followers; and, as they can be imported to the north of Nyassa at just about half the price which the Arabs can bring them for, a large trade might be done with these people, who are keen traders, and only too ready to see on which side their interest lies; while, if such commodities were supplied to them at the lowest prices compatible with small profit, the great extension of our trade would amply, we believe, cover the loss consequent on the reduction of present prices, while the prosecution of trade relations would tend to bring about a closer connection between them and the white men, and so to disarm the present feeling of mistrust and hostility. In return for these articles, we should get from the native chiefs (1) the entrée into the country, with ready permission to settle near them and so to exploit and develop the mineral wealth of the country; (2) in actual payment, ivory and such other local products as we shall speak of hereafter. From the Arabs we should get (1) we hope toleration, for we must ever bear in mind that at starting we should be utterly unable to cope with the united Arab power in these regions; (2) in actual payment, ivory, of which the Arabs are by far the best collectors. From the people themselves we shall get manual labor, porters for transport, and some minor products. The two former are the great desideratum for exploiting the country or working its minerals.

In this way the existence of the missions is a direct encouragement to trade. We have said that there is a constantly growing demand for calico and other trade goods. Let us as briefly as possible see what the country has to give us in return. One thing only, in our opinion, will pay for the initial expense of exploitation and the subsequent heavy transit expenses, and that is mineral wealth. We know for certain now that gold exists close to the lake shore. Years and years ago, alluvial gold, and also copper, were brought by the natives from Katanga. There is very good reason to believe that the gold-bearing quartz reefs south of the Zambezi extend probably from south-west to north-east through this district, towards Moero and Katanga. Asbestos has been found on the north-west shore, coal on the east, while iron and copper are worked by the natives themselves. We have, then, very fair grounds for believing that this country will repay by its mineral wealth the initial cost of exploitation. Its other products are in a sense valuable, but would not, in our own opinion, ever of themselves alone pay dividends to a large company. Of these, at present, the most important is ivory; but by far the greater part which finds its way from the interior is "dead ivory," i.e., tusks which have been kept for years, possibly for centuries, by chiefs in the far interior, who were ignorant of its value, and used it as ornamental door-posts, etc., and who now part with it to the Arab traders who have penetrated to their lands, in exchange for trade goods. This is, *ipso facto*, a decreasing product; and no less so, we think, is the "green" or newly killed ivory. Where only a year before large herds of elephants were to be met with daily, the writer has wearily followed tracks day by day without seeing a single elephant. The importation of guns and powder is responsible for this sad destruction. Native hunters shoot down remorselessly, not merely cows, but calves of any age, content to slaughter the latter to gorge on their flesh, if they have no tusks to extract; while the unfortunate

¹ Paper read by Capt. F. D. Lugard of the English Army, before the British Association at its recent meeting.

fact that the African cow-elephant carries tusks renders her, even in the eyes of European sportsmen, a legitimate prey, and the enhanced value of cow-ivory compensates for the lesser weight of her tusks as compared with the bull. Once more we would urge that the utmost endeavor be made to check this reckless slaughter. The writer has had charge of close on sixty government elephants in India for some considerable time, and again in Burmah, and may therefore claim, perhaps, to speak from some personal experience of the great services this animal, when domesticated, is capable of rendering. In a country where the horse, the ass, and the bullock — the two former imported at almost prohibitive expense — are all subject to destruction by the tsetse-fly, as well as the numerous diseases peculiar to a tropical country, the elephant, if domesticated, would be simply invaluable as a transport animal.

Second only, indeed, to the discovery of a payable export, is an efficient means of transport, to replace the slave-labor of the Arabs, and the expensive and unsatisfactory portage which the white man has at present to employ. Of other products which, after development, would form payable exports, the most important is perhaps coffee. The coffee-shrub is, we believe, indigenous on the Zambezi. On the Shiré highlands it has been cultivated with the greatest success by Messrs. Buchanan at Lomba, the Lakes Company at Mandala, and the Mission at Blantyre. At these places very large areas are now planted with fine healthy coffee-shrubs, bearing well. Tea, we believe, has been lately experimented with, but so far we are unable to say with what result, though from the analogy of India we should predict a success. Cloves and cinchona-bark should also do well. All these, being of small bulk in comparison to their value, should be lucrative articles of export, and should grow equally well on the highlands between Nyassa and Tanganyika on the north, and Bangweolo and Moero on the west. From the lowlands we may add rubber as a payable export. Several kinds of rubber-vine grow profusely at the north of the lake. At present this trade is completely untouched.

In addition to these primary products, which need time for their development, there are a large number of minor ones, which, though we think that they would not in themselves offer adequate returns for money invested, would nevertheless materially lessen the initial expenses. The conveyance of European supplies, porters, arms and ammunition, building and other material to the north of the lake (at which place we would advocate a considerable depot), together with the ordinary mission carrying-trade, will necessitate the steamers going northwards with full cargoes. On their return journeys they could be loaded with some of the secondary, less valuable, and more bulky products which we are about to enumerate.

But, in our opinion, most of these are more valuable for local use and manufacture than for export, and by means of such an application of indigenous products the cost of stations in the interior might be largely reduced by the reduction of European supplies at present necessarily imported. A favorable instance of such is the Misanguti tree. This most picturesque of trees produces an incredible number of fig-shaped fruit-pods, each of which contains from four to six scarlet beans, and each bean is saturated with oil. They are used by the natives for food; and the oil, too, is extracted by boiling. When cool, this oil or fat is solid, even at a tolerably high temperature, and has the appearance of beeswax. It burns well as a night-light, and, mixed with beeswax (an easily obtainable local product), would have sufficient consistency to make candles, and thus save one article of present import. We believe, also, that it would make excellent soap; and it is not expecting much to assume that the potash and alkalis for this manufacture could be locally found. A certain quantity, indeed, could be obtained from the large quantities of wood-ash produced by the steamer-fuel. This would not only save the import of soap for consumption, but might even supply one of the staple articles of barter. The Misanguti, moreover, supplies from its bark a capital mahogany dye; and from the fact that the natives use it to dye their fishing-nets, and from the oily properties of the tree, it is presumable that it has very highly preservative properties. The wood of this tree is hard and valuable, and, as far as we could judge, its presence and shade were not injurious to vegetation, so that it might be largely cultivated in areas devoted to cereal crops. Lastly, we would suggest

the experiment of an oil-cake made from its beans as a food for cattle and asses.

Another product of the country, at present almost wholly neglected, is hides. The Wa-Mambwa, Wa-nkande, and Angoni tribes possess enormous herds of cattle, and, except for the making of war-shields, the hides of these are little used. The hides of the buffalo, of which there are thousands in the plains at the north of the lake, being too heavy for this purpose, are entirely wasted. The great bulk of raw hides prohibits their export on the present small steamer, and would at any time be a serious detraction from their value as an export at such a distance from the coast. To obviate this, we would advocate the formation of crude tanning-pits, with the object of removing such portions as are unnecessary, and of softening the hides sufficiently to make them packable into a smaller bulk. One of the commonest trees in that district is the thorny acacia, called in India the Babul, in which country its roots and bark are largely used for tanning purposes. The forest, too, abounds with astringent fruits and berries; such as the Owlah (dear to sportsmen), and others of whose names we are ignorant. The collection and preparation of these hides would afford employment to those in inland stations; and these semi-tanned hides would largely assist in meeting local necessities, such as camp-beds, tenting, or taking, in fact, to some extent, the place of waterproof sheeting. There are, moreover, many kinds of oil-seeds (such as the ground-nuts, etc.) and of dyes which would supply the return cargo for steamers. Of other European necessities, sugar is already manufactured at Lomba by Messrs. Buchanan, and its quality is improving yearly. Wheat, linseed, flax, cotton, and perhaps indigo, we think, could be grown on the highlands, and a fair substitute can be made for wheat-flour from the local grains. Of tea and coffee we have already spoken. Opium has been successfully cultivated at Mopea on the Kwakwa for many years, and under Mr. Addison's energetic management and improved methods the company has lately renewed its vitality. Butter and cheese can be made for local consumption in the cattle-producing districts. At present these European necessities are imported. Another valuable secondary product is fibre. From the coir fibre of the Borassus palm, to the soft down of the cotton-tree, the land produces endless fibre.

Acres, nay forests, of plantain surround every Nkonde village, and the plantain fibre rots on the ground. From this, and from the bark of various trees, the natives are very clever at making rope of every size, from twine to a cable, which they call *malusi*; but being prepared green, and without the fibre being properly separated and interwoven, it becomes brittle when dry, and does not last long. They make also baskets and very superior mats of plantain-fibre. There is, however, a species of hemp which grows very freely, and of which I am informed the fibre is singularly tough, which might form a valuable article of export in the form of tow. Doubtless investigation may bring to light many valuable drugs (the *Strophanthos* proved an El Dorado till the market was glutted); while among the many lovely plants (the wild gladioli and other bulbs, the gardenia-like flowering shrubs, the tree orchids and the ferns) many species may command a sale in the British market, and help to make capital, while the more extended schemes which are to produce the dividends of the future are being developed.

The timber on the highlands is small and of no great value; but in the lowlands there are several kinds of valuable timber-trees indigenous to the country, while ebony and other ornamental woods are, we believe, found on the Shiré. Many kinds of imported trees thrive excellently both on the highlands and at the level of the lake. Of these, the mango is doing well at Bandawe, and has grown for very many years on the Zambezi, imported by the Portuguese Jesuits: it is valuable both for its fruit and timber. The Neem, valuable for its oil and the medicinal properties of its bitter leaves, the blue gum and other eucalypti, the Gold Mohur tree, orange, lemon, and loquots, also grow well, and prove that other trees growing in the same latitude and at the same altitude as those do in India would also thrive in Africa. Of such, the two great timber-trees, the teak and the Sal, would be worth introduction, as also the useful Mohwa tree; while, by the analogy of India, the oak and other timber-trees of England should do well on the higher plateaus.

In conclusion we will endeavor to answer the question as to the suitability of the country for immigration. The Shiré highlands, with their cold, bracing air, have proved by the test of many years to be well adapted to the conditions of European life. Scotch and English ladies have lived there in excellent health, and their children are robust and healthy. If this be so, we think that the still higher plateaus farther inland should prove healthy, and capable of producing the vegetables and other minor necessities of European life. But to attain these highlands, the malarious coast district must be passed through, and the graves of many ladies in this area prove its deadly influence. The first requisite, therefore, is a means of rapid conveyance from the coast, together with more fully developed means of accommodation and comfort. The opening-up of the navigation of the Zambezi from its mouth, thus establishing a direct communication with the sea-going steamers, would largely effect this, and the new steamer of the Lakes Company now put on the river leaves nothing to be desired for comfort. Enthusiasts may even picture the time when the railway — already projected — from the Cape shall be extended from Kimberley to the Zambezi, and so the malarious coast district be avoided altogether. But even the coast area itself has long been peopled by British Indian settlers, who have penetrated the whole length of the Kwakwa. The shores of the lake would be admirably suited for Indian immigration. We would, however, urge that such immigrants be drawn from northern India.

Nyassa-Land is a country, as Lord Salisbury recently said, discovered by British, opened up and to some extent civilized by us, and its possibilities we honestly believe to be great. Its climate is for the most part good, its scenery picturesque and enchanting. The time has come for its development and gradual civilization, and Britain must decide now or never, whether this opportunity is to be ours, or whether this land — historical in its past associations with the names of Livingstone and his many successors, and full of promise for the future — is to be ours, or to be left to the Arab slave-dealer for the present, and the fortuitous exploitation of some European nation in the further future.

HEALTH MATTERS.

Immunity and Immunization.

DR. H. BUCHNER has recently published a new study of this subject, and *The Sanitarium* gives the following résumé of it: Immunity in its full meaning signifies a condition of the body which permanently opposes the development of infectious processes; but there are conditions which act transiently in the same way against the danger of infection already existing. Buchner exemplifies this by a person attacked with typhus. In this case the disease, the continuous multiplication of bacilli, is not terminated before all tissues acquire transient immunity against the fungi. But what are the means by which the organism acquires immunity in a permanent or transitory way? To answer this question, Buchner first refers to Pasteur's protective inoculation, the actual efficiency of which is generally admitted at the present time. Buchner calls it a great triumph that it should be possible to immunize a living organism in this way without hurting its tissues.

Again, another means of immunization comes from France. Chamberland and Roux have injected intra-peritoneally the chemical substances of bacteria (ptomainia) in experiments on animals affected with malign œdema and with anthrax, without taking the bacteria themselves. The animals were actually rendered resistant to inoculation with living bacilli of the corresponding disease. This discovery is practically very important, inasmuch as the effects of chemical agents for the purpose of immunization are certainly more accurately measurable than those of living fungi. Theoretically the discoverers neglected drawing the necessary consequences from their results, and this has been done by Buchner with zealous energy. He prefaces his developments with a discussion of the means by which transitory immunity may be obtained. It might be possible to neutralize specific ptomaines in the organism by means of certain substances, just as Behring succeeded in decomposing the ptomaine of cholera-vibrios, cadaverine, by means of iodoform. Nature uses inflammation as an antidote against the invasion of fungi. Ten years ago Buchner pointed to this re-action

of the organism by which it acquires transient immunity, but at the present day he disposes of proofs for his hypothesis. In a former paper, Buchner has described anthracic pneumonia produced by the inhalation of anthrax bacilli. Its symptoms are those of a sero-fibrinous hemorrhagic pneumonia. In the alveoli there is found an exudation abounding in cellules and an immense quantity of anthrax bacilli. On the other hand, the pulmonary capillaries and the larger vessels were absolutely devoid of bacilli, the spleen containing only a very few of them.

For the purpose of investigating the modus by which the agents of infection are arrested in their further invasion, Buchner has lately instituted some experiments, which led to the conclusion that "inflammatory re-action not only possesses the power of arresting the passage of bacteria through the pulmonary surface, but actually to cause degeneration of the infectious bacteria, and consequent destruction." It is not permitted here to give in detail the interesting experiments which Buchner, jointly with Dr. Schickhardt, has performed on animals infected with anthrax bacilli. The microscopical result confirmed Buchner's hypothesis that inflammation originates in consequence of the bacillus, but that conversely, once originated, it induces degeneration in the bacillus, and may doubtless cause its complete decay. The latter hypothesis is corroborated by the shapeless agglomerations of granules which are found, and which represent a transformation of the bacilli.

In accordance with the fact of an antibacterial, immunizing action of inflammation, Ribbert and Lahr have ascertained, after injecting staphylococcus aureus into the trachea, that the local inflammation prevents the bacteria from penetrating into the organism, and subsequently causes them to degenerate and to die. Emmerich, and similarly Paulowski, have tried already to utilize these experiences in a practical way, — the former by his experiments with injection of erysipelas cocci in animals affected with anthrax, the latter by establishing the fact that even simple saprophytic fungi have a restraining curative influence on simultaneous anthracic infection. It may be possible in some other way, as tried already by Landerer by means of Peruvian balsam, to create in the organism a condition of excitation which might be used as a means of immunization. Through what kind of chemical and microscopical conditions an inflammatory excitation, or immunity acquired by protective inoculation, may act deleteriously on the bearers of infection, is explained on the results of Metschnikoff's well-known phagocytic theory. In Buchner's opinion, this theory constitutes one of the greatest additions to our morphological and physiological conditions of infectious processes.

Metschnikoff's doctrine, opposed from many sides, draws its principal importance from the fact of having demonstrated that viable, pathogenic bacteria may indeed be devoured by cellular elements. It explains how leucocytic and other cellular elements migrate into certain tissues in a condition of inflammatory excitation, and, exposed to infection, there display their phagocytic action. It is true, Buchner does not consider every thing explained by this process alone. On the contrary, a certain chemical reaction and concentration of the different tissue-fluids seems to be necessary for the debilitation and destruction of the fungi. Buchner, on the ground of experiment, is inclined to suppose the existence of fluid substances which, formed by the febrile process, have an antibacterial action.

This explanation being quite satisfactory for transient immunity, there are other processes to be considered in permanent immunity. Voit's experiments in Buchner's laboratory have recently furnished the proof that the organism possesses in the living blood-plasma chemical properties of this kind, deleterious for bacteria. Living blood, generally, is an unfit alimentary substratum, but by a change of its quality it may become a proper medium, and in this case a morbid affection of the organism would take place; the period of incubation would then be the time in which the blood is still possessed of those properties which arrest the bacteria in their growth, or possibly even destroy them. Immunity, then, would represent a permanent power of the organism to maintain the period of incubation. The question, in what way transition to actual morbidity is prevented, is answered by Buchner, availing himself of the experimental results obtained by Chamberland and Roux, by the suggestion that it is the adaptation of the organism to the spe-

cific virus which makes the latter gradually lose its pathogenic properties. This very supposition of adaptation underlies protective inoculation with attenuated specific fungi, as well as with dissolved specific products of decomposition.

INOCULATION AGAINST INFLAMMATION OF THE LUNGS IN CATTLE.— At the end of last year the Prussian minister of agriculture ordered experiments to be made on cattle, in order to decide the extremely important question whether inoculation affords protection against infectious inflammation of the lungs in cattle or not. These experiments, according to the *Lancet*, were carried out under the superintendence of Professor Schütz and the departmental veterinary surgeon Steffen, in the government district of Magdeburg, and have recently been finished. On Oct. 8 last, twelve young bulls were inoculated with fluid and particles from diseased lungs, — three with warm and three with cold fluid, three with warm and three with cold particles. Those inoculated with warm fluid contracted the disease most severely. On Oct. 26 all twelve, along with four uninoculated animals of the same age and breed, were placed among cattle suffering from infectious inflammation of the lungs, and their noses were repeatedly brought into the closest contact with those of the diseased animals for hours together. In December and in January all the animals were killed, and the post-mortem showed that the twelve inoculated animals had remained healthy, and that three of the four uninoculated ones had contracted the disease. The experiments were now repeated, special care being taken that all the animals (inoculated and uninoculated) were exposed to as nearly as possible equal degrees of infection, and that the fluid used for inoculation was taken warm from the lungs which had proved most effective. On Nov. 9 twelve young bulls were inoculated with different quantities (0.05 to 1.0 cubic centimetre) of warm lymph. The quantity of the fluid used did not affect the intensity of the local process. One bull died on the thirty-fifth day after inoculation, of peritonitis, caused by the spread of the inoculation process. On Dec. 1 the inoculated bulls were placed among bulls suffering from infectious inflammation of the lungs, but did not contract the disease. On Jan. 27 they were taken to another stall, and again placed among bulls suffering from the disease in question. On April 12 the eleven inoculated and two uninoculated bulls were inoculated with warm lymph between the neck and the breast, after which the two latter became severely ill, and one of them died. The previously inoculated animals, on the other hand, showed only slight symptoms at the place of inoculation. On April 12, twenty grams of warm lymph were mixed with 2,000 of warm sterilized flesh-broth, and sprayed before the nostrils of the inoculated animals. They remained healthy. On May 13 they were again placed among others which were suffering severely from the disease in question. After this, no morbid symptoms were observed in them. On June 26 one cubic centimetre of warm lymph was injected into the lungs of each of the inoculated and of two uninoculated bulls. The inoculated animals remained healthy, while the two uninoculated ones contracted the disease in a very severe form, and one of them died. At the end of July the inoculated animals were killed and dissected, and no abnormal developments were found. It therefore now seems to be proved that cattle inoculated with fresh warm lymph are protected against infectious inflammation of the lungs.

THE HEARING OF SCHOOL-CHILDREN.— Over nine thousand children have been examined in the schools of the following cities, — New York, Stuttgart, Bordeaux, Munich, and Glasgow, — and the average of defectively hearing pupils is 26 per cent plus. As a comparison test between children who were regarded as bright and those considered backward and dull scholars, teachers were requested to make a selection of seventy of each group. The results of the examination of the two sets, says the *British Medical Journal*, show twice as many with defective hearing among backward children as among the forward children. Some of the advice given to teachers would be, keep in mind the liability of existing impairment of hearing in the backward children. Children known to be suffering from defective hearing should be given seats nearer the teachers, and with their best ear towards the desk. When the defect is considerable or extreme, they should be taught in separate

classes. All boxing of the ears of children should be stringently prohibited.

CONFECTIONERS' DISEASE.— A disease peculiar to confectioners has been recently observed in France. It occurs principally in persons engaged in the manufacture of candied fruits and *maron glacés* or candied chestnuts. Five cases observed by Dr. Albertin of Lyons, described in the *Gazette Hebdomadaire*, March 19, 1889, well illustrate the nature of the disease. The affection is restricted to the nails of the hands, and usually first makes its appearance at the sides of the nails, the periungual portion becoming loosened and raised up, the nail losing its polish and becoming black. In more advanced cases an inflamed swelling appears at the base of the nail. The nail is rough, scaly, and in some cases broken in several fragments, but is never cast off in its entirety. Finally the terminal phalanx also undergoes a change in form, and becomes flat and widened. In the earlier forms of the disease very little pain is experienced, and the patient is able to go on with his work. The disease disappears as soon as the work is discontinued, although a deformed nail and a flat or bent terminal phalanx are apt to remain. Albertin states that among the large number of candy-factories which he has visited, he has not found one in which from one to three workmen were not suffering with the disease. *The Medical and Surgical Reporter* suggests that the affection is caused by handling and working in the various substances employed in the manufacture of candies, among which are mallic, tartaric, and citric acids. The hands are also alternately in cold and hot liquids; and this, as well as the manipulation of the preparations, by means of which the irritating substances find their way under the nails, may be regarded as causative factors. It would be interesting to know whether this disease exists in this country, where the manufacture of candies is so extensive.

CURIOUS TRANSMISSION OF SCARLET-FEVER.— The *Boston Post* is responsible for the story that in 1846 a boy eight years old was taken down with scarlet-fever, and died. One of the principal amusements of his illness had been looking over a large picture-book. After his death, this, with several other useful playthings, was packed away in a trunk. Twenty-six years later, in 1872, the trunk was taken to England. The trunk was opened the second day after its arrival, and the picture-book was taken out and presented to a boy two years old. During the next fortnight the little fellow was attacked with scarlet-fever. It was a wonder to the doctors who were called in consultation how the disease had been contracted, as there had been no scarlet-fever in the town for years. At last it was suggested that the picture-book might have transmitted the disease; and the medical men in attendance, on being told the facts connected with it, agreed that it had retained the poison for twenty-six years, and then communicated it to the child. This appears, says *The Medical and Surgical Reporter*, to be one of the instances in which scarlet-fever from some unknown source developed coincidentally with the handling of articles used by a patient who had the disease many years before.

MENTAL SCIENCE.

Mental Activity in Relation to Pulse and Respiration.

THAT the blood circulation in the brain is an important factor in its healthy activity, and that the intermittent supply of the same recorded by the pulse, and the intermittent purification of the blood by the lungs in breathing, must also play important parts in the maintenance of mental action, are admitted by all physiologists, though our knowledge of the precise nature of these influences is very limited. Professor Leumann of Strassburg (*Philosophische Studien*, v. No. 4) calls attention to the necessity of noting the pulse and respiration rates in psychological experiments; and, though he gives but few positive results, his treatment of the topic is highly suggestive.

Such general observations as that when out of breath, owing to running or severe exertion, not only articulation but the words themselves fail one; that in drowsiness or sleep both pulse and respiration are slackened, — indicate the connections of the two functions. Again, these rhythms make themselves felt in such ac-

tions as dancing, scanning, and even the fluctuations of sensation. For example: a star just visible to the eye fades away and reappears. The intervals of this attention wave have been measured, and, according to one observer, are from 2.5 to 3 seconds for sensations of electrical shock, 3 to 3.4 seconds for light sensations, and 3.5 to 4 seconds for sensations of hearing; or 24 to 20, 20 to 18, and 17 to 15 fluctuations per minute, — a rate strikingly similar to the rate of breathing. It would be interesting to find whether these sensation "waves" vary essentially in persons with abnormally high or low respiration rates. Again, the relation of the rate of scanning to pulse and respiration may be tested. One subject, when his pulse tells 77 per minute, reads 113 feet per minute, but, with a pulse of 83, reads 140. Individual differences in pulse and respiration may affect the normal rate of reading. One subject, with a pulse of 86 and a respiration of 26 per minute, makes 55 double steps, and reads 126 trochaic feet, in a minute; while another, with a pulse of 66 and a respiration of 22, makes 51 steps and reads 120 feet in the same time. Verse-reading in schools might be similarly tested. In a preliminary test a pupil with a pulse of 85 read 107 feet per minute, another with a pulse of 98 read 129.

In one case Professor Leumann made a distinct test, measuring the pulse at frequent intervals, and also the rate of scannings as the subject was reading. Comparing the rates before an intermission with those after, he finds an almost exact correspondence of scanning rapidity with pulse rate. When 40.1 feet are read per minute, the pulse is 85½; when 38.8 feet are read, the pulse is 82½.

It is noteworthy, too, that a large range of association times varies between .7 and .8 of a second, — the period of a normal pulse-beat. In reproducing time intervals, the period reproduced with least error is also this same period. These, however, are mere suggestions. The outcome of the paper is to accentuate the importance of noting these physiological conditions when studying psychic phenomena, and particularly when making time measurements of them.

DISTANCE AND SIZE. — One of the most vexed questions of psychological optics relates to the inference of distance when the size of an object is known, or the inference of size when the distance is known. Psychologists are agreed that the process is not immediately given in sensation, but the result of experience. The young infant reaches for things entirely beyond its grasp. Under ordinary circumstances, our inferences of size, though unconsciously performed, are extremely complicated. The estimation of half a dozen different kinds of perspective, together with what real knowledge we have of the sizes of the objects in question, enters into the result. To study the question scientifically, we must arrange the observation so as to exclude all but a single variable. When this can be done, as, for example, in the gradual removal of an object from the eye, under proper conditions, the general assumption has been that the result depends on the size of the retinal image, or by the angle made at the centre of the eye by the extreme contours of the object. In the last number of the *Philosophische Studien* (vol. v. No. 4), Dr. Götz Martius describes a few experiments that lead him to question the correctness of this view. At a constant distance of 50 centimetres from the eye of the observer he placed a rod 20, 50, or 100 centimetres long. At a much greater distance (either 2½ or 5½ metres) he had a variety of rods, differing from one another slightly in length only. Both were viewed against a continuous and uniform brown background, and the problem of the observer was to judge when the distant rod seemed equal in size to the near one. Even here the fact that we are accustomed to interpret the far in terms of the near, and pay attention only to estimating the actual size of the object, makes it difficult to separate judgment and impression; to answer, not whether, if the distant rod were brought side by side with the near one, it would be equal to it in length, but whether the retinal impressions of the two as they are seen the same. After a little practice, this can be done, though the result does not point to a definite length, but to a narrow range of lengths any one of which seems equal to the near rod. Taking the average values, one observer, with 5.25 metres between the two rods, judges the distant rods of 21.67 centimetres, of 57.62 centimetres, and of 106.62 centimetres to be

equal to near rods of 20, 50, and 100 centimetres; at 2.50 metres between the rods, the former lengths become 20.62 centimetres, 53.87 centimetres, and 107.75 centimetres. Similar results for Dr. Martius are 21.92 centimetres, 59 centimetres, 110 centimetres, and 21.62 centimetres, 56.62 centimetres, and 109.25 centimetres. What these figures show, apart from the facts that such observations are possible and that the result varies with the individual, is that a distant object, to seem equal to a near one, increases in size with the distance, but increases very slowly; much slower, that is, than the visual angle decreases. It is probable, too, at the same difference of distance, the ratio between near and distant objects of various sizes remains constant. The result requires further corroboration and extension, but, even as it is, is important in rendering improbable the usual view of the matter.

SENSIBILITY TO TONE INTERVALS. — The ear has been called the mathematical sense, because the perception of musical interval involves the nicest appreciation of definite numerical relations between the vibration rates of the tones forming the interval. The very slight deviations from a true interval recognized as such by skilled musicians, which Helmholtz has satisfactorily explained as due to the relations of the overtones of the two tones, shows us that the interval sensibility must be very fine. The accurate determination of this sensibility for the various intervals has been attempted by a few methods, but with results individually different, and containing sources of error. The whole topic has been rigorously re-investigated by Iwan Schischmanow in the psychological laboratory at Leipzig (*Philosophische Studien*, v. No. 4). The method consisted in adjusting a movable weight on a tuning-fork until (1) it just formed a certain interval with a constant fork, (2) it just appreciably diverged from it above, and (3) just appreciably diverged from it below. The results are then grouped, and an average formed, expressing in fractions of a vibration per second the difference between the vibration rate of the true interval and the tone just distinguishable as not a true interval. For two observers, S and K, of whom S is a good amateur musician and K is not musical, the results thus expressed were as follows: for the octave whose ratio is 2 : 1, S 0.220, K 0.356; the fifth (ratio 3 : 2), S 0.332, K 0.374; the fourth (ratio 4 : 3), S 0.419, K 0.403; the third (ratio 5 : 4), S 0.485, K 0.559; major sixth (ratio 5 : 3), S 0.502, K 0.506; the second (ratio 9 : 8), S 0.548, K 0.716; minor third (ratio 6 : 5), S 0.607, K 0.640; minor sixth (ratio 8 : 5), S 0.672, K 0.740; minor seventh (ratio 9 : 5), S 0.678, K 0.763; major seventh (ratio 15 : 8), S 0.861, K 0.902. A comparison of these with former results leads to the conclusion that practise and individual traits contribute to the result, but that in general the order of delicacy of the various intervals as shown by S, especially the order of the four "besa" and the "worst" perceived intervals, may be taken as fairly normal. This order corresponds nearly with that elaborated by Helmholtz on the basis of relative consonance of overtones, but it shows that perceptions of intervals are possible without such an aid. The numbers show, too, the great accuracy of the sense of musical interval. Another result is that the sensibility for the lowering of an interval is finer than for an increase of the interval, though it must be noted that the variable tone in these experiments was always lower than the constant tone.

ELECTRICAL NEWS.

Siemens's Five-Lead System.

THE municipal authorities of Königsberg, in Prussia, in conjunction with the representatives of the citizens, resolved this spring to carry out, at their own expense, an electric central station for the town, which was calculated for a supply of 30,000 16-candle glow-lamps, though arrangements are to be made at first for 8,000 lamps. The entire installation, as it is now about to be executed, merits the attention of the entire electro-technical world, and of all persons interested. A correspondent of the London *Electrical Review*, therefore, briefly gives the chief points which will be brought forward in executing the installation. The current will be supplied from four groups of slow-speed dynamos, arranged in series, and connected directly with the steam-engine. Between these dynamos and the conducting net there is placed a battery of

accumulators of suitable capacity and tension. For the net of conductors, in consequence of the extended line of streets to be traversed, the five-lead system has been selected. The leads are not cables, as has hitherto been customary, but uncovered rods of copper, resting on insulators of porcelain, and laid in channels of cement. These channels will be mostly carried underneath the flags of the footway. The distribution of the current takes place so that each of the four successive current circuits formed by the five-lead system shows a working tension of 110 volts. The execution of the entire electrical installation, original and in many respects interesting, is intrusted to the firm Naglo Brothers of Berlin, who will use for storing up electric energy "Tudor" accumulators made by the firm Müller & Einbeck of Hagen. The above-mentioned Siemens "five-lead system" has not yet been practically applied in any electrical installation; but the firm Siemens & Halske is executing two extensive installations on this system, — one at Vienna, and the other at Trient. These two installations will be shortly in operation, and as many doubts have been raised concerning the practicability of this system, which is a further development of the three-lead system, and is hence regarded as too complicated, the inauguration of the Siemens installations is awaited in technical circles with no little interest.

LENS IMAGES MADE VISIBLE BY ELECTRIC CURRENT. — In the *Photographisches Archiv*, Herr R. E. Liesegang, son of Dr. Liesegang of Dusseldorf, describes an apparatus with which it is possible to render lens images visible at an indefinite distance from the original object by means of the electric current. The instrument is based on the well-known principle that an electric current is produced by light-waves. If light strikes upon one or two platinum, silver, or copper plates, which are arranged in the form of a galvanic element, this gives rise to an electric current. If the exposed plate consists of a large number of insulated metal wires of small diameter, lying very closely together, and if some of these wires are exposed, others not, then, of course, the electric current is produced only in these exposed wires. If the wires are conducted to another analogously constructed plate, which may be placed at any distance from the first one, then the electric current will also here be produced only at the parts correspondent with the exposed wires of the first plate. By coating the second plate with any substance which by galvanic decomposition undergoes a visible change, exposed parts of the second plate can be easily distinguished from the unexposed ones. If, therefore, an image is projected by means of a lens upon the first plate, the same image will be obtained on the second plate.

AN ELECTRIC RADIATION METER. — At the meeting of the London Physical Society, Nov. 1, Mr. W. G. Gregory read a paper on "A New Electric Radiation Meter." He stated that the meter consists of a long fine platinum wire attached to a delicate magnifying spring of the Ayrton and Perry type, and stretched within a compound tube of brass and glass. At the junction between the wire and spring a small mirror is fixed. When the tube is placed parallel to a Hertz's oscillator in action, the mirror is turned in a direction indicating an extension of the wire. The arrangement is so sensitive that an elongation of $\frac{1}{3000000}$ of a millimetre can be detected; and, when placed at the distance of a metre from the oscillator, the apparent extension is such as would correspond to a change of temperature of 0.003° C. By its aid the author has roughly verified Hertz's statements, that at considerable distances the intensity of radiation varies as the inverse distance; but, before he can proceed further, it is necessary to greatly increase the sensibility of the apparatus, and, with a view of obtaining some suggestions in this direction, he exhibited it before the society. Professor Perry asked if the electro-motive force required to produce the observed results had been calculated; he also believed that the sensibility might be increased by using copper instead of platinum, and replacing the spring by a twisted strip. Mr. Blakesley inquired whether the effect of increasing the capacity of the ends of the wire had been tried. Mr. Boys said, that, if the observed effect was due to rise of temperature, he would like to see it measured thermally. He also thought the effect might be due to extension caused by rapid electric oscillations in some such way as the elongation of an iron bar caused by magnetization. In answer to this, Professor S.

P. Thompson said the matter had been investigated experimentally, but with negative results. Professor Herschel suggested the use of a compound spring such as is used in Breguet's metallic thermometers. In reply Mr. Gregory said that he had estimated the electro-motive force by observing that a Leclanché cell through 50 ohms produced about the same result. No improvement in sensitiveness was obtained by using copper wire or by increasing its capacity, and attempts to measure the rise of temperature by an air thermometer had been given up as hopeless.

DRIVING TUNING-FORKS ELECTRICALLY. — Mr. W. G. Gregory, at the meeting above mentioned, also read a paper on "A Method of Driving Tuning-Forks Electrically." In order to give the impulses about the middle of the stroke, the fork is arranged to make and break the primary circuit of a small transformer, the secondary circuit of which is completed through the electro-magnet actuating the fork. The prongs of the fork are magnetized and receive two impulses in each period. Another device was suggested, where the prongs respectively operate contacts which successively charge and discharge a condenser through the coils of the actuating magnet. Professor S. P. Thompson said the methods, if perfect, would be of great service, and suggested that a fork so driven be tested optically by comparison with a freely vibrating one. He regarded the mercury contacts used as objectionable, for their capillarity and adhesion would probably cause the impulses to lag behind the appointed epochs. Professor M'Leod remarked that Lissajou's figures gave a satisfactory method of testing the constancy of period, and could be readily observed without using lenses, and in reference to liquid condensers, suggested by the author for his second device, said that platinum plates in sulphuric acid were found to disintegrate when used for this purpose. He thought lead plates would prove suitable. Professor Jones, who read a paper on a similar subject in March last, said he now used bowed forks, with which to synchronize the speed of the disk there described; and the frequency is determined by causing the disk to complete the circuit of his Morse receiver once each revolution.

ON ELECTRIFICATIONS DUE TO CONTACT OF GASES AND LIQUIDS. — A paper on this subject was read by Mr. J. Enright before the Physical Society above alluded to. For some time past the author has been studying the electrical phenomena attending solution by connecting an insulated vessel in which the solution takes place with an electrometer. As a general rule, no effect is observed if nothing leaves the vessel, but, when gases are produced and allowed to escape, the vessel becomes charged with positive or negative electricity, depending on the nature of the liquid from which the gas passes into the air. As an example, when zinc is placed in hydrochloric acid, the deflection of the electrometer is in one direction, while the liquid is chiefly acid, but decreases and reverses as more and more zinc chloride is produced. From such observations the author hopes to obtain some information relating to atomic charges. Owing to the lateness of the hour, the latter portion of the paper and the discussion on it were postponed until the next meeting. For the above reports of the papers read at the meeting of the London Physical Society, we are indebted to *Engineering*.

NOTES AND NEWS.

A MR. M. W. DEWEY of Syracuse, N.Y., has patented an electric refrigerator, based on the well-known fact that a current of electricity passed in the proper direction across the junction of two dissimilar metals cools the joint. While Mr. Dewey's apparatus is all right as far as the principle is concerned, we would rather not express any opinion on its practical value just yet.

— Beginning with January 1 next, the Rev. T. De Witt Talmage, D.D., will become one of the editors of *The Ladies' Home Journal* of Philadelphia. The famous preacher will have a regular department each month, written by himself, with the title "Under My Study Lamp." His first contribution will appear in the January number of the journal. Dr. Talmage's salary is said to be one of the largest ever paid for editorial work.

— The regulation of the Danube, a work of much importance to the people of south-eastern Europe, has at length been commenced. The first blasts were fired at the Iron Gate early in September, in the presence of the Hungarian minister of public works.

— M. Herman Fol reports to the Académie des Sciences the result of the researches that he has been making in the depths of the Mediterranean during the summer months, his object having been to certify how far daylight penetrates. His operations have been carried on in water of remarkable clearness between Corsica and the shores of the Alpes-Maritimes, at a distance of eighteen geographical miles from the nearest land. M. Fol used gelatino-bromide plates exposed during ten minutes, whereby he has found the limit of daylight in those waters to be at a depth of 1,518 feet (465 metres). This is 327 feet short of the limit assigned to daylight in the Mediterranean by the Germans, Chun and Petersen, some years ago.

— The official list of awards at the Paris Exposition states that there have been given one grand prize to the Johns Hopkins University; one grand prize and one gold medal to Professor Rowland for his photographic map of the solar spectrum, published by the university; one gold medal and one silver medal to the Publication Agency of the university. The exhibit of the university at Paris consisted of sets of the several journals, etc., issued there. A silver medal was also awarded for the map of the solar spectrum at the photographic exhibition in Berlin this summer.

— At the International Congress of Chemists in Paris this summer, it was decided to appoint a commission to consider the subject of chemical nomenclature. The commission consists of Messrs. Berthelot, Friedel, Gautier, Schützenberger, Grimaux, Jungfleisch, Fauconnier, Combes, Béhal, Bouveault (France); Graebe (Switzerland); Alexieff, Beilstein (Russia); Baeyer, Noelting (Germany); Lieben (Austria-Hungary); Franchimont (Holland); Paterno (Italy); Armstrong (England); Istrate (Roumania); Ira Remsen (United States); Calderon (Spain); Bonkowski Bey (Turkey); Cleve (Sweden); Mourgues (Chili).¹

— In the new quarterly statement issued on behalf of the Palestine Exploration Fund, it is stated that Dr. Torrance of the Scottish Mission has undertaken to conduct a series of meteorological observations at Tiberias for the fund. Should Dr. Torrance be able to carry out this undertaking, the observations will, with those made at Saroná (now being published by Mr. Glaisher) and those made by Dr. Chaplin at Jerusalem (and reported in the quarterly statement for 1883), as *Nature* points out, place the society after a few years in the possession of materials for a fairly complete account of the meteorology of Palestine. Tiberias is 682 feet below the level of the Mediterranean; and the society hopes that, as no regular series of meteorological observations has ever been made in such a depressed situation, the results may be exceptionally interesting. As the neighborhood of Jericho is becoming to some extent a place of residence for Europeans, the society trusts that opportunity may before long present itself for meteorological observations there also.

— The Archaeological Society of Northern Wisconsin is an organization formed for scientific purposes. Its chief object is to collect, arrange, and disseminate facts and material (abundantly scattered over northern Wisconsin) relating to the peoples and tribes who have successively occupied the territory in past times. Every year new facts are disclosed; implements of iron, copper, stone, and clay are unearthed from mounds and graves that go into private hands, and are lost for any public or practical good to which they ought to be diverted. The great mineralogical resources of this region, and its geological features, afford a vast field for investigation. The co-operation of all persons interested in these and kindred subjects is solicited by the society; and contributions of articles sent to the president, Rev. George Gibson (Neehan, Wis.), the secretary, Frank Tilton (Green Bay), or to Mr. F. H. Thurston (Oconto), will be duly acknowledged.

— The *Colonies and India* states that a discovery has recently been made on a Fiji plantation which will probably prove extremely valuable in all tropical countries where the cultivation of bananas is

regarded as a settled industry. The banana-disease had for some time been causing much havoc on a plantation on Vanua Levu, and it appears that the discovery of an antidote was due to an accidental occurrence. On a flat near the seashore there was a patch of bananas much diseased, and some time ago the sea swept into it, and remained on it for about an hour. All the plants were killed as far as the standing stems were concerned; but vigorous young shoots came up freely from the roots, and were not only quite free from disease, but soon began to bear much larger bunches of fruit than the parent plants ever did. Upon noting this effect, the planters determined to try the experiment upon a number of badly diseased plants which the sea had not reached. They cut down the diseased plants, and, having stirred the ground about them, poured from one to four buckets of sea-water over each. The result was, that, while the parent stems withered, vigorous young shoots came freely away, without a sign of disease.

— Mr. George F. Kunz, in charge of the Tiffany exhibit at the Paris Exposition, has received from the ministre de l'instruction publique des beaux arts, for his work in connection with the subject of precious stones, the decoration known as l'officier d'Académie, with the right to the purple ribbon known as the "Palm of the Academy." He sailed for New York, Nov. 16.

— The French have long been seeking an expeditious means of communication with the southern provinces of China. The *Chamber of Commerce Journal* of Aug. 5, 1889, reports a discovery which promises to gratify their wishes to some extent. The Marquis de Mores has studied the basin of the Canton River, and in the course of his inquiries he heard that caravans from Yunnan, Sze-Chuen, and other provinces, were in the habit of meeting at Posé, on the Son-ki-kong, a tributary of the Canton River, and a very short distance from the Tong-king frontier. On reaching the Son-ki-kong, accompanied by MM. Thorel and Van Driesche, the Marquis de Mores found that it was a navigable river more than two hundred and seventy yards wide. This river might be placed in direct communication with French territory by a railway about one hundred and twenty-five miles in length. At present the trade of the western provinces of China passes through Canton, and is attended with great difficulty and enormous expense; and the time of transport is sixty to eighty days. It is estimated that this new route would save sixty days on an average, so that Tong-king would have every prospect of becoming the outlet for the trade of the whole of western China. The Red River, which has hitherto been looked upon as the only route into China, has a rapid fall, and ends in a muddy delta which affords no good anchorage. However, according to *Petermann's Mittheilungen* (vol. xxxv. No. 9), a steamer has ascended the river to Laokai on the frontier of Yunnan. The Marquis de Mores found colza, maize, buckwheat, and chestnuts near the river Son-ki-kong. Tobacco, silk, and indigo also are cultivated in small quantities, and their cultivation would probably be much extended if the country were rendered secure from robbers. The exploring party returned to Langson, and thence to Tien-Yen on the coast, a distance of ninety-three miles. The last part of their journey (thirty-seven miles) was performed on the river Son-Tien-Yen, — the only river in Tong-king which yields pure drinking-water, and does not form a muddy estuary. The favorable geographical position of Upper Burmah in regard to Yunnan, however, has not escaped the attention of the British Government; and in this connection it is interesting to note, as pointed out by the *Deutsche Rundschau* (September, 1889), that "by the opening of the Tungu-Mandalay line, the latter town has been brought into railway communication with the port of Rangoon, which has now acquired considerable importance. The railway is to be continued to Bhamo, so that Yunnan and the adjacent provinces of the Chinese Empire will thus be connected with the sea by a much more convenient means of transport than at present exists on their eastern side. Rangoon, and indeed Burmah altogether, will derive much benefit from this line."

— Professor T. H. Lewis, the well-known archæologist of St. Paul, recently obtained a relic of antiquity from Mr. Andrew West of Blakeley, Minn. The relic in question is a small clay cup five inches in diameter and three and one-half inches in depth. The top, or mouth, is four inches in diameter, with a notched rim. The

sides and bottom are ornamented with fine incised lines, and the material of which it is composed is pulverized granite mixed with clay. There is a clay-bed near the village of Blakeley, from which clay is taken for the manufacture of brick. The top of the terrace in which it is situated is about ninety feet above the Minnesota River. At the top there are thirty feet of fine sand, with only a slight covering of loam. Beneath the sand there is a stratum of boulders, gravel, etc., which is from two to five feet in thickness, below which the clay is found. It was above the boulders and at the bottom of the sand-bed that the cup, together with some fragments of pottery composed of shell and clay, was found. The distance from the relics to the slope of the terrace in a horizontal line was over one hundred feet, so that their location cannot be attributed to a land-slide, for the strata were unbroken.

— Among recent appointments in the Johns Hopkins University, we note those of Dr. Henry M. Hurd (superintendent of the Johns Hopkins Hospital), professor of psychiatry; Dr. William S. Halsted (surgeon to the Johns Hopkins Hospital), associate professor of surgery; Dr. Howard A. Kelly (gynecologist to the Johns Hopkins Hospital), associate professor of gynecology and obstetrics; Ethan A. Andrews (Ph.D. 1887, late instructor), associate in biology; Dr. Alexander C. Abbott (graduate student 1885-87), assistant in bacteriology and hygiene; William S. Aldrich (U.S.N.), instructor in drawing; Charles A. Borst (fellow 1888-89), assistant in astronomy; Charles H. Chapman (A.B. 1888, fellow 1888-89), instructor in mathematics; George W. Edmond (A.B. 1884), assistant in chemistry; Arthur C. Wightman (Ph.D. 1889), senior demonstrator of physiology; Arthur G. Blachstein (A.B. Cornell 1882, M.D. Leipzig 1887), fellow in pathology.

— The following is a complete list of the papers presented to the National Academy of Sciences during its meetings, Nov. 12-14: "On the Results of the Systematic Study of the Action of Definitely Related Chemical Compounds upon Animals," by W. Gibbs and H. A. Hare; "On the New Prototypes of the Kilogram and the Metre," by B. A. Gould; "Remarks upon the Present State of our Knowledge in Reference to a Revision of the Genera of Brachyopoda for the Paleontology of New York" (Vol. VIII.), by James Hall; "On Zinc Storage-Batteries," by George F. Barker; "On Saturn and its Ring," by A. Hall; "On the Economy of Energy in the Glow-Worm," by S. P. Langley; "On Photometry of Colored Light," by O. N. Rood; "On Certain Pyrophosphates," by W. Gibbs; "On the Vertebrata of the Miocene of the Cypress Hills of Canada," by E. D. Cope; "On the Early Stages of Echinoderms," by W. K. Brooks; "On Relative Wave-Lengths," by A. A. Michelson; "On the Spectrum of Zeta Ursæ Majoris," by E. C. Pickering; "On the Persistence and Meaning of the Bi-concave Centrum of the Vertebrae of Vertebrates," by J. A. Ryder; "On a Peculiar Ordinal Modification as exemplified by Fishes of the Family Halisauridæ," by Theodore Gill; "On the Heredity of Acquired Characters," by W. H. Brewer; "On the 'Positive-Negative' Hypothesis in its Application to Organic Chemistry," by Arthur Michael; "On the Results of the Transits of Venus observed in 1761 and 1769" and "On the Theory of Cosmical Temperature," by S. Newcomb; "The Desert Ranges," by J. W. Powell; "On Hypnotic Cases without Suggestion," by H. C. Wood; "On the Laramie Group," by J. S. Newberry; and "On the Skull of the Gigantic Ceratopsidæ" and "American Mesozoic Mammals," by O. C. Marsh.

— Sponges are found both on the northern and the southern coast of Cuba, but the chief ports to which they are brought for sale are Batabano on the south coast, and Caibarien on the north. British Consul Little of Havana says, according to the *Journal of the Society of Arts*, that the classes included are sheep wool, velvet, hard-head, yellow, grass, and glova. Very little reef, if any, is found in Cuba. On the south coast sheep wool and velvet are more abundant than on the north coast. Cuban sponges find a market chiefly in England, France, and the United States. The island itself consumes about one-tenth of all the sponges brought in, and these are used especially for the damping of tobacco, and for cleaning centrifugal machines on sugar estates. The sponge fisheries employ about a thousand hands, chosen exclusively from among the *matriculados*, or seamen who have served on Spanish men-of-war,

and are still bound to serve when called upon. On the south coast are employed vessels ranging from about five to twenty tons, carrying from four to eight men, and each vessel is provided with from three to six small boats. On the north coast open boats with one or two men each are used. The annual value of the sponges brought in by these vessels is between \$800,000 and \$900,000.

— It is interesting to read of a part of the world where the buffalo is not dying out, but increasing in numbers. A journal of Perth, in western Australia, says that few Australians are aware that certain parts of northern Australia have vast herds of the wild buffalo (*Bos bubalus*) careering over its plains, and wallowing in its shady pools. *Nature* states that the animals are massive and heavy, with splendid horns, and afford sport of a sufficiently dangerous nature to possess charms for the most daring hunter, a wounded buffalo being one of the most dangerous animals known, his great weight, prominent horns, and splendid courage making him as well respected as sought after. The first buffaloes were landed at Port Essington, North Australia, about the year 1829.

— Hitherto Japanese subjects have not been permitted to charter foreign vessels to sail from any but the five treaty ports. An imperial decree has, according to *The London Times*, now been issued, allowing Japanese subjects to despatch foreign vessels to any one of nine other ports, and there to load them with rice, wheat, barley, flour, coal, or sulphur. These vessels may not be used in the coast trade, and permits must be obtained from the Finance Ministry. The new ports are Yokaitchi, in the province of Ise; Shimonoseki, in Nagato; Hakata, in Tshikuzen; Moji, in Buzen; Kuchinotsu and Karatsu, in Hisen; Misumi, in Higo; Fushigi, in Etchui; and Otaru, in Yezo. Of course, all the ports of the empire will be opened unrestrictedly when the treaties with foreign powers permitting free trade, etc., come into operation.

— The course of lectures at Sibley College by non-resident lecturers in mechanical engineering begins late this year in consequence of the absence of Professor Thurston in Europe until the close of the summer vacation, at the time when it has been customary to arrange the programme, and also in consequence still more of the fact that the lecturers who were expected to open and to appear in the early part of the course have all, for one reason or another, been compelled to ask that their dates be deferred. The course opens on Nov. 22 with a lecture by Professor W. LeConte Stevens on "The History of Aeronautics." This will probably be the introduction to several discussions of this subject, to be given later in the season. The later lectures will probably include one by Professor S. P. Langley, secretary of the Smithsonian Institution, on the results of researches about concluded by him at the Allegheny Observatory, on the laws of aerial flotation and of flight in the atmosphere; and by Mr. O. Chanute, who has been investigating this subject from a theoretical point of view, and who has developed the mathematical side of the theory to a practically applicable degree. Mr. C. E. Emery, the great authority on the subject in this country, will discuss methods of laying-out a steam-boiler plant. Mr. Benjamin F. Isherwood, the engineer-in-chief of the United States Navy during the war, is expected at Cornell in December, when he will give an account of some of those researches which have become famous in the history of the heat-motors. Mr. Alexander Graham Bell will again discuss the curious phenomena discovered by him, which have been given practical interest by his ingenious methods of telephony and telegraphy along a beam of light. At some time during the winter, also, various phases of the engineer's problem of power-development will be discussed by Mr. J. M. Allen, and by Mr. George H. Babcock, the well-known inventor, and ex-president of the American Society of Mechanical Engineers. It is hoped that Mr. Leavit, the great designer of pumping-engines, the consulting engineer of the Calumet & Hecla Mining Company and of numerous other companies, the ex-president also of the Mechanical Engineers, may describe some of his interesting constructions. Mr. Holowan, another past-president of the same society, will talk later of some branch of his work. Professor Anthony, Mr. Weston the electrician, Dr. Dudley the consulting man of science of the Pennsylvania Railway, and Major Michaelis of the Army, are likely to follow later in the season.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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PROTOPLASM AND ITS HISTORY.¹

In the department of biology there are three subjects of transcendent interest; namely, protoplasm or living matter, development, and adaptation. In fact, the interest in some phases of these subjects is now so general and deep that the special students in this department feel that they have to a great extent the sympathy and co-operation of the public at large. This interest renders possible the construction of such commodious laboratories as this the latest acquisition of the University of Toronto, in which we are now permitted to meet. The generous halls and adequate equipment of this laboratory and other biological laboratories throughout our country and Europe testify to the existence of a widespread belief that the new natural history has very much to learn and much to teach in regard to many of the great problems of life.

In the annual gatherings of the members of our section for the exchange of views and for better fellowship, it has been found expedient for us to look at one or the other of these three subjects at the outset of our work in a somewhat broad and yet special manner.

Your chairman for the present year asks the privilege of selecting as his topic for the introductory address the first of the subjects mentioned. You are invited to examine the more recent additions to our knowledge of protoplasm, restricting the examination to discoveries in the field of botany.

¹ Address delivered by Professor George L. Goodale of Harvard University, as vice-president of the Biological Section of the American Association at Toronto, Aug. 28, 1889.

Whether we consider protoplasm, or the living matter of plants and animals, from the point of view of physics, of chemistry, of physiology, or of philosophy, we have before us a topic which has received, and which continues to receive, the most assiduous attention. Hence its literature, though comparatively recent, is appallingly voluminous; and any attempt to treat the subject, or any considerable part of it, exhaustively, within the limits properly imposed upon introductory addresses, would result in annoyance to you and utter discomfiture for me. Apropos of this, I am reminded of a series of experiments upon protoplasm, conducted in a German laboratory, which will illustrate the embarrassment which the case presents. The study to which I refer was with regard to certain organisms of very low grade. At a given period in the life of these organisms, their microscopic masses of protoplasm become confluent in such abundance that sufficient material can be procured for experiments on a large scale. In the special investigation referred to, a considerable quantity of protoplasm obtained in this way was subjected to enormous pressure. You can anticipate the result: there remained behind only a shrunken residue of what we may call, without figure of speech, the most juiceless and the driest of husks.

This natural result of extreme compression has stared me in the face during the preparation of the present address. A similar result is more than likely to follow my attempt to bring within very narrow limits the subject which I have chosen for your consideration.

The word "protoplasm" was coined by Hugo von Mohl in order to designate certain active contents of the vegetable cell.

We shall gain in clearness of vision by letting our glance rest first on the results of investigating vegetable cells and cell contents anterior to Von Mohl's time, in order that we may see some of the steps by which this term was reached by him. The compound microscope was not applied seriously to the examination of the structure of plants until about fifty years after its discovery by Drebbel. In 1667, Robert Hooke of England published an account of his investigations of minerals, plants, and animals under the microscope, and gave excellent illustrations of what he thought he saw. His first reference to the structure of plants is in his description of charcoal, and this is followed by a good account of common cork. In these brief and fairly accurate descriptions, the author makes use of the word "cell," applying the term to the cavities in charcoal and in cork.

Hooke's interesting treatise was soon followed by two remarkable memoirs,—one by an Italian, the other by an Englishman. Malpighi of Bologna sent to the Royal Society of London in 1670 a work entitled "Anatome Plantarum." The published volumes bear the dates 1675 and 1679. At the period these volumes were in the hands of the Royal Society, Nehemiah Grew, secretary of the society, was engaged in work almost identical with that of Malpighi; but there is no good reason to believe, as was formerly intimated, that he was indebted to Malpighi for any of the statements which he published as his own. It is, however, best for us to consider these two works together. By Grew the term "cell" appears to have been applied to the cavities in what we may term the softer tissues of the plant. It is certain that neither Malpighi nor Grew recognized, as we can now, the multifarious forms of vessels, fibres, long cells, and the like, as referrible to a common source. There is always a strong temptation to read in an old text some meaning which squares with our own notions; and one is greatly tempted to think that these assiduous investigators, Grew and Malpighi, detected the relationships which we know exist between the different elements of vegetable structure. But after giving them the benefit of every doubt, one fails to find in their writings any recognition of such affinities. On the contrary, these investigators were engaged in a study which naturally led them away from such conceptions. They were busy with descriptive work, outlining the arrangement of tissues in all organs of the plant which their knives could reach. They did not even break up the tissues into elementary parts, but they described and delineated with great skill the tissues as they were displayed in sections. Is it not incredible that these first works on vegetable structure, prepared only a few years after the earliest application of the compound microscope to the study of plants, should have remained for

almost one hundred and fifty years the only comprehensive treatises on the subject? But the most charitable inquirer fails to find during that long period any other works of importance on vegetable anatomy.

Near the close of the last century, at a period characterized by activity in many departments of speculative inquiries, the subject of vegetable structure again excited considerable attention, but little substantial advance was made. In 1804 the Royal Society of Sciences at Göttingen proposed for competition certain questions relative to the structure and the mode of growth of tissues. The chief contestants for this prize were Link, Rudolph, and Treviranus. The memoirs of the first two received the prize; that of the latter, honorable mention. The names of others should be referred to as having worked at or about this time in the same field; namely, Bernhardt, Mirbel, and Moldenhawer, the last making a great advance in certain directions. But to all of these whom I have mentioned, including the winners of the prize, the important question seems to be, how are the structural elements distributed, rather than how are they related to each other in manner of growth and as respects their origin. With the cell contents they had comparatively little to do. They were busy with the constituents of the framework.

There appears to have been a strong suspicion, on the part of some botanists during that period, that all this study of the skeleton of the plant failed to go to the bottom of the question. The only wonder is, that with their scanty and untrustworthy chemical appliances, and with their very imperfect lenses, they accomplished so much. May I remind you that the element iodine, which is the most important re-agent in the examination of the contents of vegetable cells, was not employed until the year 1812; and, further, that no good achromatic and aplanatic lenses, of even moderately high power, were constructed until 1827?

Noting the more important discoveries of the next period in their order, we come first upon that of the nucleus of vegetable cells by Robert Brown in 1833, and one mode of cell-division by Mohl in 1835. In 1838 the eccentric Schleiden published his "Contributions to Phytogenesis," in which he states substantially that cells of plants can be formed only in a fluid containing, as chief ingredients, sugar and mucus (*schleim*). By this latter term he designated the nitrogenous matters taken collectively. At his touch all disguises fell, and for the first time the vegetable cell was distinctly recognized as a unit of structure always serving as the common basis for the formation of the innumerable shapes of the structural elements.

Next comes the master, Mohl. Armed with the best optical appliance procurable, familiar with the use of the chemical re-agents then at command, and accustomed to accurate research, he reviews his own earlier work and that of his contemporaries, making rapid advance in the knowledge of the contents of the cell. In 1844, in a paper on the circulation within vegetable cells, he speaks of the living mass in each active cell, and distinctly recognizes it as that which is the treasury of stored energy and the vehicle of energy under release. He describes it as that which builds shapely forms out of unformed matter and at first hands. This substance he names "protoplasma."

If we look at the handbooks of botany just before this date of the early forties, we find references to "coagulable matters" (Treviranus), and the chemical instability of the substance within cells was suspected of having much to do with its activity; but almost all of the notes, as well as those upon the same subject found here and there in philosophical writings of the latter part of the last century, are based on pure speculation. The scientific recognition of a physical basis of vital activity must be credited to Schleiden and Mohl.

The term "protoplasm" was at once adopted by Schleiden, and a good substitute for the indefinite and misleading word *schleim*, which he had employed to designate essentially the same substance, and it became thoroughly established in scientific terminology. In 1850, Professor Cohn (and Unger in 1855) showed that the protoplasm of vegetable cells is identical with what had been described in 1835 in animal structures as *sarcode* by Dujardin, and this prepared the way for the exhaustive treatise by Max Schultz in 1858. From that date on, work in the contiguous fields of

botany and zoology has made no physical or chemical distinction between the living matter in animals and plants. Investigators in the two fields have been mutually helpful.

Mohl, in his treatise on the vegetable cell, published in 1851, gives the following account of protoplasm: "If a tissue composed of young cells be left some time in alcohol, or treated with nitric or muriatic acid, a very thin, finely granular membrane becomes detached from the inside of the walls of the cells, in the form of a closed vesicle, which becomes more or less contracted, and consequently removes all the contents of the cell which are enclosed in this vesicle from the wall of the cell. Reasons hereafter to be discussed have led me to call this inner cell the 'primordial utricle' (*primordialschlauch*). . . . In the centre of the young cell, with rare exceptions, lies the so-called *nucleus cellule* of Robert Brown ('*Zellenkern*;' 'Cytoblast' of Schleiden). . . . The remainder of the cell is more or less densely filled with an opaque, viscid fluid of a white color, having granules intermingled in it, which fluid I call 'protoplasm.'"

We must now pass without notice numerous contributions to the subject, and consider Hofmeister's description of protoplasm given in his "Vegetable Cell," published in 1867: "The substance protoplasm, whose peculiar behavior initiates all new development, is everywhere an essentially homogeneous body. It is a viscid fluid containing much water, having parts easily motile, capable of swelling, and possessing in a remarkable degree the properties of a colloid. It is a mixture of different organic matters, among which albuminoids and members of the dextrine group are always present. It has the consistence of a more or less thick mucus, and is not miscible with water to any great extent."

From these accounts we see that the following points were regarded as established: 1. All of the activities of the vegetable cell are manifested in its protoplasmic contents; 2. Protoplasm consists chemically of a nitrogenous basis; 3. Protoplasm has no demonstrable structure; 4. The protoplasmic contents in one vegetable cell are not connected with the protoplasmic contents in adjoining cells; 5. The nucleus and other vitalized granules in the vegetable cell are formed by differentiation from amorphous protoplasm.

It is now our duty to see in what manner these views have been modified during the last twenty, or rather ten, years. In describing the changes of opinion, time will not suffice for us to allude to most of the observers: a few only can be mentioned by name.

The first thesis, namely, that all of the activities of the vegetable cell are manifested in its protoplasmic contents, may be regarded as firmly established. It is at this point in our present examination when, if we had time, we should take up, one by one, the terms which have been applied to some parts of what Mohl and Hofmeister knew as protoplasm. But we can only glance at them in passing. Thus, "cytoplasma" is understood to be the mass exclusive of the granular contents of all kinds; "hyaloplasma" is the outer hyaline layer; "polioplasma" is the grayish granular part. To these terms may be added others, such as "paraplasma," etc.

The second thesis, viz., protoplasm consists chemically of a nitrogenous basis, remains unchanged. But, instead of regarding the protoplasmic basis as comparatively simple, it is now known to be exceedingly complex, and to contain numerous cognate proteids, some of which can be identified in the basic mass, others in the nucleus, and others still in the vitalized granules.

These researches must be considered also with reference to those by two active investigators, Pfeffer and De Vries. The former has shown the conditions under which active protoplasm re-acts in the presence of certain chemical excitants: the latter has demonstrated the relations of a part of this irritability of protoplasm to its physical constitution. But, as a result of all these recent studies, it becomes more and more clear that the chemical relations of the protoplasmic activities are still veiled in mystery. Botanists are receding from a position held by many only a few years ago; namely, that it is safe to use the words "albuminoids" and "protoplasm" interchangeably. Nowadays the latter term is generally restricted to morphological and physiological conceptions: the former keeps its wide chemical significance.

Just here come in the chemical studies of protoplasm,—by

Rödewald and Reinke on a large scale, by Loew and Bokorny, and by Schwarz under the microscope. All of these results compel us to recognize in protoplasm a substance of bewildering complexity of composition and constitution. Moreover, you all know how wide this field of research has suddenly become by the discovery that different microbes (which are essentially minutest masses of protoplasm) not only give rise to such diverse products, among others the ptomaines, but present such diverse chemical reactions.

Protoplasm is no longer regarded by any one in any sense as a comparatively simple substance.

The third thesis, namely, protoplasm has no demonstrable structure, has been modified in a striking manner as a result of improved appliances for research. By better methods of staining, and by the use of homogeneous immersion objectives, the apparently structureless mass is seen to be made up of parts which are easily distinguishable. There has been, and in fact is now, a suspicion that some of these appearances, under the influence of staining-agents, are post-mortem changes, and do not belong to protoplasm in a living state. But it seems to be beyond reasonable doubt that protoplasm is marvellously complex in its morphological and physical as well as its chemical constitution. One statement of the case is as follows: Under ordinary circumstances, protoplasm is composed of a mesh of inconceivable fineness, in which mesh are entangled the more liquid interfilary portions (paraplasm); so that the dry husks left in Reinke's experiment may be regarded as the residue of network from which all the moisture has been expelled. But this conception of protoplasm as a mass composed of a network of minutest fibres enclosing in the meshes another substance, presents, as has been well shown by some critics, great difficulties when we endeavor to explain the movements within the cell. It is very difficult to explain in any way the so-called wandering of protoplasm outside the cell wall or into intercellular spaces.

Fourth, we are to glance at the accepted statement that the protoplasmic body or protoplast, as it is called, of one cell is cut off by the cell wall from all connection with the contiguous cells. There are a few cases in which this intervening wall was formerly held to be pervious, but such cases were considered as exceptional. Now, however, as has been shown by Gardiner and others who have followed out his exact researches, there are intercommunicating threads of protoplasm of extreme fineness between adjoining cells; and these living threads maintain connections, sometimes direct, sometimes indirect, between one protoplasmic mass and another. This has been shown to be so widely true in the case of the plants hitherto investigated, that the generalization has been ventured on, that all the protoplasm throughout the plant is continuous. The formation of the dividing wall in cell-division is now better understood than ever before, and our knowledge of this process lends great probability to the truth of the general statement made. It is not unlikely, then, that all the living matter throughout each plant is continuous, a whole, shut off at the time of severing from the mother-plant from the body of protoplasm there, and thus making a true chain of descent.

May I ask you to observe, in passing, how this bears on the vexed subject of individuality of plants? Brücke, in 1862, declared that the living protoplasmic contents of a cell formed an elementary organism, and this idea found its fullest expression in the profound work by Hanstein in 1880. In that treatise Hanstein proposed for the living protoplasmic contents of the cell the term "protoplast," in order to indicate its individuality. But these late researches show that these protoplasts are not only highly organized and of complicated structure, but each is bound by indissoluble ties to its nearest neighbors, each helping to form a united whole.

The fifth thesis has been completely controverted. Instead of believing, as formerly, that all the granules within the cell arise *de novo* from the protoplasm in which they are embedded, we are now forced to regard all of them as springing from pre-existent bodies of the same character.

Hofmeister, in 1867, in an exhaustive description of the contents of vegetable cells, states distinctly that the nucleus arises from homogeneous protoplasm, and that in all cell-division the nucleus must first disappear, two new ones arising in its place. The

nucleus occupied a secondary place as a derivative organ; and the chlorophyll granules were believed by him and his contemporaries to be new formations from homogeneous protoplasm under certain conditions of light, temperature, and food. Researches which leave no room for doubt have shown that the nucleus, in all cases hitherto examined, springs from a pre-existent nucleus by a process of division. The process of division, with its marvellous sequence of formal arrangements of definite portions in meridional lines and in polar and equatorial masses, has been most carefully examined in almost every organ of the plant, and in connection with similar processes of cell-division in animal tissues. In no well-marked case has a nucleus been observed to arise from homogeneous protoplasm, even a few doubtful instances having been lately explained satisfactorily.

The extraordinary manner in which the nucleus, both in common cell-division and in reproductive blending, carries ancestral characters and controls the distribution of nutritive materials, is as yet the greatest mystery in vegetable life.

We pass next to consider a very important change of view in regard to the other granules embedded in the protoplasmic body, known as leaf-green or chlorophyll granules. Formerly, as we have noticed, it was held that all of these sprang by a process of differentiation from the shapeless mass in each exposed cell. Researches by Schmitz on some of the lower plants, and by Schimper and Meyer on the higher, have shown beyond any reasonable doubt that these chlorophyll granules always arise by a process of division from pre-existent granules; but this fact, taken by itself, might not possess great interest. It is, however, known, that, at the growing points where leaves are developed, the cells contain in their protoplasm granules of about the consistence and color of protoplasm itself; and these granules have the power of division, much after the fashion of the cell nucleus. But the products of such division, are essentially threefold: some of the resulting granules are colorless, like the mother granules; others become true chlorophyll granules; while others still, in those leaves which become the leaves of the flower and the fruit, assume colors other than green. In other words, we have in these associated granules, or chromatophores, a morphology which is of the highest interest. The needs of the plant bring from this common source the microscopic organs for assimilation, for storing-up starch in the form of grains, for protection and attraction. This most interesting generalization in regard to the granules taken together adds a new zest to the study of the developing plant and the evolving species.

It has been lately claimed by De Vries of Holland that the saporities or vacuoles in protoplasm divide in much the same way as do the granules just referred to, but this part of the subject is not yet beyond all doubt. That the saporities are the birthplace of most crystals, and that the aléurone grains may be desiccated saporities, has been made out by several observers. But it is not clear that vacuoles divide as granules do. What we do know beyond all reasonable question is this,—that all the working granules within the plant have sprung from pre-existent granules, and that there is no break here in the transmission from parent to offspring.

Such, then, are some of the more important changes which have taken place with regard to our knowledge of the living contents of vegetable cells. I would gladly take the time, if it could be granted, to call your attention to certain most interesting discoveries, which have been made by Pfeffer, relative to the absorption of coloring-agents by living protoplasm, and which have been supplemented by Campbell in regard to the nucleus; but more than this allusion is now impossible.

It is an interesting coincidence that with the substitution of the crude compound microscope for high-power simple lenses, in 1660, came the first works on vegetable structure; and for more than one hundred years, or until the introduction of achromatic objectives, these works were, in truth, the only authoritative treatises. With the introduction of water-immersion lenses came renewed activity in this field, and with the later discovery of homogeneous immersion lenses came the results which have now been detailed. Whether we have, at these stages, more than a series of interesting and very striking coincidences, or not, we have not time now to discuss. It is enough for our present purpose to observe, that, with the introduction of the cedar-oil immersion objectives, a

through re-investigation of certain parts of this subject began. One may be pardoned for asking whether the objectives known as apochromatics are to open up in this field new lines of research.

Can these recent discoveries relative to the continuity of protoplasm and the genetic relationship of the associated granules (including, in the widest sense, the nucleus) be made to cast any light on the question of development, as they certainly do upon the kindred question of adaptation? The answer has been given us very lately by Hugo de Vries of Amsterdam. This investigator, who has done very much to clear up certain obscurities in regard to the external relations of the cell, has recently revised the neglected doctrine of pangenesis, and applied it to the question just propounded. De Vries suggests that we divide the hypothesis of pangenesis as proposed by Darwin into two parts, as follows: 1. In every germ-cell, individual characters of the whole organism are represented by material particles, which, by their multiplication, transmit to descendants all of such peculiarities; 2. All the cells of the organism throw off, at certain periods of development, such material particles, which flow towards the germ-cells, supplying its deficiencies. Now, De Vries asks whether it is not high time for us to look at the first part of this hypothesis again, and abandon the hinderances which the latter part imposes. If we accept his suggestion, and restate the hypothesis, in view of what has been learned relative to the nucleus and other granules (the trophoplasts) within the cell, we should then read, "In every cell at a growing part are all the elements ready for multiplication. Each protoplast possesses the organs necessary for continuous transmission; the nucleus for new nuclei, the trophoplasts for new granules of all kinds, according to the needs of the plant."

The author reviews the theories bearing on the question, from the so-called plastidules of Elsborg to the germ-plasma of Weismann, and then applies his hypotheses of intracellular pangenesis to the different parts of a single plant, and to the transmission of peculiarities. The active particles recognized in Darwin's hypothesis he terms "pangens," and, regarding them as vehicles of hereditary characters, traces them throughout their course. He is not obliged to ask for any means of transportation for these pangens, for they work, so to speak, on the spot. They are ready at hand at the points of growth. We must look very sharply with reference to this at two points of growth in the flowering plant; namely, the bud and the seed. Each bud, with its growing point made up of cells containing in their protoplasm the divisible granules, carries with itself all the peculiarities which have been transmitted without appreciable change. In the formation of the bud there is fission, but no blending. The cells divide, and each new one may in turn divide until the ultimate form of the leafy branch or flower is reached. In the leafy branch new buds form, and in their turn carry forward the ancestral peculiarities; but in the flower, on the other hand, with the formation of the ovule all development is arrested (except in the rare cases of parthenogenesis and the like) unless the protoplasm of the embryonal sac receives a new impetus from material contributed by the pollen grain; and in this blending of parts which have developed under different external conditions, we see that there is a chance for variation to come in. Not only is there a blending of the nuclei, but a sharing of the accompanying trophoplasts. How this can be applied to the lower plants and other organisms cannot now be referred to. It would not be right to hold De Vries wholly responsible for the application just given, but I ask you whether the hypothesis does not appear fruitful. It seems likely to stimulate speculation and further research in this important field.

In view of De Vries' work, and of the results of recent study, which I have endeavored to bring before you this afternoon, does not the statement of Darwin possess new force?—"An organic being is a microcosm, a little universe formed of a host of self-propagating organisms inconceivably minute, and as numerous as the stars in heaven."

HOUGHTON, MIFFLIN, & CO. have in press a biography of Wilbur Fisk, the Methodist minister, by Professor George Prentice Wesleyan University, to form the second volume in their new series of American Religious Leaders.

THE ORNITHOLOGISTS' MEETING.

THE seventh congress of the American Ornithologists' Union began its session in the rooms of the American Museum of Natural History in this city, Nov. 12. Dr. C. Hart Merriam, from the committee on the migration and geographical distribution of birds, reported that no progress had been made in studying migration; but the Agricultural Department, he said, is now engaged in work relating to floral and faunal distribution. Individual species of birds are first located and mapped, and then these maps are coordinated so as to define the natural floral and faunal areas of the country. These maps will be colored so that one may see at a glance the boundaries in which certain flora and fauna abound. Dr. Robert W. Shufeldt, from the committee on the anatomy of birds, reported the progress made in the study of this anatomy for the years 1888 and 1889. The report named the books that had been published in Europe and America on this subject during the last two years. George B. Sennett, from the committee on the protection of North American birds, reported that the committee was doing what it could to protect useful birds and destroy others. They encouraged boys to kill sparrows, but to spare other birds. The New York law for the protection of birds was defective. This was to be regretted, for New York is the great market. The Pennsylvania law had been drawn with a knowledge of the defect in the New York law, and is the best law now in existence in any State.

On Wednesday, the 13th, Jonathan Dwight, jun., read a paper on "Birds that have struck the Statue of Liberty, Bedloe's Island, New York Harbor." He said, that, on account of its lighter color, more birds strike the pedestal to the statue than the statue itself. The statue was erected too late in 1886 for the migratory birds. The first to strike it was on May 19, 1887, and the next late in August, when the lights were said to be put out by birds. The first date at which birds struck the statue in 1889 was Aug. 5, when fourteen were killed. A few others were killed during the month, and a considerable number in September and October. Oct. 24 was the last date at which birds were killed. The whole number killed this year was 690, which was considerably less than in 1888 or 1887. He found that every cold wave in the early fall was followed by migratory birds flying against the statue. Of the dead birds picked up this year, 60 per cent belonged to one species, the Maryland yellow-throats. The remaining 40 per cent included a great variety. A paper on "The Abundance of the Wild Pigeon in Central and Eastern New York in 1835," prepared by Professor R. W. Whitfield, was read by Mr. Dutcher. Early in the sixties there was a great flight of pigeons in the Hudson valley. Flocks were so large that one could not see their extent, and they cast shadows like clouds. Dr. C. Hart Merriam said the gregarious habits of pigeons had made their struggle for existence peculiarly hard, because they were so liable to attack on their breeding-ground. The result was, the few survivors have learned to abandon the old habits, and they now scatter and breed in isolated pairs. There was no danger that they would be exterminated. A paper was read by Dr. Edgar A. Mearns, entitled "Observations on the Avifauna of Arizona." After brief discussion, Dr. C. Hart Merriam read a paper entitled "Remarks on San Francisco Mountain and Vicinity (Arizona) from the Faunal Standpoint." "The Winter Distribution of the Bobolink, with Remarks on its Routes of Migration," was the subject of a paper by Frank M. Chapman. After some discussion, Mr. Chapman read another paper, "On the Changes of Plumage in the Bobolink."

At Thursday's session Mr. Leverett M. Loomis read a paper, giving his observations on some of the summer birds of the alpine portions of Pickens County, S. C. Col. N. S. Goss, State ornithologist of Kansas, read two brief papers, — one on the question whether the poor-will and the frosted are varieties of the same species, or distinct; and the other on "The Mottled Duck in Kansas." Jonathan Dwight, jun., read a paper on "Some Birds observed near the Straits of Mackinac during 1888." In a search for a pigeon-roost, Mr. Dwight came upon a parade-ground of migrating birds in Michigan, and, in a few days following the 20th of May, secured a great number. He had prepared a list of 119 species thus secured. Dr. Edgar A. Mearns read a paper, "The Western Form of the Warbling Vireo." Mr. William Brewster

gave the substance of two papers, — one on "The Little Brown Crane in Rhode Island," and the other on "The Capture of the Canada Jay near Cambridge, Mass."

At the closing session of the congress on Friday, President J. A. Allen presented a paper on the classification of the Maximilian types of South American birds now in the American Museum. He also presented a paper on "Seasonal and Individual Variation in Certain Flycatchers of the Genus *Elaenia*." Mr. Frank M. Chapman read a paper on "The Forms of the Maryland Yellow-Throat." President Allen read a paper on classification, in which the difficulties of the work were made evident.

The next congress will be held in Washington the third Tuesday in November, 1890.

BOOK-REVIEWS.

The Continuous Creation. By MYRON ADAMS. New York, Houghton, Mifflin, & Co. 12°. \$1.50.

THIS work is one of those attempts, now so numerous, to reconcile Christianity and science. The author is a clergyman, and the views set forth in this volume are such as he has long taught to his congregation. He accepts the evolutionary philosophy quite as unreservedly as any scientist could do, and endeavors to show that it is in no way hostile to any essential truth of religion. There is nothing in his views or arguments that is specially new; but they are presented in a style that is somewhat above the ordinary, being not only clear and refined, but also of a true literary flavor. Mr. Adams holds the view, which other Christian thinkers have expressed, that evolution is "the mode of God in doing things, in causing things to come to pass." Creation is conceived as a continuous and never-ending process, and evolution as the universal law of becoming." This idea of continuous creation is nothing new, but has been held by many philosophers of the past, including the Alexandrian Christians. But the prevalent doctrine of the Church has regarded creation as a work done once for all by an omnipotent fiat; and hence, when the evolution theory appeared, it was found to be out of harmony with the orthodox view. Of course, Mr. Adams has no difficulty in showing that the new theory is in no way inconsistent with a philosophical theism. It is curious, however, that nearly all the criticisms of Christianity with which the world is now rife should be attributed to the evolutionary school, for very few of them are original with that school. Most of the changes now going on in the traditional religion are due to other influences, and would have taken place just the same if evolution had never been thought of. How far those changes have already gone, Mr. Adams's book plainly shows; for his Christianity is so different from that of former times that it is hardly recognizable under the same name. But he shows an excellent spirit and a true religious earnestness, and his work will be interesting to those who are interested in its subject.

The Public Regulation of Railways. By W. D. DABNEY. New York, Putnam. 12°. \$1.25.

THIS is one of the most sensible books on the railway question that we have seen, though it cannot be said to offer much that is original. Most writers who discuss the railway question are animated either by hostility to the railway companies or by partiality for them; and it is pleasant to read a work that discusses the subject in a judicial spirit. Mr. Dabney's book consists of two parts: the first dealing with the legal aspects of the subject; the second, with the economical. He is opposed to any scheme for the purchase and operation of the railways by the government, and gives the usual reasons for this view. But, on the other hand, he holds that the partial monopoly that necessarily attaches to the railway business, and the vast power over industrial interests which the companies wield, make it necessary that they should be carefully supervised by public authority. He goes into the details of many judicial decisions and questions of law affecting the railways, and then takes up such questions as those of pooling, discrimination, "the long and short haul," and many others; and his opinions, whether one agrees with them or not, are evidently the result of careful study. He condemns discrimination between persons in unqualified terms, but thinks that discrimination in favor of certain

places is sometimes not only justifiable, but inevitable. The work is worthy of perusal by all who wish to understand the subject and to see justice done to all parties.

Pawnee Hero Stories and Folk-Tales. By GEORGE B. GRINNELL. New York, Forest and Stream Publ. Co. 12°. \$2.

THE author of this work has lived for several years among the Pawnees, and, during his last visit to the tribe, gathered as many of their familiar stories as he could, and set them down in writing precisely as they were told to him. The hero stories are mostly warlike, and relate particularly to horse-stealing, which, as Mr. Grinnell reminds us, was simply a mode of warfare. It appears that the Pawnees are adepts in personating wolves by dressing themselves in skins or other appropriate disguises, and crawling on all-fours; and by this means they could approach close to an enemy's camp without being discovered. Many of these stories recount such exploits, and some are quite diverting. The folk-tales are far more fantastic, and are full of the marvellous; as, for instance, the story of the Dun Horse. This animal was very wise and a good conversationalist; but after a while he died, and the men of the tribe cut him up into little pieces. Very soon, however, a strong wind blew upon the pieces, and they were put together again, and the horse restored to life.

Besides these native stories, Mr. Grinnell gives us a series of notes on the Pawnee people and their customs, which will be of use to students of such subjects. He attempts to trace the origin and migrations of the tribe, but reliable information on these points is very scanty. The religious sentiments of the Pawnees are said to be strong, and their religious exercises frequent and fervent. Some marvellous and inexplicable tales are told, and stated to be true, of the doings of their medicine-men. The Pawnees are now settled in the Indian Territory, and are rapidly dwindling in numbers. When the author first visited the tribe, "it numbered more than three thousand people: now there are only a little more than eight hundred of them." He thinks that some measures ought to be taken to preserve a record of their language, and suggests that the Smithsonian Institution should take the matter up.

Electricity in our Homes and Workshops. By SYDNEY F. WALKER. New York, Van Nostrand. 16°.

THE ground covered by this work is somewhat limited, but it is gone over thoroughly and conscientiously, leaving little to be desired even by the most exacting. The intention of the author when he began his task, as intimated in the preface, was to cover the whole ground occupied by electrical apparatus; but circumstances compelled him to limit his labors to what are known as auxiliaries to the practical business of life, — those in which only small currents are used. We hope, however, that the author, when he realizes the eagerness with which books on such subjects, written by competent men, are looked for by all interested in the popular side of electrical progress, will give us something in a similar vein on electric lighting, transmission of power, electrical measurements, and other topics.

Mr. Walker explains, in easily understood terms, the every-day working of many of the forms of electrical apparatus with which experience has made us more or less familiar; that is to say, he explains, in language devoid of unnecessary technicalities, the working of an electric circuit, the properties and application of the magnet, and the theory and operation of galvanic batteries. He also gives some chapters to electric bells and their fittings, to electric mining signals and their operation, and to telephonic apparatus. But the most interesting chapter in the book is that which the author calls a "glossary of terms," but which is really something more. It is by far the best popular explanation of electrical terms, considering its brevity, that we know of; and, now that the daily press is giving us a brief respite from the "overhead wire" sensation, we would commend this glossary to the newspaper reporters, so that they may be prepared to do full justice to the technicalities of electricity as soon as that subject comes uppermost again. The multifarious uses of the electrical current have become so necessary a part of our daily life, that those who wish to speak or write intelligently of it must pay attention to its terminology.

The book is well printed, neatly and substantially bound, and is illustrated by 127 engravings.

The Works of Walter Bagehot. Ed. by FORREST MORGAN. Hartford, The Travelers Insurance Co. 5 vols. 8°. \$5.

THIS fine edition of Bagehot's works will be very welcome to students of theoretical and practical politics. The editor's original intention was to issue simply a reprint of such of the author's writings as had already appeared in England; but he soon found that the text was badly corrupted, owing mainly to Bagehot's slovenly style of writing, and to the fact that he often failed to correct his proofs. Proper names were found to be misspelled in many cases; grammatical blunders of the worst kind were numbered by scores; and, worst of all, the quotations, which are so frequent in the essays and elsewhere, were more often wrong than right. Many of these errors Mr. Morgan has corrected silently; but some of the quotations are so badly mangled that he has left them in the text as the author wrote them, and has given the correct form in a note. The works are prefaced by a memoir by Mr. R. H. Hutton, which was published in England soon after Bagehot's death. Then follow three volumes of essays, mostly biographical or literary; while the two concluding volumes contain the more elaborate works on "The English Constitution," "Physics and Politics," and others.

That Bagehot holds a high rank as a political thinker and writer is undeniable, for he was not only the author of the works here collected, but also a leader of thought on practical affairs by means of his editorials in the *Economist*; yet his writings are very unequal in merit. His political views were too oligarchical, and he even went so far as to applaud Louis Napoleon's *coup d'état*, and to hail the perpetrator of it as a savior of society. The work on "The English Constitution" is the best known, and in our opinion the ablest, though Mr. Morgan gives the preference to "Physics and Politics." The studies in economics are suggestive, and serve to correct and complete some theories of the earlier writers. This edition is a very handsome one; and, as it is sold at the extremely low price of five dollars, the publishers can only find their recompense in the reputation the work will bring them.

AMONG THE PUBLISHERS.

JOHN WILEY & SONS have in press the first part of a Ruskin bibliography.

—An interesting table of contents is presented in *Belford's Magazine* for November. Besides a complete novel, "In God's Country," by D. Higbee, there are several shorter stories and poems by well-known writers, some timely editorials, and a few book-reviews. Felix Oswald writes interestingly on the "Curiosities of Longevity;" "The Labor Problem" is discussed by Alfred F. Jury; and, under the title "The Failure of Democracy," Clinton Furbish points out the way to prevent such a catastrophe.

—Dr. William Perry Northrup has written for the December *Scribner* some picturesque impressions of a summer in Brittany, describing particularly the pardon of Ste. Anne d'Auray, a unique religious festival. Ex-Minister Edward J. Phelps, in his article on the age of words, writes rather disparagingly of contemporary fiction. Edgar Mayhew Bacon will present a humorous view of Bahama negro character.

—In an article on "Building Associations," in the December *Lippincott's*, Thomas Gaffney describes the benefits that accrue to the members of these institutions, tells how to form and run such associations, and points out their influence for good upon the nation at large. In "Novelistic Habits and 'The Morgesons,'" Julian Hawthorne gives his theories as to how novels should be written. In the same number William Shepard tells about "The Evolution of Famous Sayings," and shows how many famous *bon mots* and epigrams antedate the existence of the men who are generally supposed to have originated them.

—Robert Bonner's Sons have ready "Great Senators of the United States Forty Years Ago (1848-49)," by Oliver Dyer, at that time a reporter in the Senate for the *National Intelligencer*, which was forty years ago a widely circulated newspaper. The author came into close contact with the distinguished statesmen of his day, and gives personal recollections of Calhoun, Benton, Clay, Webster, Gen. Houston, and Jefferson Davis, and many less-known men.

—Gebbie & Co. have just issued a publication on a subject that is at present attracting attention, electricity. It is entitled "Babylon Electrified," and is written by A. Bleunard, a French scientist, and not only comprises an account of travels from London to Babylon, but demonstrates by imagination the present possibilities of electricity. It is illustrated by numerous engravings by Montader.

—Messrs. Putnam have issued a reprint of "Money," by James Platt, — a book that has had a large sale in England, though why it should have it is not easy to see. It is, indeed, a sensible and conscientious work; but it contains nothing new or striking, and the style is rambling and somewhat garrulous. It may be this very style, however, that makes the work popular. Mr. Platt's views are sound and practical, being in fact the views held by most English economists. He justly holds that a correct knowledge of money and credit is essential to the prosperity of a nation, and that such knowledge is not to be had without some study. He gives an account of the nature and uses of money and also of its history, and then follows chapters on banking, interest, panics, and other matters connected with the general theme. He shows a thorough knowledge of the subject, both in its theoretical and in its practical aspects, and the reader who is not familiar with the economics of money will obtain a good deal of information from its pages.

—In *The Chautauquan* for December, Professor James A. Harrison of Washington and Lee University has the first of a series of papers on the archaeology of Italy; "The Humors of Ignorance" is an article by W. S. Walsh, in which many instances are cited to show how ignorant an intelligent person may be on subjects which everybody expects him to know; W. T. Hornaday tells of the destruction of our wild animals; Dr. J. M. Buckley continues his discussion of "Traits of Human Nature;" an answer to the question "How can I become a distinct speaker?" is given by Professor R. L. Cunnock of North-western University; Ernest Lambert tells about the Island of Jersey, its history, its relics and antiquities, and the peculiarities of its people; the issue contains a study of "Modern English Politics and Society;" by J. Ranken Towse; there is an article by Professor R. F. Weidner, D.D., of Augustana Theological Seminary, on "Recent Objections to the Bible Answered;" some statistics are given in an article on "Working-Girls;" "An Indian's Memory, How Long is it?" is discussed by Egerton R. Young; and "Convict Labor in Alabama" is treated by Ernest Ingersoll.

—The Hon. Edward S. Phelps, lately minister to England, has prepared for the December *Forum* an article on divorce. A contribution to the literature of the controversy about Romanism will be made by Bishop McQuaid of Rochester, N.Y. He undertakes to show that the common-school system is paternalistic and socialistic in its tendencies, and that a gross wrong is done to Catholic parents by taxing them to maintain the public schools. The organization of farmers into granges, alliances, wheels, and combinations by other names, has for two years been going on at a much more rapid rate than ever before. The limit of the old grange movement has long ago been passed. These organizations now contain a membership of a million, and a movement is on foot to consolidate the granges, the alliances, and all the other combinations. An explanation of this movement, as well as of the aims and methods of each organization (all of which are secret), will be published in this number by W. A. Peffer of Kansas. An old plan to solve the race question in the South, namely, by promoting emigration to the West Indies, to Mexico, or to Africa, is revived simultaneously by persons who approach the problems from many points of view. The Mexican Government is reported to have the subject under consideration. A colored man from the South is lecturing in some of the Northern cities in favor of this scheme, and advocates of it are presenting it in books and periodical literature. Professor Henry A. Scowp of Emory College, Georgia, who looks at the subject from the Southern point of view and with sympathy for the colored race, has prepared an article for *The Forum*, in which he undertakes to show that assisted emigration is the only solution of the negro problem, and affords the only means of escape from dangers that constantly become more menacing.

Publications received at Editor's Office,
Nov. 4-16.

- ADAMS, M. The Continuous Creation. Boston and New York, Houghton, Mifflin, & Co. 259 p. 12°. \$1.50.
- CLARKE, T. C., and others. The American Railway: Its Construction, Development, Management, and Appliances. With an Introduction by Thomas M. Cooley. New York, Scribner. 456 p. 8°.
- DARNEY, W. D. The Public Regulation of Railways. New York and London, Putnam. 263 p. 12°. \$1.25.
- DUNTON, L., ed. The World and its People. Book I. First Lessons. Book II. Glances of the World. New York, Boston, and Chicago, Silver, Burdett, & Co. 319 p. 12°. 35 cents each.
- GRINNELL, G. B. Pawnee Hero Stories and Folk-Tales. New York, Forest and Stream Publ. Co. 417 p. 12°. \$2.
- HARNON, J. T. On the Creation and Physical Structure of the Earth. London and New York, Longmans, Green, & Co. 150 p. 8°. \$2.50.
- HULBERG, L. Niels Kihm's Wallfahrt in die Unterwelt. Ed. by E. H. Babbitt. Boston, Heath. 63 p. 16°.
- HUGG, V. Bug-Jargal. Ed. by James Boswell. Boston, Heath. 226 p. 16°.
- MACFARLANE, A. Elementary Mathematical Tables. Boston and London, Ginn. 105 p. 8°. 85 cents.
- MILLS, E. J., and ROWAN, F. J. Fuel and its Applications (being Vol. I. of Chemical Technology, ed. by C. E. Groves and W. Thorp). Philadelphia, Blakiston. 822 p. 8°. \$7.50.
- MORGAN, T. J. Studies in Pedagogy. Boston, Silver, Burdett, & Co. 355 p. 12°. \$1.75.

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— The Leonard Scott Publishing Company write us they are still publishing the *American Naturalist* in its serial order, notwithstanding the announcements or statements of other parties.

— The eighth annual series (1890) of "Johns Hopkins University Studies in History and Politics," edited by Herbert B. Adams, will be published in twelve monthly numbers, averaging fifty pages each, and will be devoted to history, politics, and education. Among the papers that may be expected are "The Beginnings of American Nationality; The Constitutional Relations between the Continental Congress and the Colonies and States," by Albion W. Small, president of Colby University; "Development of Municipal Unity in the Lombard Communes," by William Klapp Williams; "Local Government in Wisconsin," by David E. Spencer; "The Study of History in France, Germany, Belgium, and Holland," by Professor Paul Frédéricq of the University of Ghent, translated by Henrietta Leonard; "Spanish Colonization in the Southwest," by Frank W. Blackmar, professor of history and sociology in the University of Kansas; "Seminary Notes on Recent Historical Literature," by H. B. Adams, J. M. Vincent, W. B. Scaife, and others; "Higher Education of the People: A Series of Social and Educational Studies," by Herbert B. Adams of Johns Hopkins University; "Notes on the Government and Administration of the United States," by W. W. Willoughby and W. F. Willoughby. Other papers will be announced from time to time. Seven series of the "University Studies" are now complete. The publication of a series of notes supplementary to the "Johns Hopkins University Studies in Historical and Political Science" was begun in January, 1889. The following have thus far been issued: "Municipal Government in England," by Dr. Albert Shaw of Minneapolis; "Social Work in Australia and London," by Mr. William Grey of London; "Encouragement of Higher Education," by Professor Herbert B. Adams; "The Problem of City Government," by Hon. Seth Low of Brooklyn; "The Libraries of Baltimore," by Mr. P. R. Uhler of the Peabody Institute; "Work among the Working-women in Baltimore," by Professor H. B. Adams; "Charities: The Relation of the State, the City, and the Individual to Modern Philanthropic Work," by A. G. Warner; "Law and History," by Dr. Walter B. Scaife. These "Notes" are sent without charge to regular subscribers to the "Studies."

LETTERS TO THE EDITOR.

*Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

The Various Discoveries of Lake Mistassini.

My attention has been called to a communication of Mr. Jacques W. Redway in *Science* of Nov. 8, on the various discoveries of Lake Mistassini. I wish to correct a few misleading statements in it about the work of the Geological Survey of Canada. From Mr. Redway's letter it would appear that the Geological Survey was accountable for the various startling reports as to the immense size of the lake which have appeared from time to time during the past few years. This is not the case, as the only official reports on that region are those of Messrs. Richardson and McOuat in 1870 and 1871, and that of the writer in 1885. Mr. Bignall, who is credited by Mr. Redway with the survey of the lake, was employed by the Geological Survey and the Crown Lands Department of Quebec to make a complete survey of the lake in 1884, but, owing to certain reasons, was recalled before he had made any surveys on Lake Mistassini; and the work commenced by Messrs. Richardson and McOuat was continued and finished by myself. From the report of that survey, it may be seen that Mistassini is only one hundred miles long, with an average breadth of twelve miles.

Mr. Bignall and his sons are accountable for many of the stories as to the great size of the lake; but as they did not go around the lake, and have only Indian hearsay evidence for their statements, they may be taken for what they are worth against actual measurements.

It is a well-known fact that persons unaccustomed to the proper estimation of distances are liable to enlarge the portions traversed by them on great bodies of water, and to make the unknown parts often too small, thus greatly distorting the appearance of such lakes. These causes, along with those mentioned by Mr. Redway, would tend to throw Père Laure's map all out of proportion, and a more natural explanation of it can be given by taking these facts into account.

The lake was entered at the head of the south-east bay by the ordinary route from the Saguenay, as shown by the "Abanel portage," and the small southern portion of the bay enlarged and called "Lac Dauphin." "Lac des Père Abanel" extends as far as the narrows at the Hudson Bay Post; and "Jean Bay," from the Hudson Bay Post to the Big Narrows (Le grand percé). The point marked "Ancien Etablissement" is the point between the south-east and south-west bays, where the Indians still congregate in summer, to live on the fish which are there taken in great quantities.

The remainder and greater part of the lake is represented by that portion called "Lac des Mistassins," which, being unexplored, is made relatively much too small. By this interpretation of Père Laure's map we are not obliged to swing it 30°, dry up Lac Dauphin, and change the relative labels of different parts, to make it correspond with the modern map. Experience in the archæan region to the north of the St. Lawrence shows that the differences of level between the high and low lands there have reached almost a minimum, and consequently the denuding action of the rivers is very small.

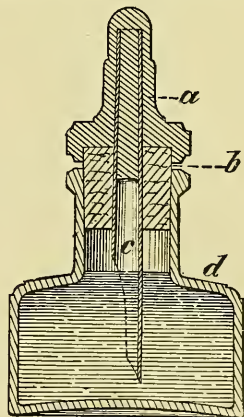
A. P. LOW.

Ottawa, Nov. 12.

INDUSTRIAL NOTES.

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Will exchange "Princeton Review" for 1883, Hugh Miller's works on geology and other scientific works, for back numbers of "The Auk," "American Naturalist," or other scientific periodicals or books. Write.—J. M. Keck, Chardon, Ohio.

I wish to exchange *Lepidoptera* with parties in the eastern and southern states. I will send western species for those found in other localities.—P. C. Truman, Volga, Brookings Co., Dakota.

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CALENDAR OF SOCIETIES.

Boston Society of Natural History.

Nov. 20.—S. H. Scudder, Distribution of Insects in the Rocky Mountain Tertiaries, and the Discovery of New Localities for collecting Fossils of this Group; W. M. Davis, Geographic Development of Northern New Jersey.

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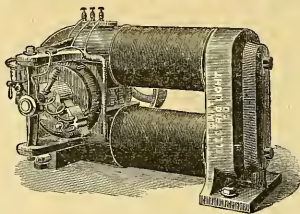
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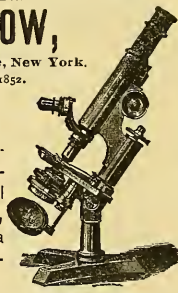
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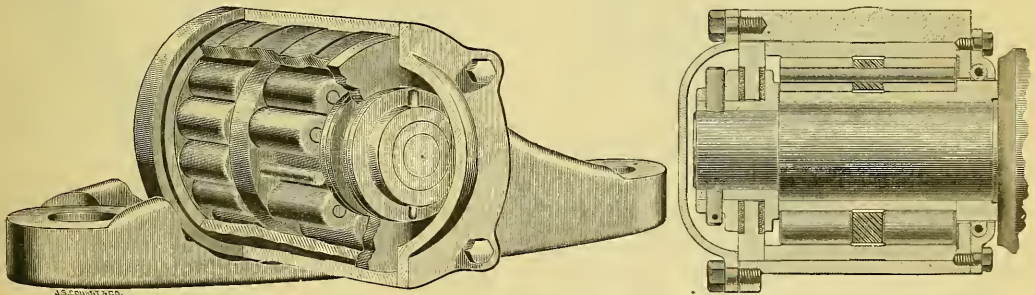
THIS bearing is adapted for use on car axles, dynamo-shafts, and similar places where there is high speed or heavy pressure, or both. It consists of a double set of rollers held in place by a sort of skeleton frame, and enclosed in a box of suitable construction. The rollers are of steel, of the same degree of hardness as when cut from the bar. They fit snugly around the shaft or axle, and bear against the inside of the box, revolving on their axes, and travelling around with the shaft, thus reducing the friction to almost zero, or, in other words, to rolling friction. Mr. J. A. Dyblie of the Chicago Arc Light and Power Company turned a six-inch shaft with his thumb and finger to and fro with the greatest ease.

The construction of the device may easily be understood by an inspection of the accompanying illustrations. Fig. 1 is a perspective view, with part of the outer shell or box broken away to show the interior, and one of the rollers removed to show the pin upon which it revolves. This pin, it must be remembered, performs no duty

the bearing is made dust-proof by a cap at one end and an expansive packing at the other, which, it is claimed, keep the lubricating material absolutely free from dust and water, so that it does not require renewal during the life of an ordinary chilled car-wheel.

Another advantage claimed is, that, when the brake is strongly applied, the strain comes on the rolls opposite the brake-shoe, causing no cramping, the axles turning as freely in the boxes as ever. In ordinary bearings the tendency is to crowd the journal out of the brasses, thereby reducing the bearing surface, inducing a tendency to heat when the journal returns to the centre of the box upon the release of the brake.

In a test of a two-inch journal in one of these bearings, under a pressure of four hundred pounds, without lubrication, it made a record of six thousand revolutions a minute for two hours without heating. Under a five-thousand-pound street-car, holding the regular number of passengers, a set of these bearings has been in use over two years with only one lubrication; and, though the car has been off the track the usual number of times, the bearings show no detrimental wear. They are now doing good service on about



ROLLER-BEARINGS FOR REDUCING FRICTION.

except to keep the roller in place when the shaft is removed, and to keep the roller in line with the shaft when in use. It bears no part of the weight of the shaft or axle, that all being transferred to the box by the rollers. Fig. 2 is a sectional view of the bearing, showing a very important feature; namely, the thrust-plate and collars, which take the end-thrust of the axle caused by the side-motion of the cars, as in going around a curve. This feature is shown at the left of the sectional view. The thrust-plate is bolted firmly to the box, and has two leatheroid collars — one on each side — between it and the thrust-collars, which latter are keyed to the end of the axle. This thrust-bearing has an area of sixty-three square inches, in contact at both ends of the car-axle, while that of the master car-builders' standard axle has an area of only seventeen square inches, in contact at only one end of the axle at a time.

It is stated, that, in a set of these bearings on a train running between Boston and Philadelphia, the rollers show a reduction in diameter of less than five one-thousandths of an inch, after a total service of forty-five thousand miles. They also remain uniform in size from end to end. This shows a very small amount of friction. Much of the long life of these rolls is doubtless due to the fact that

twenty street-cars, and are being applied to electric car-motors, stationary motors, shafting, and in various other places where a minimum of friction is desired.

FUNGOUS DISEASES OF PLANTS.

VARIOUS rusts, smuts, mildews, blights, and similar diseases of cultivated plants, have been generally known and dreaded since plants began to be cultivated. Any understanding of the cause of these troubles, of the conditions of their occurrence, and of their relations to each other and to the plants they infest, is a matter of comparatively recent acquisition even among botanists. Among American farmers and gardeners it is only recently that intelligent inquiry and thought regarding these important sources of loss have been awakened, and they are but just beginning to be popularly spoken of as fungous diseases. With this increased popular interest has naturally arisen an increased interest in their scientific investigation, which is as yet but fairly begun, and in the practical application of our technical knowledge in devising ways and means for checking the spread and preventing the ravages of the pests.

In the October bulletin of the Hatch Experiment Station of the Massachusetts Agricultural College, Professor James Ellis Humphrey, professor of vegetable physiology, summarizes the results of his investigations on the subject. It is doubtless true that to the average reader the term "fungus" carries with it no definite idea. This is due partly to the newness of the popular use of the term and the meagreness of generally accessible sources of information concerning the fungi, and partly to the inherent difficulty and technicality of the subject. To obtain a clear notion of organisms so small as to be barely recognizable by the naked eye, and requiring high powers of the microscope for their study, yet with such apparently disproportionate capacities for mischief, is not easy. It is for this very reason all the more important, that, in a discussion of fungous diseases intended for popular information, an attempt should be made at the outset to remove, so far as may be, this fundamental difficulty.

In the first place, then, a fungus is a plant — as truly and essentially a plant as the corn-stalk or rose-bush on which it grows. Yet it is not only much smaller, but also much simpler, than these. While the plant-body of the corn or rose shows much specialization of structure, having the various vegetative functions of the plant performed by distinct organs (the root, stem, and leaves), very many plants show no such specialization, but have all their vegetative functions performed by the whole plant-body, which then needs no variety of organs. Of the latter class of plants are the rockweeds and sea-mosses, the fresh-water pond-scums and the fungi, which are obviously much simpler and more primitive plants than those with roots, stems, and leaves. In all true fungi the plant-body consists of numerous simple or branching white threads which spread over the surface or through the substance of the object on which the fungus grows. These threads constitute the so-called "mycelium" of the fungus, and are comparable with the more elaborate plant-body of other plants, since they perform all its vegetative functions.

Equally important with its own healthy growth is the provision by any plant or animal for the perpetuation of its kind, and to this end it develops organs of reproduction. In many of those plants provided with root, stem, and leaf, these reproductive organs are grouped into a structure called a flower; and such plants are known as "flowering plants." They all produce, by the further development of certain parts of their flowers, structures known as "seeds," which can, under favorable conditions, develop into new plants similar to that which produced them.

Fungi do not produce flowers, and they vary greatly in their reproduction; but they all agree in producing bodies called "spores," — much simpler than seeds, as would be expected, but analogous to seeds in their ability to develop, under favorable conditions, into plants similar to those which produced them. These spores are usually produced on special fruiting or reproductive threads, which grow from the vegetative threads of the mycelium of the fungus. The reproductive threads may remain separate, thus producing their spores free in the air; or they may become interlaced or consolidated into a complicated fruiting structure, on which the spores are produced either superficially or in cavities, from which they finally escape into the air. The spores of fungi, being so small and light, are readily taken up and widely spread by currents of air, and are easily carried by insects from plant to plant. In such ways a fungous disease may spread from a single insignificant case until it becomes epidemic over a large area.

In the course of its life-cycle, the ordinary flowering plant passes from the seed, through the seedling, to the adult plant, bearing flowers and then seeds like that from which it grew. Many of the fungi, however, pass through a much more complex life-cycle, during which a given fungus may produce several kinds of spores, and assume several forms so unlike each other that they can be recognized as different stages of the same plant only by careful, patient cultivation and study. It is convenient to select some one stage of such a variable fungus as its perfect or adult form, and it is natural and logical to regard as such that stage in which the fungus shows the greatest elaboration of structure, while the simpler stages through which it passes are commonly called "imperfect forms." This tendency of fungi to variety in form, or "pleomorphism," as it is called, greatly increases the difficulty of their study,

and complicates those problems which concern the successful combating of fungous diseases.

A question which very naturally suggests itself is, "Why do fungi attack and cause diseases of other plants, instead of living independently?" This question involves matters of the greatest interest and of fundamental importance and significance. It is well known that all "green" plants owe their characteristic color to the presence of a definite pigment known as "leaf-green," or "chlorophyll," which is so generally present among the higher plants, that to most minds the very word "plant" carries with it the idea of greenness. Now, the possession of chlorophyll is the pre-eminent feature which gives to plants their all-important place in the economy of nature. No living thing can continue to live on inorganic substances, but all require as food some of those materials of comparatively complex chemical composition known as organic substances. The materials furnished by the earth, the air, and water are all of simple composition and unorganized; but in leaf-green we have the connecting link, the means of bridging the interval between the inorganic and the organic. Professor Humphrey does not discuss the process in detail. He thinks it sufficient for present purposes to say, that, in Nature's laboratory of the leaf, some of the simple constituents of air and water are combined, by the action of leaf-green in the sunlight, into the complex organic compounds which serve the plant as food. The chemistry of this remarkable process is not well understood, but the commonest permanent form in which these food-materials appear is that of starch.

Now, as was noticed above, the threads of the fungi are white, uncolored; that is, they contain no leaf-green: consequently the fungi cannot elaborate their own food-material, but must obtain it, ready elaborated, from some other source. Evidently the available sources of organic food-supply fall under two heads, — living organisms; and dead organic matter, commonly decaying. On this basis, the fungi may be divided into two classes, — those which derive their nourishment from other living things, and those which live on the remains of dead organisms. The latter, known as "corpse plants" or "saprophytes," include the moulds, toad-stools, and many other fungi; but the first-named group is that which at present is of interest, since it contains the various groups mentioned at the beginning, which live on or in the bodies of other living plants at their expense, and cause extreme weakening or even the death of the affected plants. Such fungi are known as "parasites," and the plants they attack are called their "hosts." This distinction between saprophytic and parasitic fungi is a very useful one; but no sharp line can be drawn between the two groups, since some fungi seem to be able to live either as parasites or as saprophytes, while it is probable that very many pleomorphic fungi are parasites in some of their forms, and saprophytes in other stages of their life-cycle.

Finally, the interesting fact may be noted, that any given parasitic fungus is usually restricted in its capacity for harm to a single host-plant or to a few closely related ones; though, on the other hand, closely related fungi may attack plants of widely different relationships. Thus, the mildew of the lettuce and that of the onion are very closely related fungi; yet neither mildew can attack the host-plant of the other, since the structural resemblances are few and the relationship remote between the lettuce and the onion.

From the above facts may be derived a few important principles for guidance in attempts to avoid or check the ravages of fungi among plants cultivated for use or beauty. Since the mycelium of a parasitic fungus grows usually within the tissues of its host-plant, it is too late to try remedies after a plant is once infected. It is true that a few fungi are superficial in growth, and a treatment may perhaps be found which shall destroy such parasites without harm to the host; but in most cases the aim must be to fortify exposed plants against infection by the timely application of protective solutions or mixtures, which shall prevent the germination of the spores which fall upon the plant so treated. Some progress has been made in this direction, and some results have been reached which justify hopes of ultimate general success in largely avoiding the present enormous annual losses resulting from fungous diseases.

The treatment which now gives promise of most general applicability and efficiency is the spraying of the plants with a solution of sulphate of copper (blue-stone) or with one of the preparations in which it is the important ingredient, known as "eau celeste," "Bordeaux mixture," etc. It seems very possible, too, that plants may be fortified against the attacks of parasitic fungi, or their susceptibility to such attacks be largely diminished, by special fertilization, for the purpose of introducing into the plant substances which, while not interfering with its growth, shall make it a less congenial soil for the growth of fungi. The line of investigation here suggested has not yet been followed out, although it offers an opportunity for chemo-physiological work which may yield important results. It is obvious, also, that a vigorously healthy plant will resist the fatal influence of parasites far better than a poorly nourished one.

Much may be done, after a plant is too far gone to be saved, to prevent further spread of the disease, by removing and destroying the diseased parts. It is not sufficient, however, to throw the portions removed into the rubbish heap: the spores must be actually

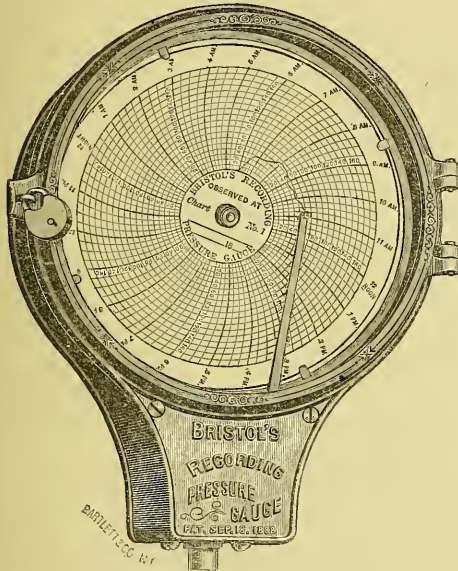


FIG. 1.

A NEW RECORDING PRESSURE-GAUGE.¹

IN designing the recording pressure-gauge herewith illustrated, the object was to produce an instrument which would be fundamentally simple, and consequently reliable, and which could be placed upon the market at a moderate cost.

Fig. 1 represents the instrument complete, and ready for application. Fig. 2 shows the pressure-tube with the inking-pointer attached; the front of the case, dial, and cover of clock, being removed. The pressure-tube *A* is of flattened cross-section, and bent into approximately a sinusoidal form. A flexible strip *B*, of the same metal as the tube, is secured at the ends and along the bends, as shown in Fig. 2. The bent tube may be considered as a series of Bourdon springs placed end to end.

Pressure applied to the tube produces a tendency to straighten each bend, or collectively to elongate the whole. This tendency to lengthen the tube is resisted by the flexible strip *B*, and thereby converted into a multiplied lateral motion. The inking-pointer is attached directly to the end of the pressure-tube, as shown in Fig.

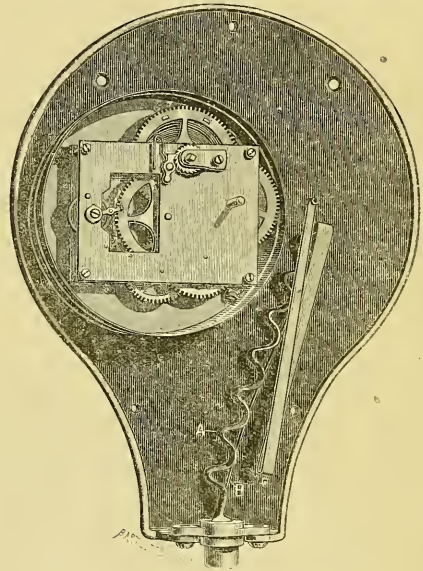


FIG. 2.

destroyed, and this can be effectually done only by burning. A considerable number of fungi produce, in the plants on which they live, resting-spores, which ordinarily remain on or near the ground in dead leaves or stubble, survive the winter, and, germinating in the spring, infect the new growth. In these cases the danger of a severe attack in the following year can be greatly lessened by clearing up and burning all such sources of infection.

Numerous instances can be cited of more or less common weeds or wild plants so closely related to certain cultivated plants that they are liable to the attacks of the same fungi, and so serve to perpetuate those fungi, and to infect the related cultivated plants when growing near. Evidently, then, such plants should be carefully and thoroughly exterminated wherever they may prove a source of danger.

Professor Humphrey then went on to speak of the application of the foregoing facts and principles in the consideration of a few particular fungous diseases.

W. T. DENNIS, commissioner of fisheries for Indiana, has issued a call for a State convention of the disciples of the rod and reel, and dog and gun, to meet at Indianapolis, Ind., on Thursday, Dec. 19, at noon.

2, from which it will be seen that the usual mechanism and multiplying-devices are dispensed with, since the motion of the tube itself is positive and of sufficient range. The special advantage of this is evident, considering that in all other pressure-gauges the movement of the tube or diaphragm is small, and requires a system of mechanism to multiply the motion many times before it is available for indicating purposes. These multiplying-devices must be delicately constructed and properly cared for, and even under the most favorable conditions they are liable at any moment to be a source of error.

In the instrument illustrated the tube is designed for a range of one hundred and eighty pounds per square inch; for other ranges its sensitiveness may be varied at will by changing its proportions, as length, shape of cross-section, or thickness. The printed charts for receiving the record make one revolution in twenty-four hours, and are provided with radial arcs and concentric circles, the divisions on the radial arcs corresponding to differences in pressure; while those on the concentric circles correspond to the hours of the day and night.

During the past year and a half, several of the instruments have

¹ Paper read by W. H. Bristol of Hoboken, N.J., before the American Society of Mechanical Engineers, at its meeting, Nov. 21, 1889.

been in operation upon the steam-boilers at Stevens Institute, and have given perfectly satisfactory results.

In regard to making the tubes alike, it will be well to state that there has been no difficulty in producing a number in which the deflections were equal for equal pressures, and which have been directly applied to a standard chart, without adjustment. It will be readily seen, that, in case there should be slight differences in the deflections, such differences may be allowed for by raising or lowering the tube with reference to the dial. This is equivalent to shortening or lengthening the deflections along the radial arcs. For an indicating instrument, it is only necessary to provide a graduated arc for the end of the tube to move over.

It is evident that the instrument is adapted for a vacuum as well as for a pressure-gauge, and it naturally follows, that, if sufficiently sensitive, it will serve as a barometer, and measure changes of atmospheric pressure.

The model herewith exhibited for this purpose was made by electro-deposition of nickel upon a piece of solder of the proper form, the solder being afterward melted out in oil. The walls of this tube are $\frac{1}{100}$ of an inch thick. When this tube is exhausted of air and sealed, as shown, it gives a deflection of about three inches and a half for an external change of pressure of one atmosphere.

Another application of the pressure tube is in the recording thermometer. The tube may be filled with a very expansible liquid, such as alcohol, and sealed. Variations in temperature produce expansion of the enclosed liquid, which, in turn, gives deflections of the tube to correspond. These deflections may be used to record directly, without multiplying-devices, as shown in one of the models.

The tubes of the pressure-gauges to be inspected have been made by the writer at Stevens Institute, for the purpose of thoroughly testing the novel form. The results have been perfectly satisfactory, and our recent experience in manufacturing has demonstrated the possibility of duplicating the tubes in quantities for a standard chart.

NOTES OF TOMATOES.

PERHAPS the most frequent and noteworthy observation made upon the culture of the tomato during several years of experimentation with the plant at the Cornell Agricultural Station has been the great increase in vigor and productiveness which comes from careful handling and good tillage. It often appears as if this vigor is not only characteristic of the immediate generation, but that it is hereditary for a time to a profitable degree. "Handling" or transplanting of young plants, when frequently and properly done, is invaluable; and, so far as the plant is concerned, three or four transplantings are better than one. In the station work, in order to get the greatest results from tests, the plants are handled in pots, preferably rose-pots, and are transplanted several times. The handling is expeditious, and is not too expensive for the use of any one who grows tomatoes for home use. For market culture they find that two transplantings are usually profitable. Stocky plants, vigorous, and growing rapidly, are better than simply early plants, however; and frequency of transplanting must not be confounded with early sowing and consequent necessity for several shiftings. Tomato-plants—or any plants, in fact—should not be shifted for the simple purpose of preventing crowding or "drawing." Transplanting serves the purpose of maintaining a steady and symmetrical growth, and it should occur before the plant becomes checked from neglect. A good tomato-plant at the time of setting in the field, is one which is stocky enough to hold the weight of the earth and pot when a number of plants are grasped in the hand by their tops, and are carried along the rows. They require no staking when set. A tall and weak plant with a blossom on the top is not considered worth setting. It is a common mistake to set tomato-plants in the field too early. Cold nights, even though several degrees above frost, check the plants, sometimes seriously.

How early the plants should be started for profit is a question which demands attention. A few writers have maintained of late that nothing is gained in earliness and productiveness by early starting under glass. This is undoubtedly true if the early plants

are not well grown, but the Cornell experience is quite to the contrary with stocky and vigorous plants. Whether this increase is worth what it costs, is a question which must be answered by every grower for himself.

In every instance the early-sown plants gave earlier fruits than the others; and in every case but one, in which the yields were practically the same, the total yield is much greater. The gain in earliness sometimes amounts to three or even four weeks. The disadvantage of very late planting (middle of May) is particularly pronounced in the results at Cornell, especially in point of productiveness. This productiveness, however, is really a measure of earliness, inasmuch as it simply records the weight of fruit which had ripened up to Oct. 10, when the tomato season was closed by frost. Could the season have been sufficiently extended, no doubt the ultimate productiveness of the various plantings would have been the same.

It is a common notion that soils containing little or no manure are preferable to well-enriched soils for tomato-growing. It is supposed that rich soils tend to make vine at the expense of fruit, causing lateness of maturity and consequent lessening of yield; and the supposition is prevalent that rich soils tend to make fruits "rougher," or more irregular in shape. A careful test upon these points has been made during the past season at Cornell, with the result that heavy manuring for tomatoes may give decided benefits; yet it is possible that the character of the soil or season may have much to do with the behavior of the plants under these conditions.

The manuring of one plat was excessive, but the gain due to the very heavy dressing was not sufficient to pay for the extra cost. But if excessive manuring did not greatly increase yield, neither did it always tend to an unprofitable production of vine at the expense of yield and earliness, as is commonly supposed.

The tomato is one of the most variable and inconstant of kitchen-garden plants. As a rule, varieties differ but slightly from their allies, and a considerable plantation and a critical eye are needed to determine many of even the common sorts. It is certainly true that at least half of the varieties which have been offered in the last few years are practically the same as other varieties.

Varieties of tomatoes are as a rule short-lived. Ten years may be considered the average profitable life of a variety, and many sorts break up and disappear in two or three years. This inconstancy of type is largely due, no doubt, to the haste with which new sorts are put upon the market.

The demand in tomatoes now calls for fruits which are regular in shape, solid, large, and plants which are productive. The old angular sorts are rapidly disappearing in commercial practice. There has been no gain in earliness for the species for many years, if at all, and little if any need be expected. The cherry and plum sorts, with a few of the angular-fruited and wrinkled-leaved varieties, are still the earliest sorts. Yet comparative earliness between commercial varieties is an important consideration. There is also no gain in capability to resist rot: the cherry, plum, and angular sorts are still most exempt, the cherry and plum varieties entirely so.

An experiment was undertaken to determine if keeping qualities are correlated with solidity. Representative samples of many varieties, taken so far as possible in the same stage of maturity, were placed together upon a forcing-house table, and the fruits were removed as soon as they began to decay. It was found that some of the frailest varieties kept the longest. It appears, therefore, that solidity must be measured by a general judgment rather than by any definite expression. This conclusion is quite at variance with common opinion.

Much has been said concerning the superiority of certain varieties for cooking purposes, aside from quality of fruit. There is said to be characteristic differences between varieties in time of cooking and amount of shrinkage. A painstaking cooking test was made with a few varieties, but the results are so variable as to appear to be merely accidental or characteristic of individual fruits. The fruits were cut into thin slices and placed in boiling water. The shrinkages in weight and bulk do not appear to be correlated. In some instances shrinkage was slight, while in other varieties, equally as solid and good, it was great.

Four-fifths of the varieties of tomatoes now offered by dealers possess no points of superiority for general culture. It should be borne in mind that a variety which is simply good is not worth introducing. It must present some point of decided superiority over the best kinds at present known, in order to possess merit. This fact appears to be commonly overlooked in all classes of vegetables, and every year the grower is bewildered with the display of novelties.

HEALTH MATTERS.

IS MAN LEFT-LEGGED? — Dr. W. K. Sibley read a paper before the British Association in which he argued that man was naturally left-legged. Standing working with the right hand, there was a tendency to balance on the left leg. Race-paths were nearly always made for running in circles to the right, and the majority of movements (such as dancing, running, etc.) were more readily performed to the right. In walking it was natural to bear to the right; crowds as well as individuals did so. Troops started off with the left foot; the left foot was placed in the stirrup or step of the bicycle in mounting; the left foot was the one from which a man took off in jumping. *The Medical Record*, to which we are indebted for the above information, goes on to say, that, from measurements made by Dr. Garson of the skeletons of the two legs, in 54.3 per cent the left leg was the longer, and in 35.8 the right. From measurements of 200 pairs of feet, it was found that in 44 per cent the left, and in 21.5 the right, was longer, while in 34.5 they were equal.

THE STOMACH-BRUSH. — A dental journal publishes the following, translated from the German: In 1713 there was published a pamphlet entitled "A Complete Account of the most Useful Stomach Brush which is now to be had at the Brushmakers at the Old Court Sadler's Shop in Broad Street in Colln-on-the-Spree." Many a one may have wished to be able once in a while to have his stomach thoroughly cleaned out, and this speculative brush-maker gave a practicable means to give effect to this wish. In the pamphlet there is a drawing of the stomach-brush: it resembles a pipe-cleaner, but of course is larger. The stalk is made of four wires twisted together, covered with thread, silk, or small ribbons: it is twenty-six inches long. The brush at the under end is two inches long and one and a half broad, and is made of goat's-beard hair; but, when one has been accustomed to use it for three or four weeks, a horse-hair brush is substituted, this hair being somewhat stronger, and so the effect is better. The application of this most excellent brush is very simple. It is pressed through the throat down into the stomach, which, by drawing up and down of the brush, is cleaned. Thereafter cold water or brandy is to be drunk, and the operation is repeated till the cleaning is perfect. The cure is to be repeated every morning. The author says, according to the *British Medical Journal*, "At first you will find it rather troublesome to get the brush down, but when you put it in your mouth and on your palate, draw in breath and wind, and press it gently and gradually down, and, without any particular trouble, it will reach the stomach. After eight to fourteen days' practice, it will come as easily to you as eating or drinking." Of course, the daily application of the stomach-brush is the infallible remedy or preventive of all diseases that can be imagined. "Whoever uses this cure requires no other medicine, for it is good against all—cold, hot, and poisonous fevers, it gives a good appetite for eating, it is good against asthma, hemorrhage, headache, chest complaints, coughs, consumptions, apoplexy, toothache, sore eyes, dysentery, quinsy on the tongue, quinsy in the throat, ulcers, abscesses, cardiacity: it favors digestion, strengthens the heart, drives away pimples on the skin, is against choking in the stomach, etc., makes too fat and asthmatical and swollen-up people thin, and, on the other hand, makes meagre and thin people fat. The great effect, however, is produced only when the use of the brush is combined with that of an elixir. This is compounded of aloes, saffron, rhubarb, lark-mushroom, wormseed, eugian, myrrh, theriac. After the stomach-washing, forty to fifty drops of the elixir is to be taken in wine, and this preserves for twenty-four hours against all poison and pestilence."

VACCINATION ON THE LEG. — A French practitioner, in the course of a large number of revaccinations, was struck with the fact that the operation was far more successful when performed on the leg than when the arm was selected. He has since availed himself of an opportunity of verifying his first impression; and last year, having to revaccinate 177 school-children, he chose the left leg in 99, and the left arm in 78, and carefully compared the results obtained, dividing them into three groups according as the eruption was typical, doubtful, or absent. Of the 99 cases vaccinated on the leg, as we learn from the *Medical Press and Circular*, 23 were typical, 31 doubtful, and 45 unsuccessful, being equivalent to a percentage of 23.2 and 31.3 respectively. Of the 78 children vaccinated on the arm, the numbers were 11 typical, 25 doubtful, and 42 failures, equal to 14.1 and 32 per cent respectively. The percentage of failures was 45.45 on the leg, as compared with 53.84 on the arm.

AFRICAN JUMPERS. — Dr. Bennett of Griqualand writes in the *South African Journal* an account of a peculiar nervous affection which is met with among the Griquas and other natives and individuals of mixed descent living in Griqualand. He suggests that perhaps the affection is similar to that prevalent among the French Canadians, and known there by the name of "jumpers." Dr. Bennett says, "The affection is entirely confined to the male sex, and I have never seen or heard of a case in the female. The victims of this strange form of neurosis go through the most extraordinary and grotesque antics on the slightest provocation. A whistle, a touch, a shout, — any thing, in fact, sudden and unexpected, — will 'set them going.' Some will stiffen their limbs, make hideous grimaces, and waltz about as if they had no joints in their body. Others will jump wildly about like dancing dervishes, imitating the particular sound that had acted as an exciting cause. Some, again, will make use of the most obscene expressions on a transient impulse, correcting themselves immediately afterward, and expressing their regret for having used such language; while others, on the spur of the moment, will do any thing they are told to do. If they should happen to have a piece of tobacco in their hand, and one should suddenly shout, 'Throw it away!' they will do so at once, running away for a short distance, and trembling all over their body. I remember one case in particular: it was that of a 'bastard' boy, a mason by trade. He had been handed a piece of tobacco, and the person who handed it to him shouted out suddenly, 'Throw it away: it is a snake!' He first danced about wildly for a short time, and then ran away as fast as he was able; but he had not gone far, when he fell down in a 'fit,' and it was some time before he recovered."

SMALL-POX. — Dr. Lewentaner of Constantinople, writing in the *Bulletin Général de Thérapeutique*, No. 32, 1889, speaks very encouragingly of the success attending an antiseptic method of treating this disease, which he tried in several cases. The advantages of this method of treatment are summed up by *The Medical Record* as follows: 1. All the children treated in this way recovered, although the ordinary mortality of the disease is forty per cent. 2. The duration of the disease was decidedly shortened, the period elapsing from the commencement of the eruption to the falling-off of the crusts being twelve or thirteen days. 3. The disease ran its entire course almost without fever. 4. The danger to those around the patient is greatly lessened. In Dr. Lewentaner's cases there were other children exposed, but, notwithstanding that they were not vaccinated, they did not contract the disease. 5. The simplicity of the method, as compared with the treatment by baths and cold applications, has much to recommend it. 6. Æsthetically, also, the antiseptic method of treatment offers great advantages, since it prevents absolutely all pitting.

HEREDITY OF ACQUIRED CHARACTERISTICS. — Professor William H. Brewer of Yale read a paper on the above subject at the recent meeting of the National Academy of Sciences in Philadelphia. He combats the view of Weismann, who has published a volume in support of the proposition that characteristics acquired by individuals are not transmissible. Weismann supports this proposition by experiments on mice, whose tails he cut off for successive generations, without inducing a tailless diathesis in their offspring. Brewer discussed four kinds of variation: 1. Variation

in size; 2. Variation caused by exercise, training, and education; 3. Variations due to disease; 4. Characters assumed as the result of accident or mutilation. It is well settled that abundance of food affects the development and size of the individual and of the offspring. All cattle-breeding proceeds on this postulate. A good example of the second class of variations is afforded by the evolution of the trotting horse, which began during the present century, and has proceeded so far as to produce a breed of horses which have actually lost the instinct to run, and trot even while they are young. Variations due to disease are equally powerful, but less susceptible of demonstration. An example is ringbone in horses, caused by accident to the individual, but transmitted to offspring. As regards heredity of mutilations, numerous instances are cited, among which were enumerated several cases of malformed fingers in offspring of parents whose fingers had been injured by accident. Conspicuous instances of sports developing into varieties are certain forms of merino-sheep, and sequoia-trees of a certain type of foliage. Professor Brooks, in discussing the paper, according to the abstract in *The Medical Record*, opposed Brewer's view, and said that adaptations of nature have been evolved for the good of the species, not for that of the individual: hence they are not ordinarily transmitted, and the inherited effect of the influence of environment bears no appreciable effect on the evolution of species. Thus the larva of worker and drone bees is protected by an envelope of silk all around, while that of the queen bee leaves the abdomen unprotected, for the obvious purpose of enabling the mature queen to sting her larval rival when the swarming season is over, thus sacrificing the individual for the good of the community. The generation of polymorphic hydroids is an instance where the functions of generation are not exercised by the working members of the group, so that instincts acquired by experience are not transmitted. The bodies of all animals are similar polymorphic aggregations of cells. The cells of the body which are exposed to external influences and vicissitudes are outside the line of succession in generation. Dr. H. C. Wood of Philadelphia also opposed Brewer's conclusions. He doubts whether there is such a thing as hereditary disease. It is not the disease, but the liability to disease, that is inherited; in other words, the lack of power of resistance to external irritation. Consumption, for instance, is caused by the presence of an organism, the bacillus. This bacillus is certainly not inherited. We all breathe it, but not all become consumptive. Persons who have not sufficient power of resistance are affected by disease. These persons have inherited a weak constitution, or their powers of resistance have been weakened. This is all the heredity there is about it.

NOTES AND NEWS.

THE recent great reduction in the price of aluminum, made possible by improved methods of production, will doubtless lead to its adoption, to the exclusion of other metals, in the manufacture of transits, compasses, field and opera glasses, hand-levels, etc. The fact that it takes a beautiful finish, has a low specific gravity, is easily worked, and is practically non-corrosive, makes it the ideal metal for such purposes.

— The properties of quicksand are thus described in the *Mechanical News*: "The difference between building-sand and true quicksand is most easily explained by comparing building-sand to road-metal, while the quicksand must be represented by fragments no larger than large buckshot, but shaped like very smooth potatoes. In a word, the quicksand is small and thoroughly water-worn, so that every fragment has been deprived of all its angles and fairly well polished. Its particles are very small as compared with those of the building-sand. The smaller the size and the more complete the rounding, the more nearly will the sand approach a liquid condition when it is moistened. The first glance at a fairly mounted sample of quicksand under a microscope is sufficient to show that the quickness of the sand is amply accounted for by the innumerable friction-wheels which the particles themselves furnish. Sharp or building sand, on the other hand, will show few round corners, many angles, corners, and a general condition like that of broken stone. Sea-sand is often unfit for building, even though perfectly deprived of its salt, the reason being that the particles

have been worn and polished till they have no more binding-power than so many cobblestones. It is well to remember that quicksand when dry, if very fine, shows the same properties as a liquid. In holding up the centres of large bridges, it is sometimes put into cylinders with a plunger on top of it. It will, when thus confined, hold up the load like a column of water. When it is desired to strike the centres, a plug is drawn out of the side of the cylinders, and the sand flows out like so much water. The advantage, of course, is that the sand does not need a packed piston, and does not leak out, though the work be prolonged for years. Quicksand, when dry and confined, forms an admirable foundation, and when wet can be loaded over its whole surface, and give a good support if side openings can be avoided.

— According to the Paris correspondent of London *Industries*, the Maussier process of manufacturing aluminum is coming to the front, for it is announced that one of the largest engineering firms has undertaken to work it on an extensive scale. The process, he continues, comprises three distinct periods and kinds of operations,—the desilicification, the reduction, and the liquation. The desilicification is effected by means of fluorine or fluoride of calcium at a high temperature in the presence of carbon. Lime, or the carbonates of potassium or sodium, may be added to facilitate the decomposition of the silicate. The reduction or expulsion of the oxygen is obtained by means of iron and manganese raised to incandescence in the presence of carbon. The liquation, the object of which is to separate the aluminum from the iron and the manganese, is effected by dropping the molten mass into carbon ingot moulds. These moulds are made of wood-charcoal. The aluminum so obtained is nearly pure.

— To add to the many obligations under which he has laid Cambridge University, Professor Sidgwick has offered to give £1,500 towards the completion of the new buildings urgently required for physiology, on condition that the work is undertaken forthwith. The Financial Board has accordingly recommended a scheme by which this can be effected. *Nature* adds, "The alliance between mental science and physiology which this gift represents is a bright feature of Cambridge studies at present."

— A novel and interesting application of science to art may now be seen at the Arts Exhibition, London, where Mrs. Watts Hughes shows specimens of what she calls "voice figures." As described in *Nature*, these are practically Chladni's figures produced in a viscid medium. Semi-fluid paste is spread on an elastic membrane stretched over the mouth of a receiver. A single note "steadily and accurately sung" into the receiver throws the paste into waves and curves. The patterns formed are either photographed immediately after production, or are transferred as water-color impressions while the membrane is still vibrating. Fanciful names, e.g., "wave," "line," "flower," "tree," "fern," are given to these. The effect, especially in transparencies, is very beautiful. Some of the forms would repay the study of physicists as well as of artists. The most interesting are perhaps the "daisy forms," in which we are told that "the number of petals increases as the pitch of the note which produces them rises." The apparatus employed is not exhibited, and the descriptive label is not very clear, but we understand that Mrs. Hughes would be most pleased to explain the matter to any one scientifically interested in it. Her address is 19 Barnsbury Park, N.

— The recently established Geological Survey of Arkansas, of which Dr. John C. Branner is director, has taken up its work with remarkable vigor and success. The first volume, containing the administrative report for 1888 and a report on the geology of western central Arkansas, was rapidly followed by the second, on the neozoic geology of south-western Arkansas, the body of which is the result of the joint work of the United States Geological Survey and of the Geological Survey of Arkansas. By this co-operation Professor Robert T. Hill was able to extend his studies on mesozoic geology over Arkansas, and the volume is chiefly taken up by his report. The third volume is a preliminary report upon a portion of the coal-regions of Arkansas, which will be followed by a fuller report later on, as topographical as well as geological work is still being carried on.

— The medals of the Royal Society have this year been awarded as follows: the Copley medal to the Rev. Dr. Salmon, F.R.S., for his various papers on subjects of pure mathematics, and for the valuable mathematical treatises of which he is the author; a royal medal to Dr. W. H. Gaskell, F.R.S., for his researches in cardiac physiology, and his important discoveries in the anatomy and physiology of the sympathetic nervous system; a royal medal to Professor Thorpe, F.F.S., for his researches on fluorine compounds, and his determination of the atomic weights of titanium and gold; and the Davy medal to Dr. W. H. Perkin, F.R.S., for his researches on magnetic rotation in relation to chemical constitution.

— The rapid decrease in the number of kangaroos is beginning to attract the attention of scientific societies in Australia. From the collective reports of the various stock-inspectors it was estimated that in 1887 there were 1,881,510 kangaroos. In 1888 the number fell to 1,170,380, a decrease of 711,130. The chief obstacle to the adoption of measures for the effectual protection of the kangaroo, says *Nature*, is his vigorous appetite. One full-grown kangaroo eats as much grass as six sheep; and graziers, who as a class are not, it is to be feared, readily accessible to the influence of sentiment, find that the food eaten by this interesting animal might be more profitably utilized otherwise. In a communication on the subject, lately submitted to the Linnean Society of New South Wales, Mr. Trebeck suggested that the National Park might be used for the preservation not only of kangaroos, but of very many members of the Australian fauna and flora.

— The following, from a circular in regard to a one-thousand-dollar prize manual, may interest some of our readers: "The American Secular Union, a voluntary association having for its object the complete separation of Church and State in practice as well as in profession, and in no way committed to any system of religious belief or disbelief, acting herein by its president, Richard B. Westbrook, A.M., LL.D., as its special trustee and attorney-in-fact, hereby offers a premium of one thousand dollars lawful money of the United States for the best essay, treatise, or manual adapted to aid and assist teachers in our free public schools and in the Girard College for orphans, and other public and charitable institutions professing to be unsectarian, to thoroughly instruct children and youth in the purest principles of morality without inculcating religious doctrines; thus recognizing the legal right under our Federal Constitution of all our citizens, Jews and Gentiles, Catholics and Protestants, Liberals and Agnostics, and all other classes, whether believers or disbelievers, to have their children instructed in all the branches of a common secular education in our State schools, without having their tender minds biased for or against any sect or party whatever. It is desired that the manual for which this premium is offered shall not be a reading-book for schools, nor a mere code of morals, much less a system of ethical philosophy, but rather a concise yet comprehensive and suggestive exhibit, with familiar and practical illustrations of those universal foundation principles and axiomatic truths which underlie all sound morality and rightfulness, thus developing and educating that inherent moral sense which is more or less common to all rational human beings. In short, to show how to teach children the natural and essential difference between right and wrong, and the reasons therefor, without reference to sacerdotal creeds and sectarian dogmas, is the chief object to be kept in mind in writing for this premium; as it is the unquestionable right of every tax-payer and citizen of this free Republic to have their children educated in our common schools without having their minds prejudiced on those disputed subjects which may safely be intrusted to the family, the churches, and the Sunday-schools, where they properly belong. While each writer will be expected to confine himself or herself to the main object of this offer, the widest practical freedom in the form and range of treatment will be allowed, but all prejudice and partisanship regarding current controversies should be scrupulously avoided. The manual should not contain less than 60,000 words, nor more than 100,000, though these limits will not be insisted upon in a work of special merit. The papers should all be submitted by April 1, 1890, though more time will be granted if necessary; but the committee will be ready to receive manuscripts by the first day of January, 1890. Each manuscript

should be in typewriting, or at least should be very legibly written, to insure a careful reading, and should have a special mark or designation, and the name and post-office address of the author should be sent at the same time in a sealed envelope—not to be opened until after the award is made—bearing the same mark, and both addressed to R. B. Westbrook, No. 1707 Oxford Street, Philadelphia, Penn., post or express prepaid. Unaccepted manuscripts will be returned to the writers at their own expense, and the accepted manuscript shall become the exclusive property of the Union, to be held in trust by the trustee herein named; and the premium of one thousand dollars will be promptly paid, without discount, when the copyright is thus secured. The money is now on deposit, in trust, with the Guarantee Trust and Safe Deposit Company in Philadelphia, for the object contemplated. A representative and impartial committee shall in due time be carefully selected by the subscribers to this fund or a majority of them, to act as judges of the manuscripts submitted, and to award the prize. The trustee herein named shall be a member and the chairman of said committee, whether he continues in the presidency of the American Secular Union or not. Writers of all nations are invited to join in the friendly contest, and the award will be made without regard to nationality or sex."

— The National Educational Association and Council of Education have decided to hold their next annual conventions at St. Paul, Minn., July 4 to 11, 1890. Hon. James H. Canfield of Lawrence, Kan., is president of the association. It is expected that there will be twenty thousand teachers present from all points of the Union. The Western railroads have already agreed to give half rates, plus two dollars membership fee, to all persons who attend; and Eastern and Southern roads will make low rates, which will be announced at an early date. St. Paul has organized a local executive committee, and the most complete arrangements are being made to give the teachers a welcome to the North-west, and to make the meeting a great success. There will be ample hotel accommodation at reasonable rates. Local excursions are being planned to all important points of interest in the North-west and on the Pacific coast, which will furnish teachers with the finest summer holiday trips that they ever enjoyed. The official "Bulletin," containing programmes, rates, and full particulars, to be issued in March, will be sent free by addressing S. Sherin, secretary local executive committee, St. Paul, Minn.

— A remarkably interesting paper on the last living aboriginal of Tasmania was read by Mr. James Barnard at the meeting of the Tasmanian Royal Society about two months ago. It has hitherto been generally believed that the aboriginal Tasmanians are extinct. Mr. Barnard, however, as we learn from *Nature*, contends that there is still one survivor,—Fanny Cochrane Smith of Port Cygnet, the mother of six sons and five daughters, all of whom are living. She is now about fifty-five years of age. Fanny's claims to the honor of being a pure representative of the ancient race have been disputed, but Mr. Barnard makes out a good case in her favor. He himself remembers her as she was forty years ago, when there were still about thirty or forty natives at Oyster Cave; "and certainly at that time," he says, "I never heard a doubt expressed of her not being a true aboriginal."

— No question in the range of agricultural subjects discussed is awakening more interest among New York's 350,000 farmers than the subject of cattle-foods and their economical use in feeding rations for the production of milk, and its products butter and cheese. This being true, it is believed that the information derived from scientific investigation, along with the practical experience of New York cattle-feeders, will be welcomed by dairymen as one advance step towards successful dairying. New York State has one and a half million milch cows, probably producing, on an average, less than three thousand pounds of milk per year; and the average annual butter product per cow for the State is undoubtedly less than one hundred and thirty pounds. This should not be, when there are whole herds averaging three hundred and some four hundred pounds of butter per year for each cow. Animals producing these by no means phenomenal yields are not confined to any particular breed, and are often grades of our so-called native

or no-breed animals. Proper selection, systematic breeding, and judicious feeding have produced these profitable animals and herds. What has been accomplished by the few should be striven for by the many, and feed must be a prime factor in developing the ideal dairy animal or herd. Careful breeding and selection must hold the most prominent place; but breeding and selection, unless accompanied by good care and judicious feeding, will ultimately result in failure. In the October bulletin of the New York Agricultural Experiment Station, of which Peter Collier is director, are brought together tables, with proper explanations, showing the composition of cattle-foods, the digestibility of such foods, the amount digested from various foods in general use, and finally several feeding-rations are given, together with those rations fed by a few of the farmers in different parts of the State.

— According to the *Novoe Vremya*, the carrier-pigeon has been turned to a curious use in Russia. It is to convey negatives of photographs taken in a balloon. The first experiment was made from the cupola of the Cathedral of Isaac, and the subject photographed was the Winter Palace. "The plates were packed in envelopes impenetrable to light, and then tied to the feet of the pigeon, who safely and quickly carried them to the station at Volkovo." So we are told; but there is an extensive hiatus in the account, as pointed out by the *British Journal of Photography*. The wonderful material on which the negatives were taken is not stated, nor the mode of preserving from light, nor how this is proposed to be arranged in a balloon, nor the distance of the bird's flight. This is all a very different affair from the Paris Pigeon Post, the messages in which were photographed by collodion on glass, which was afterwards peeled from its support, and enclosed in a packet attached to, not the bird's feet, but a tail-feather. Seeing that about fifteen grains is looked upon as a practical weight for a bird to carry, it would appear that very little negative and light-tight wrapping could be included in the weight, which does not include much in the shape, for example, of thin paper, seeing that even so slight an object as a five-pound (or any other) bank-note weighs more than that amount.

— As showing a good reason for the flocking of students from America and England to Germany, the following letter of Professor Silvanus P. Thompson to the London *Times* is in point: "Your Brussels correspondent, who attributes the attendance of English students at the technical high schools (or *polytechnicums*) in Germany, and particularly at that in Berlin, to the non-existence of such institutions in this country, must be ignorant of the fact that for five years a really splendid establishment of this character has been actively at work in London. I refer to the Central Institution, founded by the City and Guilds of London, in Exhibition Road. The equipment of this establishment for mechanical engineering and for electrical engineering far exceeds that of the Technical High School in Berlin, though in some other departments it is necessarily not equal. The cost of the Central Institution, which is the nearest approach in this country to a true polytechnic, was, however, only £90,000, while that at Berlin cost over £600,000. I may add that that other establishment of the City and Guilds of London Institute, the Finsbury Technical College, from which I write, and which has been open somewhat longer, cost about £35,000 only; but yet it can, in the departments mentioned, show educational results that will not compare unfavorably with those of the Berlin Technical High School. Yet the entire building at Finsbury could be contained within the entrance-hall of the palatial establishment at Berlin." In this same connection the remarks of the German correspondent of the *Daily Telegraph* are interesting, as they give the number of foreign students enrolled on the books of the *Technische Hochschule*, or "Technical University," of Berlin. Since 1884 the palatial *Technische Hochschule* of Charlottenburg, near Berlin (called the *Berliner Technische Hochschule*), has certainly given instruction to an increasing number of foreign students, but the influx has not been so very extraordinary. Since the winter term of 1885, when there were only two British subjects on the books, the numbers have been, winter of 1886, four; summer of 1887, five; winter of 1887, eight; summer of 1888, ten; winter of 1888, eleven; summer of 1889, thirteen. Russia heads the list, having contributed, in 1881, thirteen

pupils, and in the last term, forty-two. Norway comes next, with twenty-five last term. From North America there were seven. Then came Austria, South America, Servia, Switzerland, Sweden, Italy, Roumania, Spain, Holland, Luxembourg, and Greece. The number of foreign students amounted in the last term to 129, some 15 per cent of the total number on the books. This, compared with the thirty-three enrolled in 1881, shows a good increase. From the above official figures no deductions of importance can be drawn as to the estimation shown by British technical students for the very excellent *Technische Hochschule* of Berlin.

— It would seem as if the influence of bacteria and micro-organisms generally upon higher forms of life was only just beginning to be understood. The researches of naturalists are constantly bringing new and unexpected facts to light. For instance: there is nothing better known than the frequent phosphorescence exhibited by marine animals, and especially the crustacea. This phosphorescence is frequently infectious; that is to say, it can be communicated by touch. A French naturalist, M. Giard, has just made known the results of some observations and experiments he has been making with *Talitrus* and other crustacea. On microscopically examining a brightly phosphorescent specimen he found walking slowly on the beach instead of leaping, as its habit usually is, he traced the phosphorescent light to the presence of bacteria in its muscles, which were greatly altered. On inoculating other and healthy individuals of this and other species, the same disease was produced among them, and M. Giard says that his laboratory was quite lit up at night with these diseased but luminous crustacea. The inoculation was continued to the sixth generation, apparently without any attenuation of the microbic action. The disease seems to follow a regular course, and the crustaceans died in three or four days. The phosphorescence, however, always lingered a few hours after death. Crabs were inoculated in the same way.

— Dr. Noetling, of the Indian Geological Survey, to whose report on the petroleum deposits of Burmah reference has already been made, gives an interesting description of the native method of digging oil-wells. As soon as a native has made up his mind where he is going to have a new oil-well, as stated in the *London Times*, the workmen (usually four in number) begin to dig a square shaft, the sides of which measure between four feet and four feet six inches. Over this pit a cross-beam, supported on stanchions at either side, is placed, in the centre of which is a small wooden drum or cylinder, which, with its axis, is made of a single piece of wood, the latter running on coarse fork-shaped supports. The leather rope used in hauling up the oil passes over the drum, and on it is fastened the workman who is going to be lowered down, as well as the common earthenware pot in which the oil is drawn up. If possible, the well is so placed that the men or women drawing the rope walk down an inclined plane along the slope of a hill. The tools employed in digging are quite primitive, and can only be used in soft strata. Timber is used to support the walls of the shaft, and the latter is lined with wood. This wooden wall has considerable strength; but it has to be carefully watched, lest it should give way. The workmen are lowered in an ingenious way. The man sits on two slings formed of strong rope running between his legs and knotted over his left shoulder. To prevent sliding, a thin rope runs down from the knot, across the breast, underneath the right shoulder, to the back, where it is fastened to the rope forming the slings. A second rope for the same purpose is fastened round the hips. On account of the explosive gas filling the shaft, no light can be taken down: the workman, therefore, ties up his eyes previous to descending, so as to enable him to see during the short time he is in the well; otherwise it would take him longer to accustom his eyes to the darkness than he is able to stay down on account of the gas, which renders breathing difficult. The data obtained by Dr. Noetling as to the time occupied in the ascent and descent, and the period during which the laborer can remain below, show that not 25 per cent of the total working time is really spent in extracting the oil. Two hundred and ninety seconds is the longest time any man, however strong, can remain below without becoming unconscious, while in some he can only remain sixty seconds. With increasing depths the difficulties in obtaining the oil after the Burmese methods become insuperable:

hence the limit is 310 feet, and the workers object to more than 250 feet. The drawing-up of the oil is as primitive as every thing else. The rope is fastened round the neck of the ball-shaped pot, and, being lowered, is allowed to fill by sinking in the oil below. The oil thus raised is poured into another pot of the same shape, but much larger; and twelve of these are packed on each country cart.

— Among some mineral samples lately forwarded by Dr. Belgrade to the Mines Department for examination from a newly discovered lode in the Broken Hill district, New South Wales, were three in which the analyst, Mr. Minage, detected the presence of platinum. According to the *Engineering and Mining Journal*, sample No. 1, ochreous felspathic rock, yielded, on assay, platinum at the rate of 1 ounce 9 pennyweights 9 grains per ton; gold, a minute trace; no silver. No. 2, compact ferruginous claystone, yielded, platinum, 6 pennyweights 12 grains per ton; gold, a minute trace; no silver. No. 3, ferruginous felspathic rock with green carbonate of copper, yielded, platinum, a strong trace (under 5 pennyweights per ton); no gold or silver; a small quantity of platinum metals, iridosonine, iridium, etc. This discovery is of interest, as it is the first recorded instance of the occurrence in New South Wales of platinum *in situ* in a lode. Platinum has been found in alluvial deposits in the Bathurst, Clarence, and Richmond River districts, but not in paying quantity.

— Mr. Joseph C. Arthur, in a recent bulletin issued by the Agricultural Experiment Station of Indiana, summarizes as follows the results of some experiments on stinking smut (known as "bunt" in England): It is one of the most destructive diseases to which the wheat-crop is subject; not that it deteriorates the total product, but it causes a complete loss of a part, not infrequently of half or more, of the crop. It probably occurs to some extent throughout all wheat-growing regions, but most prominently in Indiana, Iowa, and adjacent States, as well as in California and Europe. It is caused by a fungus growing inside the wheat-plant. There are two species of this fungus, differing only in microscopic characters, — *Tilletia tritici*, with rough spores; and *Tilletia foetens*, with smooth spores. The latter is most common in the Mississippi valley. Spores of the fungus, which are very nearly or quite in contact with the germ end of the wheat-grain, or touching the young plantlet between its attachment to the seed and the first joint, can grow into the tender tissues of the plant as the seed sprouts, and, drawing nourishment from the juices, develop along with the wheat, and finally produce spores in the kernels. A single spore may thus cause all the heads of a stool of wheat to smut. The disease does not spread from plant to plant or from field to field, but the infection always takes place at the time the seed sprouts. No remedy can be applied after the grain is sown, but the disease can be prevented by sowing clean seed in a clean soil, and covering well. If a farm is already infested, seed known to be pure can be obtained, or the smutty seed can be purified by thoroughly wetting with a solution of blue vitriol, using one pound or more to a gallon of water, and either sow damp or first dry with plaster or slacked lime. Take care that the thrasher, storage bin, fanning mill, seeder, sacks, and every thing else coming in contact with grain to be used as seed, are thoroughly disinfected, if they have previously been used for smutty wheat. Do not follow smutted wheat with wheat again for one, or better still, for two years, but with some other crop. Do not apply stable-manure or permit stock to run on land to be put into wheat, if smutty grain or straw has been used for feeding or bedding. Where there is danger of infection, do not sow wheat on wet or insufficiently drained land, and use a variety of wheat least affected by smut. The cost and trouble of ridding a farm of stinking smut, and keeping it free, are very slight compared to the loss which is likely to result from inattention. The statements just made regarding stinking smut apply equally well to black smut, with the following exceptions: black smut is more common everywhere than the other, and causes a loss greater than is usually supposed, but which rarely reaches the large percentages of stinking smut; it is caused by a fungus (*Ustilago segetum*) of similar habits to the other smut, but, unlike that, is not confined to wheat, but attacks other small grains as well; the means of clearing a farm of black smut are essentially the same as for the other, but

with the differences that wheat, oats, rye, and barley are all susceptible to the disease, and cannot follow one another when clearing the soil of the spores; and that grain with hulls requires longer soaking with blue vitriol than hullless grain.

— In a recent letter to the company engaged in introducing the magnolia anti-friction metal, mentioned in these columns a few weeks ago, the chief engineer of the steamship "Owego" gives a very favorable report of its use on that vessel. The "Owego" is said to be the fastest vessel on the Great Lakes. She is 2,500 tons burden, and has triple-expansion engines of 3,000 horse-power, with cylinders 28, 42½, and 72 inches in diameter respectively, and 4½ feet stroke. Some time ago the metal used in the low-pressure crank-pin bearing, fourteen inches in diameter by sixteen inches long, heated till it melted and ran out. Magnolia-metal was substituted, since which time, the engineer states, "the chill has not been off the brasses, although we have encountered weather that would lift the propeller-wheel out of the water."

— The lecture committee of the Nineteenth Century Club reports that its programme this season has been arranged so as to give a greater preponderance to literature and art, in order to meet the criticism of last winter that the subjects were too much of a political and ethical character. It was not, however, originally intended that Miss Edwards's address should be on the "Art of the Novelist;" but this topic seemed preferable because her other addresses will be delivered in New York and Brooklyn before she will appear before the club. The following is the list of subjects and speakers as thus far arranged; subject, of course, to unforeseen changes. A star against a name indicates that the speaker is not yet positively engaged. Nov. 22, 1889, "The Pulpit and Politics," Rev. Henry Van Dyke, D.D. (Presbyterian); discussion by Mr. R. R. Bowker (Episcopalian), Rev. Amory H. Bradford, D.D. (Congregationalist), and Hon. Jno. A. Taylor (Unitarian). Dec. 13, "The Construction of a Play," Mr. Bronson Howard; discussion by A. M. Palmer, Mr. Dion Boucicault.* Jan. 10, 1890, "Russian Nihilists and Novelists," Professor H. H. Boyesen; discussion by Mr. Hamilton W. Mabic (associate editor of the *Christian Union*), and ————. Jan. 31, "The Political Relations of the United States and Canada," Professor Goldwin Smith (of Toronto); discussion not yet settled. Feb. 21, "The New Southern Literature," Mr. Thomas Nelson Page (of Virginia); discussion by Mr. Richard Watson Gilder and Mrs. Maud Howe Elliott. March 18, "The Art of the Novelist," Miss Amelia B. Edwards; discussion not yet settled. April 4, an address by Hon. Seth Low on some topic, probably educational, not yet determined upon. April 25, "The Eastern Question," Hon. Oscar S. Straus (ex-minister to Turkey); discussion by Mr. George Kennan. The following are proposed and held in reserve: "Folk Music," by Mr. Frank H. Potter; "Nationalism," by Hon. T. W. Higginson; "Psychical Research," by Rev. Minot J. Savage, D.D.;* "The Roman Church and the Schools," by Hon. W. Bourke Cockran;* "English Socialism," Mr. Percival Chubb;* "The Organization of Charity;" "Dress Reform." Friday evenings have been taken this year instead of Wednesdays because last year many members of the club were unable to attend on the last-named day. On other days the assembly rooms are not to be had. Accordingly the house committee has engaged the rooms for the above dates; Miss Edwards's lecture, however, being on Tuesday, by the special favor of the manager of the Opera House. The following orders have been made with regard to the conversational meetings provided for by vote at the last business meeting of the club: 1st, That the four members' meetings to be held the coming winter at private houses be conducted informally and conversationally, as far as due regard to order will permit. 2d, That the president designate some member of the club to preside over and conduct each of these meetings. 3d, That the person so designated shall, at least ten days prior to the meeting over which he is to preside, select and give to the secretary the subject to be discussed, which must first be approved by the lecture committee of the club. The secretary shall thereupon give at least one week's notice to all the members, of the time and place of such meeting, together with the subject to be discussed. 4th, No vote shall be taken upon any subject of discussion at any of these meetings.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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IN THIS NUMBER we print the extracts from recent letters of Stanley that have reached this country. They show, that after getting back to the shores of the Victoria Nyanza, after his long journey back to the Kongo, after his first meeting with Emin Pacha in the early part of 1888, he found that the Pacha's authority had been considerably impaired; in fact, that at one time he had actually been a prisoner in the hands of his own troops. But, in spite of this, Emin showed some signs of hesitation about leaving the Sudan, which resulted in considerable of a strain on Stanley's patience. The rebellion was checked by a southern movement of the Mahdist forces, and Emin was once more free. The country, however, was in so disorganized a state, that Stanley finally set a date on which he must start for the coast, and is now on his way, with Emin as a doubting and reluctant companion. Whether Emin's vast stores of ivory and valuable collections are being brought out to civilization seems doubtful; but it seems likely that this long-lost army of southern Egypt will soon be a thing of the past, and that the region will be given over to barbarism till stronger forces are brought to bear.

THE OPINION EXPRESSED by the eminent engineer Mr. Towne, quoted in another column, as to our ability to properly prepare for an international exposition in 1892, because of the limited time at our disposal, will not be shared by many who have given attention to the subject. Ample time is, of course, necessary; but one or two years' time, in the present highly developed state of the architectural and engineering arts, and in what may be termed "the art of promoting expositions," is ample for doing what could not be done in double that time when the exposition of 1876 was planned. The opinion of Mr. Towne is worthy of consideration, but we think it is also worthy of reconsideration.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

THE tenth annual meeting of the American Society of Mechanical Engineers was held in this city on Nov. 18, 19, 20, and 21. The meeting was opened by an enjoyable evening reception at the society's rooms, at 64 Madison Avenue, on Monday, the 18th; and the business sessions began on Tuesday at the rooms of the Academy of Medicine, 12 West 31st Street, about a hundred and thirty members being present. Mr. Henry R. Towne, the retiring president, delivered the opening address, which consisted mainly of an account of the recent engineers' excursion to Europe, with some remarks on the Paris Exposition and the projected world's fair in this city, followed by an account of the present condition of the society. He briefly compared the time which had been found necessary to prepare for the Paris Exposition with that now left in which to prepare for an exposition in this city in 1892, and expressed the opinion that at least a year's postponement would be found necessary, and perhaps two years, if the fair was to be at all adequate to the occasion. Four years and a half were given to preparations for the Paris Exposition, while we have but little more than half that time in which to get ready. He congratulated the society on its vigorous growth, from a membership of 189 at the end of the first year (1880), to 1,049 at present. Mr. Towne concluded his address by hoping that the many local societies of mechanical and civil engineers would in time be converted into chapters or sections of a national society, and that there would be some one organization soon formed to include the best portions of all the societies.

The address, which was well received and heartily applauded, was followed by the reading of reports of the various officers and committees, and the discussion and adoption of resolutions on securing legislation to provide a government bureau of record, "wherein may be entered respectably recognized and approved standards, for the promotion of uniformity in the products of the arts, in technical customs, and in nomenclature." Other resolutions concerning the management of the society were also adopted.

The reading and discussion of papers were then taken up. The first paper was on "Properties of the Vapor of Water," by V. Dwelshauvers-Dery, which was followed by a paper on the "Theory and Design of Chimneys," by Horace B. Gale; one on the "Philosophy of Multiple Cylinders or Compound Engines," by R. H. Thurston; "Flow of Steam through Orifices," and "Experimental Study of the Different Types of Calorimeter," by C. H. Peabody; "Cost of Lubricating Car Journals," by L. S. Randolph; "Steam-Pipes for Collieries," by E. F. C. Davis; "Rolling Steel Rails," by D. K. Nicholson; and "Methods of reducing the Fire Loss," by C. J. H. Woodbury. In the evening many of the members, accompanied by ladies, discussed a subscription dinner.

Wednesday was devoted by the members to their annual excursion, in the course of which they visited the government instruction and proving ground at Willet's Point, as well as other places of interest. At Willet's Point, sight-seeing commenced by a visit to the torpedo laboratory. Every thing was investigated, and obliging officers were found ready to explain the workings of the intricate apparatus used in the experiments.

The instruments attracting the most attention from the visitors were a Thomson galvanometer, a galvanometer with a reading telescope, a Thomson electric-current balance, a Thomson multicellular electrostatic voltmeter, a British post-office standard galvanometer, and an English "shutter" apparatus for operating and exploding torpedoes from shore. The general use of electricity in all these systems interested the observers at once. If our naval officers wish to fire a mine, they employ the electric spark. If they desire to drive a fish torpedo, they transmit to a motor within it a current of electricity. In steering it so as to strike the object to be destroyed, they employ the same means. If they wish to find a torpedo of their own which was lost, or to discover one concealed by an enemy, they make use of inductive effects as illustrated in the telephone, and actually use the telephone, which informs them of their approach to any metallic mass; also when they set torpedoes in channels to be defended, or have arranged submerged mines, electricity enables them to determine whether they are in order for use, or when they have been injured by accident or decay.

The museum and batteries at the Point were then visited in turn, and thoroughly examined and even criticised; but the general impression was that the apparatus and museum were a fair exposition of the progress of the art of modern warfare in this country, and well adapted to the teaching of practical work in torpedo defences. The station at Willet's Point is almost an advanced engineers' school, where young engineers graduating from West Point are sent for a course of engineering instruction, particularly in relation to torpedo-work.

Before leaving the Point, three torpedoes were exploded about three hundred feet distant from the shore for the benefit of the excursionists. The first one, containing about fifty pounds of mortar-powder, shot a column of water about one hundred feet into the air; but the second, containing fifty pounds of dynamite, not only doubled the distance, but seemed to reach bottom, judging from the discoloration of the surrounding water. The third and last, containing one hundred and fifty pounds of mortar-powder, caused a terrific report, and the flame which showed above the surface seemed to indicate that the torpedo had not been submerged deep enough.

In the evening, after the return of the excursionists, a reception and collation were tendered the visiting members by the Engineers' Club.

At the Thursday session the following papers were read and discussed: "Indicator Rigging for Compound Engines," by Fred. W. Parsons; "A New Recording Pressure-Gauge," by W. H. Bristol; "General Solution of the Transmission of Force in a Steam-Engine," by D. S. Jacobus; "Street-Railway Car Gear for Modern Speeds," by S. J. MacFarren; "The Comparison of Indicators," by J. Burkitt Webb; "The Cards from the Pawtucket Pumping-Engine with and without Jacket," by James E. Denton; "How to use Steam Expansively in Direct-Acting Pumps," by J. F. Holloway; "Cost of Steam and Water Power," by C. T. Main; and "Graphical Analysis of Reciprocating Motions," by Oberlin Smith. After the reading of these papers, the following resolution was unanimously adopted: "Resolved, That the American Society of Mechanical Engineers cordially indorses and heartily urges the holding of the proposed great international exhibition in this country in the near future to celebrate the four hundredth anniversary of the discovery of America."

In the evening the society's guests and members visited the American Institute Fair by invitation.

On Friday the engineers visited Elizabethport, N.J., where they examined the works of the Singer Manufacturing Company and the Babcock and Wilcox boiler-works.

President Towne, in closing the session, made a proposition concerning the world's fair, to the effect that the society had approved of his statement that additional time was needed to make the fair a success, and that his proposition was to have a grand celebration and the unveiling of a monument of Columbus on the date of the four hundredth anniversary of the discovery of America, and then open the world's fair in May, 1893.

The officers elected for the ensuing year are as follows: president, Oberlin Smith of Bridgeton (N.J.); vice-presidents, Joel Sharp of Salem (O.), George W. Weeks of Clinton (Mass.), DeVolson Wood of Hoboken (N.J.); treasurer, William H. Wiley of New York; managers, J. E. Denton of Hoboken (N.J.), C. W. Nason of New York, H. H. Westinghouse of Pittsburgh (Penn.).

STANLEY AND EMIN.

MR. MARSTON of Sampson Low & Co., London, has received a letter from Henry M. Stanley, dated South End Victoria Nyanza, Sept. 3, from which the following extracts are taken:—

"The rebels of the Emin government relied upon their craft and on the wiles of the 'heathen Chinese,' and it is amusing now to look back and note how punishment has fallen on them. Was it Providence, or was it luck? Let those who love to analyze such matters reflect on it. Traitors without camp, and traitors within, were watched, and the most active conspirator was discovered, tried, and hanged.

"The traitors without fell foul of one another and ruined themselves. If it is not luck, then it is surely Providence in answer to good men's prayers.

"Far away, our own people, tempted by their extreme wretchedness and misery, sold our rifles and ammunition to our natural enemies, the Manyema, the slave-traders' true friends, without the least grace either of bodies or souls. What happy influence was it that restrained me from destroying all concerned in it? Each time I read the story of Nelson's and Parkes's sufferings I feel vexed at my forbearance, and yet again I feel thankful for a higher power than man's which severely afflicted them with cold-blooded murders by causing them to fall upon one another a few weeks after the rescue and relief of Nelson and Parkes.

"The memory of those days alternately hardens and unmans me. With the rescue of Emin Pacha, poor old Casati, and those who preferred Egypt's flesh-pots to the coarse plenty of the province near Nyanza, we returned; and while we were patiently waiting, the doom of the rebels was consummated. Since that time of anxiety and unhappy outlook I have been at the point of death from a dreadful illness. The strain had been too much; and for twenty-eight days I lay helpless, tended by the kind and skillful hands of Surgeon Parkes. Then little by little I gathered strength, and finally gave orders for the march for home.

"Discovery after discovery in this wonderful region was made,—the snowy ranges of Ruevenzeni, the Cloud King or Rain Creator, the Semliki River, the Albert Edward Nyanza, the plains of Noogora, the salt lakes of Kative, the new peoples of the Wakonju or Great Mountains, the dwellers of the rich forest region, the Awamba, the fine-featured Wasonyora, the Wanyoro bandits, and then Lake Albert Edward, the tribes and shepherd races of the eastern uplands, then Wanyakori, besides the Wanyaruwamba and Wazinja, until at last we came to a church whose cross dominated a Christian settlement, and we knew we had reached the outskirts of blessed civilization."

Mr. Mackinnon, the chairman of the Emin relief committee, has also received a letter from Stanley. It is dated Aug. 5, and was written at Kafuru, an Arab settlement on the Karage. It begins, "My last report was sent off by Salim Ben Mohammed in the early part of September, 1888. Over a year full of stirring events has passed since then. I will endeavor to inform you what has occurred." Stanley goes on to recount the arrangements made by him to meet Emin, and, after describing how he hunted up the missing rear column, continues,—

"I have already told you that the rear column was in a deplorable state; that out of the one hundred and two members remaining I doubted whether fifty would live to reach the lake; but, having collected a large number of canoes, the goods and sick men were transported in these vessels in such a smooth and expeditious manner that there were remarkably few casualties in the remnant of the rear column. But wild natives, having repeatedly defeated the Ugarrowwas raiders, and by this means discovered the extent of their own strength, gave considerable trouble and inflicted considerable loss among our best men, who had always to bear the brunt of the fighting and the fatigue of paddling. However, we had no reason to be dissatisfied with the time we had made.

"When progress by river became too tedious and difficult, an order to cast off canoes was given. This was four days' journey above the Ugarrowwas station, or about three hundred miles above Banalaya. We decided, that, as the south bank of the Ituri River was pretty well known to us, it would be best to try the north bank, although we should have to traverse for some days the despoiled lands which had been a common centre for the Ugarrowwas and Kilongalagas bands of raiders. We were about one hundred miles from Grassland, which opened up a prospect of future feasts of beef, veal, and mutton, and a pleasing variety of vegetables, as well as oil and butter for cooking."

"On Oct. 30, having cast off the canoes, the land-march began in earnest, and we two days later discovered a large plantain plantation in charge of Dwaris. The people flung themselves on the plantains to make as large provision as possible for the dreaded wilderness ahead. The most enterprising always secured a fair share, and twelve hours later would be furnished with a week's provision of plantain flour. The feeble and indolent revelled for the time being on an abundance of roasted fruit, but always neglected providing for the future, and thus became victims to famine after moving from this place.

"Ten days passed before we reached another plantation, during which we lost more men than we had lost between Banalaya and Ugarrowwas. Small-pox broke out among the Manyema, and the mortality was terrible. Our Zanzibaris escaped the pest, however, owing to the vaccination they had undergone on board the 'Madura.' We were now about four days' march above the confluence of the Ihuru and the Ituri Rivers, and within about a mile from Ishuru. As there was no possibility of crossing this violent tributary of the Ituri or the Aruvimi, we had to follow its right bank till a crossing could be discovered. Four days later we stumbled across the principal village of the district, called Andikumu. It was surrounded by the finest plantation of bananas and plantains we had yet seen, which all the Manyemas' habit of spoliation and destruction had been unable to destroy. There our people, after severe starvation during fourteen days, gorged themselves to such excess that it contributed greatly to lessen our numbers. Every twentieth individual suffered from some complaint which entirely incapacitated him for duty.

"The Ihuru River was about four miles south-south-east from this place, flowing from east-north-east. It was about sixty yards broad and deep, owing to heavy rains. From Andikumu six days' march north-east brought us to another flourishing settlement, called Indeman, situated about four hours' march from a river supposed to be the Ihuru. Here I was considerably nonplussed by a grievous discrepancy between native accounts and my own observations. The natives called it the Ihuru River, and my instruments and chronometer made it very evident it could not be the Ihuru. We knew finally. After capturing some Daris, we discovered it was the right branch of the Ihuru, called the Dui River, this agreeing with my own view. We searched, and found a place where we could build a bridge across. Bonny and our Zanzibari chief threw themselves into the work, and in a few hours the Dui River was safely bridged. We passed from Indeman into a district entirely unvisited by Manyema."

Here the writer describes daily conflicts with the Wambutti dwarfs, which he found very numerous in this region. The Wambuttis clung to the north-east route, which Stanley wanted to take. Accordingly, he went south-east, and followed elephant-tracks. He says, "But on Dec. 9 we were compelled to halt for forage in the middle of a vast forest, at a spot indicated by my chart to be not more than two or three miles from Ituri River, which many of our people had seen while we resided at Fort Bodo. I sent one hundred and fifty rifles back to a settlement that was fifteen miles back on the route we had come, while many Manyema followers also undertook to follow them. I quote from my journal part of what I wrote on Dec. 14, the sixth day of the absence of the foragers:—

"Six days have transpired since our foragers left us. For the first four days the time passed rapidly, I might say almost pleasantly, being occupied in recalculating my observations from Ugarrowwas to Lake Albert down to date, owing to a few discrepancies here and there, which my second and third visits and duplicate and triplicate observations enabled me to correct. My occupation then ended, I was left to wonder why the large band of foragers did not return. On the fifth day, having distributed all the stock of flour in camp, and having killed the only goat we possessed, I was compelled to open the officers' provision-boxes and take a pound pot of butter, with two cupfuls of my flour, to make an imitation gruel, there being nothing else save tea, coffee, sugar, and a pot of sago, in the boxes.

"In the afternoon a boy died, and the condition of a majority of the rest was most disheartening. Some could not stand, falling down in the effort to do so. These constant sights acted on my nerves, until I began to feel not only moral but physical sympathy, as though the weakness was contagious. Before night a Mahdi carrier died. The last of our Somalis gave signs of collapse, and the few Sudanese with us were scarcely able to move. When the morning of the sixth day dawned, we made broth with the usual pot of butter, an abundance of water, a pot of condensed milk, and a cupful of flour, for one hundred and thirty people. The chiefs and Bonny were called to a council. At my suggesting a reverse to the foragers of such a nature as to exclude our men from returning with the news of the disaster, they were altogether unable

to comprehend such a possibility. They believed it possible that these one hundred and fifty men were searching for food, without which they would not return. They were then asked to consider the supposition that they were five days searching for food, and had then had lost the road perhaps, or, having no white leader, had scattered to loot goats, and had entirely forgotten their starving friends and brothers in the camp. What would be the state of the one hundred and thirty people five days hence?"

"Bonny offered to stay with ten men in the camp if I provided ten days' food for each person, while I would set out to search for the men. Food to make a light cupful of gruel for ten men for ten days was not difficult to procure, but the sick and feeble remaining must starve unless I met with good fortune; and accordingly a store of buttermilk, flour, and biscuits was prepared and handed over to the charge of Bonny. In the afternoon of the seventh day we mustered everybody, besides the garrison of the camp, ten men.

"Sadi, a Manyema chief, surrendered fourteen of his men to their doom; Kibbobora, another chief, abandoned his brother; and Fundi, another Manyema chief, left one of his wives and her little boy. We left twenty-six feeble and sick wretches, already past all hope unless food could be brought them within twenty-four hours. In a cheery tone, though my heart was never heavier, I told the forty-three hunger-bitten people that I was going back to hunt for the missing men. We travelled nine miles that afternoon, having passed several dead people on the road; and early on the eighth day of their absence from camp we met them, marching in an easy fashion, but when we were met the pace was altered, so that in twenty-six hours from leaving Starvation Camp we were back with a cheery abundance around us of gruel and porridge, boiling bananas, boiling plantains, roasting meat, and simmering soup. This had been my nearest approach to absolute starvation in all my African experience. Altogether, twenty-one persons succumbed in this dreadful camp.

"On Dec. 17 the Ihuru River was reached in three hours, and, having a presentiment that the garrison of Fort Bodo were still where I left them, the Ihuru was crossed the next day, and for the two following days we steered through the forest regardless of paths. We had the good fortune to strike the western angle of the Fort Bodo plantations on the 20th, and found that my presentiment was true. Lieut. Stairs and the garrison were still at Fort Bodo, fifty-one souls remaining out of fifty-nine.

"Not a word had been heard of Emin or of Jephson during the seven months of my absence. Knowing the latter to be an energetic man, we were left to conjecture what detained Jephson, even if the affairs of his province had detained Emin. On Dec. 23 the united expedition continued the march eastward; and as we had now to work by relays, owing to the fifty extra loads, we did not reach the Ituri Ferry, which was our last camp in the forest region before emerging on grass-land, until Jan. 9. My anxiety about Mr. Jephson and Emin would not permit me to dawdle on the road, making double trips in this manner: so, selecting a rich plantation and a good camping site east of the Ituri River, I left Stairs in command with one hundred and twenty-four people, including Parkes and Nelson, and on Jan. 11 continued my march eastward.

"The people of the plains, fearing a repetition of the fighting of December, 1887, flocked to the camp as we advanced, and formally tendered their submission, agreeing to the contributions and supplies. The blood of brotherhood was made, the exchange of gifts was made, and a firm friendship established. The huts of our camp were constructed by natives, and food, fuel, and water were brought to the expedition as soon as a halting-place was decided on. We heard no news of white men on Lake Albert from the plain people until on the 16th, at a place called Gaviras. Messengers from Kavalli came with a packet of letters, with one letter written on three dates, with several days' interval between, from Jephson, and two notes from Emin, confirming the news in Jephson's letter. You can but imagine the intense surprise I felt while reading the letters by giving you extracts from them in Jephson's own words:—

"I am writing to tell you the position of affairs in this country, and I trust the letter will be delivered to you at Kavalli in time to warn you to be careful. On Aug. 18 a rebellion broke out here,

and the Pacha and I were made prisoners. The Pacha is a complete prisoner, but I am allowed to go about the station; but my movements are watched. The rebellion has been gotten up by some half-dozen Egyptians (officers and clerks); and gradually others joined, some through inclination, but most through fear. The soldiers, with the exception of those at Labore, have never taken part in it, but have quietly given in to their officers.'

"Jephson continued, 'When the Pacha and I were on our way to Regaf, two men — one an officer, Abdul Voal Effendi, and the other a clerk — went about and told the people they had seen you, and that you were only an adventurer, and had not come from Egypt; that the letters you brought from the Khedive and Nubar were forgeries; that it was untrue Khartum had fallen; and that the Pacha and you had made a plot to take them, their wives, and their children out of the country, and hand them over as slaves to the English. Such words, in an ignorant, fanatical country like this, acted like fire among the people, and the result was a general rebellion, and we were made prisoners. The rebels then collected the officers from the different stations, and held a large meeting here to determine what measures they should take; and all those who did not join the movement were so insulted and abused that they were obliged, for their own safety, to acquiesce in what was done.

"The Pacha was deposed, and those officers suspected of being friendly to him were removed from their posts, and those friendly to the rebels were put in their place. It was decided to take the Pacha as a prisoner to Regaf, and some of the worst rebels were even in for putting him in irons; but the officers were afraid to put their plans into execution, as the soldiers said they never would permit any one to lay a hand on him. Plans were also made to entrap you when you returned, and strip you of all you had. Things were in this condition when we were startled by the news that the Mahdi's people had arrived at Lado with three steamers and nine sandals and nuggets, and had established themselves on the site of the old station. Omar Sali, their general, sent up three peacock dervishes with a letter to the Pacha, demanding the instant surrender of the country. The rebel officers seized them, and put them into prison, and decided on war. After a few days the Mahdists attacked and captured Regaf, killing five officers and numbers of soldiers, and taking many women and children prisoners; and all the stores and ammunition in the station were lost. The result of this was a general stampede of the people from the stations of Biddon, Kirri, and Muggi, who fled with their women and children to Labore, abandoning almost every thing. At Kirri the ammunition was abandoned, and was seized by natives. The Pacha reckons that the Mahdists number about one thousand five hundred. The officers and a large number of soldiers have returned to Muggi, and intend to make a stand against the Mahdists.

"Our position here is extremely unpleasant, for since the rebellion all is chaos and confusion. There is no head, and half a dozen conflicting orders are given every day, and no one obeys. The rebel officers are wholly unable to control the soldiers. The Boris have joined the Mahdists. If they come down here with a rush, nothing can save us. The officers are all frightened at what has taken place, and are anxiously awaiting your arrival, and desire to leave the country with you; for they are now really persuaded that Khartum has fallen, and that you have come from the Khedive. We are like rats in a trap. They will neither let us act nor retire; and I fear, unless you come very soon, you will be too late, and our fate will be like that of the rest of the garrisons of the Sudan. Had this rebellion not happened, the Pacha could have kept the Mahdists in check some time, but now he is powerless to act.

"I would suggest, on your arrival at Kavallis, that you write a letter in Arabic to Shukri Aga, chief of the Msawa Station, telling him of your arrival, and telling him that you wished to see the Pacha and myself. Write also to the Pacha or myself, telling us what number of men you have with you. It would, perhaps, be better to write me, as a letter to him might be confiscated. Neither the Pacha nor myself thinks there is the slightest danger now of any attempt to capture you, for the people are now fully persuaded that you are come from Egypt, and they look to you to get them

out of their difficulties. Still it would be well for you to make your camp strong. If we are not able to get out of the country, please remember me to my friends,' etc.

"A postscript, dated Nov. 24, says, 'Shortly after I had written you, the soldiers were led by their officers to attempt to retake Regaf; but the Mahdists defended it, and killed six officers and a large number of soldiers. Among the officers killed were some of the Pacha's worst enemies. The soldiers in all the stations were so panic-stricken and angry at what happened, that they declared they would not attempt to fight unless the Pacha was set at liberty. So the rebel officers were obliged to free him, and sent him to Wadelai, where he is free to do as he pleases; but at present he has not resumed authority in the country. He is, I believe, by no means anxious to do so. We hope in a few days to be at Tunguru Station, on the lake, two days by steamer from Nsabe; and I trust when we hear of your arrival that the Pacha himself will be able to come down with me to see you. We hear that the Mahdists sent steamers down to Khartum for re-enforcements. If so, they cannot be up here for another six weeks. If they come up here with re-enforcements, it will be all up with us; for the soldiers will never stand against them, and it will be a mere walk-over. Every one is anxiously looking for your arrival, for the coming of the Mahdists has completely cowed them. We may just manage to get out if you do not come later than the end of December, but it is entirely impossible to foresee what will happen.'

"Jephson, in a second postscript, dated Dec. 18, says, 'Mogo, the messenger, not having started, I send a second postscript. We were not at Tunguru on Nov. 25. The Mahdists surrounded Duffie Station, and besieged it for four days. The soldiers, of whom there were about five hundred, managed to repulse them, and they retired to Regaf, their headquarters. They have sent down to Khartum for re-enforcements, and doubtless will attack again when strengthened. In our flight from Wadelai the officers requested me to destroy our boats; and the advances, therefore, broke it up. Duffie is being renovated as fast as possible. The Pacha is unable to move hand or foot, as there is still a very strong party against him, and the officers are no longer in immediate fear of the Mahdists. Do not on any account come down to us at my former camp on the lake near Kavallis Island, but make your camp at Kavallis, on the plateau above. Send a letter directly you arrive there, and as soon as we hear of your arrival we will come to you. I will not disguise facts from you, that you will have a difficult and dangerous work before you in dealing with the Pacha's people. I trust you will arrive before the Mahdists are re-enforced, or your case will be desperate.'

Stanley answered, "I have read your letter half a dozen times over, but fail to grasp the situation thoroughly, because in some important details one letter contradicts the other. In one you say the Pacha is a close prisoner, while you are allowed a certain amount of liberty; in the other you say you will come to me as soon as you hear of our arrival here, and 'I trust,' you say, 'that the Pacha will be able to accompany me.' Being prisoners, I fail to see how you could leave Tunguru at all. All this is not very clear to us, who are fresh from the bush. If the Pacha can come, send a courier, on your arrival at our old camp on the lake below here, to announce the fact, and I will send a strong detachment to escort him up to the plateau; even to carry him, if he needs it. I feel too exhausted, after my thirteen hundred miles of travel since I parted from you last May, to go down to the lake again. The Pacha must have some pity for me. Don't be alarmed or uneasy on our account. Nothing hostile can approach us within twelve miles without my knowing it. I am in the thickest of a friendly population; and if I sound a war-note, within four hours I can have two thousand warriors to assist me to repel any force disposed to violence; and if it is to be a war, why, then, I am ready for the cunningest Arab alive. I want to help the Pacha somehow, but he must also help me and credit me."

"On Jan. 16 I received with this batch of letters two notes from the Pacha himself, confirming the above, but not a word from either Jephson or the Pacha, indicating the Pacha's purpose. Did he still waver, or was he at last resolved? With any other man than the Pacha or Gordon, one would imagine, that being a prisoner, and a fierce enemy hourly expecting to give the *coup mortal*

he would gladly embrace the first chance to escape from the country. Given up by his government, there was no hint in these letters what course the Pacha would follow. These few hints of mine, however, will throw some light on my postscript, which here follows; and, in my state of mind after reading these letters, I wrote a formal letter which might be read by any person,—Pacha, Jephson, or any of the rebels,—and addressed it to Jephson, as requested; but on a separate sheet of paper I wrote a private postscript for Jephson's perusal, as follows:—

KAVALLIS, January.

MY DEAR JEPHSON, — I now send thirty rifles and three Kavallis men down to the lake with my letters, with my urgent instructions that a canoe should be set off and the bearers be rewarded. I may be able to stay longer than six days here, perhaps ten days. I will do my best to prolong my stay until you arrive without rupturing the peace. Should we get out of this trouble, I am his most devoted servant and friend, but if he hesitates again, I shall be plunged in wonder and perplexity. I could save a dozen pachas if they were willing to be saved. I would go on my knees and implore the Pacha to be sensible of his own case. He is wise enough in all things else, even for his own interest. Be kind and good to him for his many virtues, but do not you be drawn into the fatal fascination the Sudan territory seems to have for all Europeans in late years. As they touch its ground, they seem to be drawn into a whirlpool, which sucks them in, and covers them with its waves. The only way to avoid it is to obey blindly, devotedly, and unquestioningly all orders from the outside.

The committee said, "Relieve Emin with this ammunition. If he wishes to come out, the ammunition will enable him to do so. If he elects to stay, it will be of service to him." The Khedive said the same thing, and added, that, if the Pacha and his officers wished to stay, they could do so on their own responsibility. Sir Evelyn Baring said the same thing in clear, decided words; and here I am, after 4,100 miles of travel, with the last instalment of relief. Let him who is authorized to take it, take it and come. I am ready to send him all my strength, and will assist him; but this time there must be no hesitation, but positive yea or nay, and home we go.

Yours sincerely,
STANLEY.

In the course of his correspondence Mr. Stanley says, —
"On Feb. 6, Jephson arrived in the afternoon at our camp at Kavallis. I was startled to hear Jephson, in plain undoubting words, say, 'Sentiment is the Pacha's worst enemy. No one keeps Emin back but Emin himself.' This is the summary of what Jephson learned during the nine months from May 25, 1888, to Feb. 6, 1889. I gathered sufficient from Jephson's verbal report to conclude that during nine months neither the Pacha, Casati, nor any man in the province, had arrived nearer any other conclusion than what was told us ten months before. However, the diversion in our favor created by the Mahdists' invasion, and the dreadful slaughter they made of all they met, inspired us with hope that we could get a definite answer at last, though Jephson could only reply, 'I really can't tell you what the Pacha means to do. He says he wishes to go away, but will not move. No one will move. It is impossible to say what any man will do. Perhaps another advance by the Mahdists will send them all pellmell towards you, to be again irresolute and requiring several weeks' rest.'"

Stanley next describes how he had already sent orders to mass the whole of his forces ready for contingencies. He also speaks of the suggestions he made to Emin as to the best means of joining him, insisting upon something definite; otherwise it would be his (Stanley's) duty to destroy the ammunition, and march homeward. He continues, —

"On Feb. 13, a native courier appeared in camp with a letter from Emin, and with the news that he was actually at anchor just below our plateau camp. But this is his formal letter to me, dated the 13th:—

STR, — In answer to your letter of the 7th instant, I have the honor to inform you that yesterday I arrived here with my two steamers, carrying a first lot of people desirous to leave this country under your escort. As soon as I have arranged for a cover for my people, the steamers have to start for Msua Station to bring on another lot of people. Awaiting transport with me are some twelve officers anxious to see you, and only forty soldiers. They have come under my orders to request you to give them some time to bring their brothers from Wadela, and I promised them to do my best to assist them. Things having to some extent now

changed, you will be able to make them undergo whatever conditions you see fit to impose upon them. To arrange these, I shall start from here with officers for your camp, after having provided for the camp; and if you send carriers, I could avail myself of some of them. I hope sincerely that the great difficulties you had to undergo, and the great sacrifices made by your expedition on its way to assist us may be rewarded by full success in bringing out my people. The wave of insanity which overran the country has subsided, and of such people as are now coming with me we may be sure. Permit me to express once more my cordial thanks for whatever you have done for us,

Yours,
EMIN.

BARNACLES.

AMONG the curious myths which in the middle ages did duty for natural science, one of the longest-lived, and yet one of the most extraordinary, was that which not only conceived the common shell-fish, the barnacle, to be the fruit of a tree, but went on to allege its transformation into the sea-bird known as the barnacle-geese. The successive changes from fruit to fish and from fish to fowl which the myth involved proved no obstacle to its wide acceptance and long-continued credence. According to an article by S. Heywood Seville, published in a recent number of *Knowledge*, it was widely current before the end of the twelfth century. Giraldus Cambrensis, writing in the reign of Henry II., gives, in his "Topographia Hibernia," a detailed account of it. "There are in this place," says he in one passage, "many birds which are called barnacles. Against nature, nature produces them in a most extraordinary way. They are produced from fir timber, tossed along the sea, and are at first like gum. Afterwards they hang down by their beaks as if from a seaweed attached to the timber, surrounded by shells in order to grow more freely. Having thus, in process of time, been clothed with a strong coat of feathers, they either fall into the water or fly freely away into the air. They derive their food and growth from the sap of the weed or the sea by a secret and most wonderful process of alimentation. I have frequently with my own eyes seen more than a thousand of these same bodies of birds hanging down on the seashore from one piece of timber, enclosed in shells and already formed. They do not breed and lay eggs like other birds, nor do they ever hatch any eggs, nor do they seem to build nests in any corner of the earth." After this account, Giraldus proceeds to inveigh against the custom, which prevailed in some parts of Ireland, of eating the barnacle-geese during Lent,—a custom which was justified by those who followed it by the argument that the geese were "not flesh, nor born of flesh," and which affords striking proof of the credence accorded to the story.

Though contradicted from time to time by some of the bolder writers and observers, the fable kept a strong hold on the popular mind, and even the educated were not ashamed to avow their belief in it. Sir John Maundeville alludes to it in his "Travels," where he speaks of the "trees that bear a fruit that becomes flying birds." Sir John somewhat naively adds, that the people "towards Upper India," to whom he recounted the story, "had there-of great marvel that some of them thought it was an impossibility." The "Travels" appeared about 1370, and more than two centuries later the subject was treated with considerable fulness, and in the most obvious good faith, by John Gerarde, who, in his "Herbal," published in 1597, devotes to it a chapter entitled "Of the Goose-tree, Barnacle-tree, or the tree bearing Geese," in which, after narrating the current belief as to the barnacle-geese being produced in the north of Scotland from shell-fish growing on trees, he proceeds to pledge his own credit as to the main facts of the story. Clearly, the myth was current in Shakspeare's time; and although, in an edition of the "Herbal" published in 1636, the editor added a note of caution to the reader at the foot of the chapter, yet eighty years after Gerardé wrote, a scientific writer was to be found, who, writing for scientific readers, asserted, of his own knowledge, the existence of the birds within the shells. This was Sir Robert Moray, who describes himself as "lately one of His Majesty's council for the Kingdom of Scotland," and who contributed to the "Philosophical Transactions" of 1677-78 a paper entitled "A Relation Concerning Barnacles," from which the following passages are transacted: "Being in the Island of East, I saw

lying upon the shore a cut of a large fir-tree, of about 2½ foot diameter and 9 or 10 foot long, which had lain so long out of the water that it was very dry; and most of the shells that had formerly covered it were worn or rubbed off. Only on the parts that lay next the ground there still hung multitudes of little shells, having within them little birds perfectly shaped. . . . The shells hang on the tree by a neck longer than the shell; of a kind of filmy substance, round and hollow, and creased, not unlike the windpipe of a chicken, spreading out broadest where it is fastened to the tree, from which it seems to draw and convey the matter which serves for the growth and vegetation of the shell, and the little bird within it. . . . This bird in every shell that I opened, as well the least as the biggest, I found so curiously and completely formed that there appeared nothing wanting as to the internal parts for making up a perfect sea-fowl; every little part appearing so distinctly that the whole looked like a large bird seen through a concave or diminishing glass, color and feature being everywhere so clear and neat. The little bill like that of a goose, the eyes marked, the head, neck, breast, wings, tail, and feet formed, the feathers everywhere perfectly shaped and blackish colored, and the feet like those of other water-fowl to my best remembrance."

Such was the old belief existing during five centuries, at any rate, and probably accepted at periods both earlier and later than those from which the preceding examples are taken. To modern observers it seems utterly absurd. Science has shown its absolute groundlessness as natural history; and Professor Max Müller, to complete the rout, has put forward, in his "Lectures on the Science of Language," a very interesting theory of its probable origin from the point of view of philology. But the latest researches have shown that the barnacle has been deposited from his place in a mythical metamorphosis, only to take part in his life-history as now ascertained in another transformation scene quite as wonderful, and this time vouched by the careful observations of our best naturalists.

In the adult state, Mr. Seville goes on to say, the barnacle consists of a shell-fish permanently attached, by a fleshy peduncle or stalk, to a piece of timber or rock or of some other object in the sea. The shell opens by a peculiar valve-like arrangement, and, through the aperture thus formed, several pairs of long, many-jointed "cirri," or feelers, are put forth, which, by their constant waving motion, whirl to the creature's mouth the small particles which form its food. Huxley's description is concise and expressive: "A crustacean fixed by its head, and kicking the food into its mouth with its legs." It is not the change of this creature into a goose that science can now surprise us with: that story must be given up along with the accounts of griffins, phoenixes, and dragons. The fruit theory as to its origin must also be abandoned; but, though the new account does not involve quite so violent a transition as that from the vegetable to the animal kingdom, it is still in the steps by which the adult form is reached that those changes are revealed which almost entitle the barnacle to the reputation for facile metamorphosis with which our forefathers credited it. The steps in question are (besides the egg) the two stages known respectively as the *Nauplius* and *Cypris* stages. Immediately on its escape from the egg, the young barnacle appears as an animal of microscopic size, active and free-swimming, equipped with a broad shield or shield on its back, and having three pairs of legs, a single eye, a mouth, and a forked tail. This is the *Nauplius*, and in outward appearance the young creature exhibits at this stage no single point of resemblance to the parent form. It feeds and grows apace, and moults several times. It then enters the next condition of its existence, — the *Cypris* stage. The broad shield-shaped carapace becomes folded together, somewhat after the pattern of a bivalved shell, and almost encloses its owner. The foremost limbs are transformed into a very peculiar pair of suctorial or adherent feelers, and the two hinder pairs are cast off, their place being taken by six pairs of powerful swimming-legs with bifid extremities. A pair of compound eyes is another new feature of this stage; and altogether the *Cypris*, while still quite distinct from the adult barnacle, presents a very different appearance from the *Nauplius*. The mouth is wanting, or at least is functionless, being covered by an integument without aperture. Existence in this stage is therefore necessarily short, and the

Cypris soon fixes upon its future abode by attaching itself by its suctorial feelers to some piece of drift-wood, pile, or rock. A kind of cement, which it secretes by means of special glands, pours out round the base of attachment, and quickly hardens, gluing the ends of the feelers firmly to the surface on which they rest. The compound eyes are shortly afterwards moulted, the body straightens out, and the shell thus comes to stand almost perpendicularly to the surface of attachment. Other changes follow: the shape of the shell is modified, and the position of the animal within alters in such a manner that the under surface of its body is turned directly away from the point of attachment; the integument covering the mouth is cast off; the legs cease all swimming ambulatory functions, and soon become mere cirri, sweeping the water for prey; the feelers are gradually covered with a fleshy pulp, and, losing all trace of their old form, are converted into a single stalk of attachment; the new parts of the shell which are to form the valvular opening, and other protecting plates, begin to form, and, for all practical purposes, the barnacle, though still very minute, has attained its adult form, future development being mainly in the matter of size.

The old legend involved a double change from fruit to fish, and from fish to bird; the new history also deals with a double change, from *Nauplius* to *Cypris*, and from *Cypris* to barnacle. For one series of wonders another has been substituted, and, if this is not sufficient to restrain us from too hastily condemning our forefathers' credulity, it will be well to remember how recently we have arrived at the truth. Little more than fifty years ago the position of the barnacle in the animal kingdom was still completely unsettled. Agreeing in most of its outward characteristics with the *Mollusca*, it was commonly classed with them. The *Nauplius* and *Cypris* were not connected with the parent form, but, if described at all, were treated as distinct animals. In 1830 J. Vaughan Thompson's description of his observations of their metamorphoses cast a new light on the subject; but the question still remained somewhat open ground for naturalists, and it was not until 1851-53 that Darwin, in his "Monograph of the Cirripedia," definitely settled the barnacle's claim to be classed with the *Crustacea*, and established beyond dispute the facts of its complicated and peculiar life-history.

BOOK-REVIEWS.

The Development of the Philosophy of the Steam-Engine. By ROBERT H. THURSTON. New York, Wiley. 16°. 75 cents.

THIS historical sketch, which relates not only to the steam-engine, but also to the various heat-engines embodying the same principles, was originally prepared by Professor Thurston some five or six years ago, and was presented in the form of a paper to the British Association for the Advancement of Science in 1884, at its Montreal meeting. The paper was favorably received, and was incorporated in full in the association's "Transactions" of that year. Believing the time appropriate for the publication of such a sketch, he now gives it to the public in a more permanent and accessible form. Though the author does not hold that the theory of the steam-engine is yet in its final perfect and complete form, he believes that the main principles and essential facts of a complete theory are well determined and well recognized by advanced thinkers and intelligent practitioners. This view of the case, we think, will not be disputed; and all persons concerned in engine-designing will find this sketch of the development of the philosophy of the steam-engine a valuable guide in working out future improvements.

Oceania: Linguistic and Anthropological. By Rev. D. MACDONALD. Melbourne, M. L. Hutchinson; London, Sampson Low. 16°.

THE author takes the stand that the ancient Oceanic mother-tongue was a branch of the Semitic family, and that while, like the other languages of this stock, it had much in common with all the rest of phonetics, grammar, and vocabulary, it had certain peculiarities, and that therefore the modern Oceanic dialects are Neo-Semitic, "somewhat as Modern Syriac." The author compares Malagassy, Malay, Efate, and Samoan with many Semitic dialects, and calls his new family Semitic-Oceanic. The author can hardly claim to have succeeded in proving such a relationship.

The Bermuda Islands. By ANGELO HEILPRIN. Philadelphia, The Author. 8°.

PROFESSOR ANGELO HEILPRIN, in the summer of 1888, made an excursion to the Bermuda Islands, in order to study certain points in the structure and physiognomy of coral reefs, for the study of which the Bermudas offer special advantages. The present volume is the result of his observations on this journey. His observations regarding the formation of the island are fully in ac-

cord with those of Darwin, but, as the author points out, do not prove the correctness of the Darwinian hypothesis. Elevations and subsidences are both shown to have marked the region in its development. The author devotes an elaborate chapter of his book to a discussion of the various theories of formation of coral reefs, and expresses himself rather in favor of the old theory of Darwin. Where the author's results regarding the theory of formation of coral reefs are mainly of a negative character, his zoogeographic

Publications received at Editor's Office,
Nov. 18-23.

- NEW JERSEY. Annual Report of the Board of Education and the Superintendent of Public Instruction, of for the School Year ending Aug. 31, 1888. Camden, State. 241 p. 8°.
- PLATT, J. Money. New York and London, Putnam. 267 p. 12°.
- ROTHSCHILD, M. D. A Hand-Book of Precious Stones. New York and London, Putnam. 143 p. 16°. \$1.
- SHALER, N. S. Aspects of the Earth. A Popular Account of some Familiar Geological Phenomena. New York, Scribner. 344 p. 8°. \$4.
- SPENCER, G. L. A Hand-Book for Sugar Manufacturers and their Chemists. New York, Wiley. 221 p. 16°. \$2.
- THURSTON, R. H. The Development of the Philosophy of the Steam-Engine. New York, Wiley. 48 p. 12°. 75 cents.
- TREVERT, E. Everybody's Hand-Book of Electricity. With Glossary of Electrical Terms and Tables for Incandescent Wiring. Boston, Darnell and Upham. 160 p. 12°. 25 cents.
- WEEK'S Talk, The. Vol. I. No. 1. w. New York, A. K. Stearns & Co. 8 p. 4°. \$3.50 per year.
- WILSON, W. The State, Elements of Historical and Practical Politics. Boston, Heath. 686 p. 12°. \$2.
- WOOD, De V. Thermo-dynamics, Heat Motors, and Refrigerating Machinery. 3d ed. New York, Wiley. 452 p. 8°. \$4.

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results are of great interest. He finds that the Bermudian fauna is essentially a wind-drift and current-drift fauna, whose elements have been received in principal part from the United States and the West Indies. Some portion of the fauna appears to have been derived from the west coast of Europe and Africa, or from the Azores. The fauna appears to be of considerable antiquity,—a conclusion which is supported by the fact that the predecessor of a group of *Pulmonata* now peculiar to the islands is found fossil or sub-fossil in the rocks of these islands. Certain marked elements of the Bermudian fauna are of a distinctively Pacific type, but it seems impossible at the present time to explain this mixed relationship. The book is illustrated with good views from the Bermudas, and a number of plates illustrating the concluding chapters on zoölogy.

AMONG THE PUBLISHERS.

THE second part of the "Contributions to the Micro-Palæontology of the Cambro-Silurian Rocks of Canada," published by the Canadian Geological and Natural History Survey, is by Mr. E. O. Ulrich of the Geological Survey of Illinois. It consists of a descriptive report on some fossil *Polysoa* (*Bryozoa*) and *Ostracoda* from Manitoba, and is illustrated by two full-page lithographic plates. To facilitate the binding of the present part with Mr. Foord's previously published report, the pagination and numbering of the plates of both have been made consecutive.

—A new guide-book to Florida, by Charles Ledyard Norton, will be published by Longmans, Green, & Co. early in December. The scheme of the volume is similar to that of the well-known Baedeker guides, adapted to requirements of travellers in such a country as Florida. Separate maps of the counties with post-roads and the new railway systems are a noteworthy feature of the book. This guide-book is a revival, on a new and more comprehensive plan, of "The Florida Annual" originally published, and most favorably received by the public, in 1885.

—The "Handbook of Precious Stones," by M. D. Rothschild, just published by G. P. Putnam's Sons of this city, is intended for the merchant, workman, and amateur. Mr. Rothschild is a well-known diamond-dealer of this city; and he was led to write this book by finding how many of those having to do with diamonds, rubies, sapphires, and emeralds, know nothing of these precious stones. The information is given in concise form, we fear even too concisely; but we trust that Mr. Rothschild's ambition may be gratified, and that a second and larger edition may appear in due time.

—Mr. Edwin Lasseter Bynner opens the December number of the *Atlantic Monthly* with an article of interest to the antiquarian, and especially to the student of Old Boston. This paper is devoted to "The Old Bunch of Grapes" Tavern, one of the most famous New England hostleries of the last century, and Mr. Bynner gives an amusing account of the various events which took place within its hospitable walls. Mr. Henry Van Brunt's paper on "Architecture in the West" tells about the difficulties which Western architects have to struggle against, and the new school of architecture which is gradually arising to solve the problem of making art keep step with progress without losing the finer and more delicate artistic sense. It will be studied by all Western men and all architects with a great deal of interest. Professor N. S. Shaler of Harvard College contributes a paper on "School Vacations;" and Mr. William Cranston Lawton, whose articles on the Greek drama have been among the best literary papers the *Atlantic* has lately had, writes about "Delphi: The Locality and its Legends;" and "Latin and Saxon America" (the relations of this country with South American countries) forms the subject of a paper by Mr. Albert G. Browne.

INDUSTRIAL NOTES.

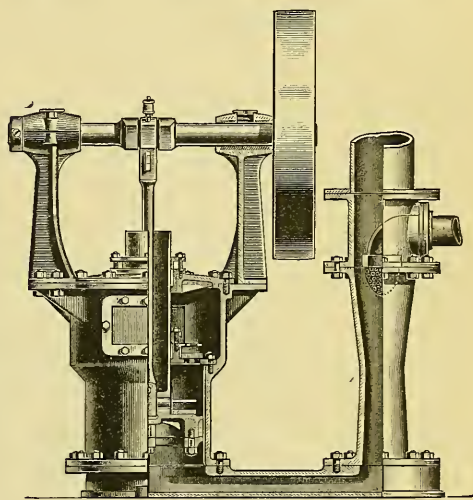
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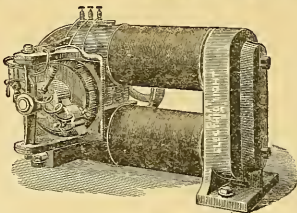
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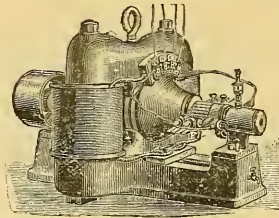
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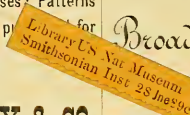
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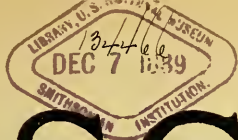
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SCIENCE

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SEVENTH YEAR.
VOL. XIV. No. 357.

NEW YORK, DECEMBER 6, 1889

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THE FORWARD GAS-ENGINE.

THE more thoughtful among us will welcome any improvement in the arts which will modify the conditions under which motive power is available, and render it more accessible to small establishments whose existence depends upon the closest economy in all directions. One means of attaining this end is the introduction of gas-motors into these small industries. The great care and attention which have been paid to economic conditions in Europe have caused this subject to receive more consideration there than in this country: hence many important improvements in this class of ma-

It is now for the first time presented in the form of a business enterprise on this side of the Atlantic.

The distinguishing feature of this engine is a rotating valve by which the ignition of the combustible charge in the cylinder is effected. In the valve are eight ignition ports, which come into action successively. Each port, having performed its duty, makes a complete revolution before it comes into action again, and in the mean time is exposed to the air, by which the greater part of the heat which it has absorbed is carried away. This insures the cool working of the valve, which runs scarcely any risk of cutting, while the constant motion in one direction affords another element of

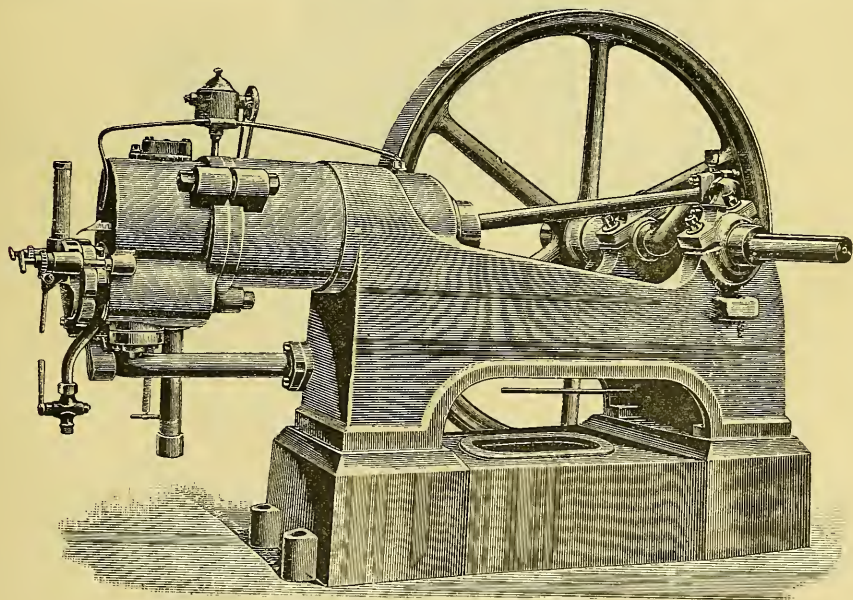


FIG. 1.—THE FORWARD GAS ENGINE.

chinery have found their origin and their greatest field among our transatlantic kindred. The sharp rivalry, however, engendered among them by the great demand, has stimulated efforts to perfect these motors, which have finally resulted in the group of inventions, patented both in Europe and America, by the producers of the Forward gas-engines. This motor has only been on the market for about a year in Europe, but is rapidly coming to the front. It was exhibited at the recent electrical and industrial exhibition at Birmingham, where, we are informed, it received the only gold medal for excellence of construction in gas-engines, as well as the only medal awarded gas-engines for electric lighting, although the other leading motors of the same class were well represented.

safety. Every time the cylinder takes in a charge, the valve gives a partial revolution; but, when the gas is cut off completely, the valve ceases to move, and the small firing charge, which would otherwise be wasted, is saved. The number of missed explosions, however, is not great in this engine, as the strength of the charge is reduced as the work falls off, until it approaches the point at which it would cease to explode; the gas is then cut off entirely, and the valve left stationary until the governor arms again fall.

The mechanical devices by means of which these operations are performed are shown by the accompanying illustrations. Figs. 1 and 2 are perspective views of a 4-horse-power engine; Fig. 3 is an outline of the working parts, looking from the crank-shaft; and

Figs. 4 and 5 are plan and sectional views of the ignition valve. The valve *a* (Figs. 3, 4, and 5) is mounted on a pivot at the rear of the combustion chamber of the cylinder, and has a number of

ture. The disk *a* is, by the intermittent motion imparted to it, brought into position at the required time for igniting the mixture in the cylinder. The slot or small gas-chamber *f g* in the disk *a*,

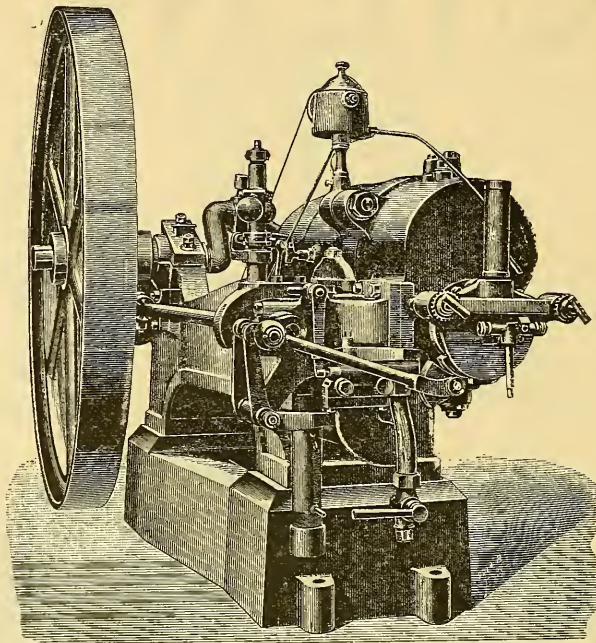


FIG. 2.

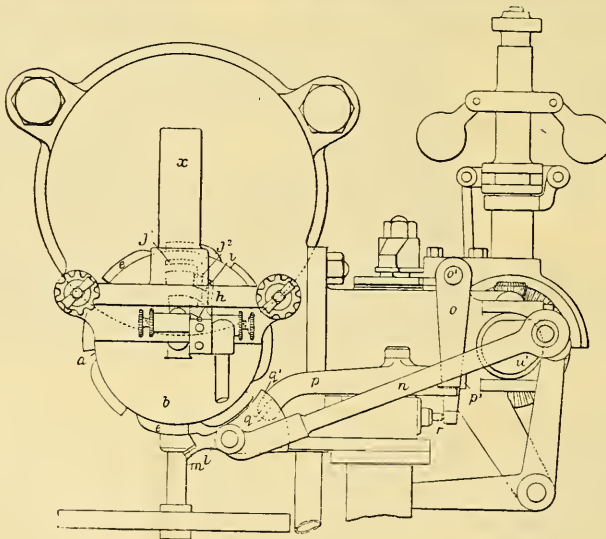


FIG. 3.

ratchet-teeth (*e*) around its circumference. It is rotated by a pawl, *l*, worked by a small crank at the end of the side shaft, and a connecting link, *n*. The cylinder being charged with compressed explosive mixture, the port *d* is also charged with the gaseous mix-

ture, which is approaching the port *d*, receives inflammable gas from the fixed gas-duct *j* in the cover *b*, the passage *j''* in the rotating disk *a* being brought opposite during the motion of the said disk, and communicating with the duct or curved slot *j* in the cover *b*. The

slot or small gas-chamber *f g* receives atmospheric air to form an inflammable mixture with the gas in the small chamber through the duct *f*² in the fixed cover *b*, which duct *f*² communicates with the port *g* of the small gas-chamber *f g*.

By the action of the ratchet motion the small gas-chamber *f g* in the disk *a*, having been charged in the manner described, is carried rapidly forward, and the gaseous mixture therein is ignited by the fixed relighting gas-jet *h*². The igniting of the charge in the

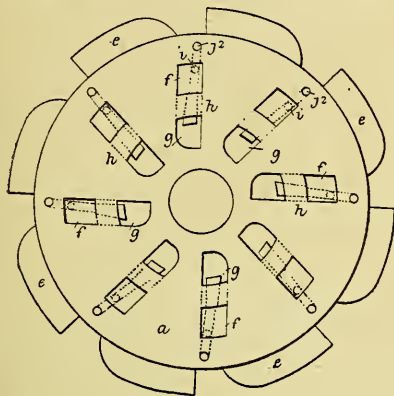


FIG. 4.

small gas-chamber *f g* takes place immediately before the passage *h* comes opposite the port *d* into the gas-cylinder *a*². The passage *h* coming opposite the port *d*, the flame in the small gas chamber *f g* ignites the gaseous mixture in the port *d* and the engine cylinder *a*². The passage *h* opens into the port *g* of the small gas-chamber *f g* immediately after the small gas-chamber and the port *f*² are closed, the duct *i* communicating with the port *d* a little

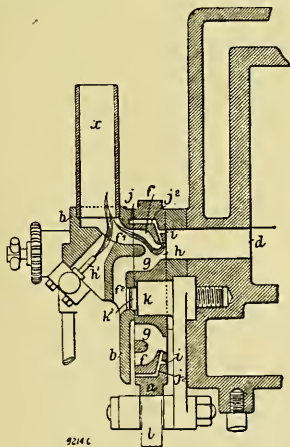


FIG. 5.

before the part *h* communicates with the port *d* to effect the ignition of the gaseous mixture in the gas-chamber or cylinder *a*².

The supply of gas is regulated by the lever *o* and the gas-valve *r*. The lever receives its motion through a spindle, *o*, from a second lever, which is acted upon by a cam on the side shaft. This cam is under the control of the governor. The lever *o* carries a cam, *p*¹, which engages with a lever, *p*, having at its end a stud, *q*¹, taking into a slot, *q*, in the pawl *l*. Upon the lever *o* moving

so as to open the gas tappet-valve, the cam *p*¹ operates upon the lever *p*, causing the stud *q* to be disengaged from the slot, and allowing the pawl to fall into the teeth of the valve. When the engine is running so fast that the gas-valve is not opened, the stud holds the pawl out of gear.

This engine has been subjected to a series of tests by Professor R. H. Smith of Mason College, Birmingham, and has given most satisfactory and economical results. It was tried at full working load, at half load, and without load, the latter test being divided into three parts,—at fast, medium, and slow speeds. The full working load trial lasted 85 minutes, the speed being 176.86 revolutions per minute. The indicated horse-power was 5.54, and the brake horse-power 4.807, giving a mechanical efficiency of 0.8677. The gas consumed in driving the engine was 163.2 feet, or 20.79



FIG. 6.

Initial pressure.....	220	lbs. per sq. in.
Average mean pressure.....	77.73	" "
Revolutions per minute.....	175	

cubic feet per hour per indicated horse-power, and 23.97 feet per brake horse-power. Fig. 6 shows an average indicator card taken during this trial; and Fig. 7, a high-pressure card, illustrating how the governor supplies a richer charge of gas when any sudden demand is made on the engine. At half-power, the brake horse-power was 3.084, equal to a gas consumption of 31.86 feet per horse-power per hour. The lighting jet burned about two feet an hour in both cases. When the engine was running empty, it burned 53 feet of gas per hour at the high speed, 44 feet at the medium speed, and 34 feet at the low speed. A comparison of these results with those obtained in the Society of Arts trial in England shows that the Forward gas-engine ranks very high in the matter of economy, while its mechanical simplicity is a great additional recommendation.

One of these engines, of 4 horse-power, is now on exhibition in



FIG. 7.

Initial pressure.....	165	lbs. per sq. in.
Average mean pressure.....	65.11	" "
Revolutions per minute.....	177	

Boston, by the Forward Gas Engine Company, who, we understand, control the patents for this country, and will soon begin their manufacture.

A DANGEROUS INSECT PEST IN MEDFORD, MASS.

MR. C. H. FERNALD of the Division of Entomology of the Hatch Experiment Station of the Massachusetts Agricultural College, Amherst, Mass., has issued a special bulletin on "A Dangerous Insect Pest in Medford," known as the gypsy-moth (*Ocneria dispar* L.). On the 27th of last June, during his absence in Europe, several caterpillars were received at the station from Hon. William R. Sessions, secretary of the Board of Agriculture, with the request for information as to what they were, and the best methods of destroying them. These caterpillars were brought into the secretary's office by Mr. John Stetson of Medford, Mass., who stated that they were very destructive in that town, eating the leaves of fruit and shade trees. Mrs. Fernald, who had charge of the entomological work during Mr. Fernald's absence, determined the insect to be

the gypsy-moth (*Oceria dispar* Linn.) of Europe; but as the moths were emerging, and laying their eggs for next year's brood, there was nothing to recommend at that time except to destroy the moths and their eggs as far as possible, and prepare for the destruction of the caterpillars when they first appear next spring.

There is a statement in the second volume of the *American Entomologist*, p. 111 (published in 1870), and also in Riley's "Second Missouri Report on Insects," p. 10, that "only a year ago the larva of a certain owl moth (*Hypogymna dispar*), which is a great pest in Europe both to fruit-trees and forest-trees, was accidentally introduced by a Massachusetts entomologist into New England."

Mr. Samuel Henshaw and Dr. Hagen of Cambridge both state that the entomologist who introduced this insect was Mr. L. Trouvelot, now living in Paris, but at that time living near Glenwood, Medford, where he attempted some experiments in raising silk from our native silk-worms, and also introduced European species for the same purpose.

It seems, then, that this was an accidental introduction, but that they have now become acclimated, and are spreading, and doing so much damage as to cause very great alarm.

The gypsy-moth is abundant in nearly all parts of Europe, northern and western Asia, and it even extends as far as Japan. In this country it occurs only in Medford, Mass., occupying an area in the form of an ellipse about a mile and a half long by half a mile wide. This represents the territory where the outbreak occurred, and where the insects were very abundant. Without doubt, they are distributed in smaller quantities outside of this ellipse, but how far it is now impossible to tell.

This insect was reported as feeding upon the leaves of apple, cherry, quince, elm, linden, maple, balm of Gilead, birch, oak, willow, wisteria, Norway spruce, and corn. The food-plants given in Europe are apple, pear, plum, cherry, quince, apricot, lime, pomegranate, linden, elm, birch, beech, oak, poplar, willow, hornbeam, ash, hazel-nut, larch, fir, azalea, myrtle, rose, cabbage, and many others. Curtis, in his "British Entomology," states that they are sometimes very destructive in gardens. Professor W. P. Brooks reported this insect as very abundant in Sapporo, Japan, in 1883, and gave strawberry as a food-plant in addition to those mentioned above.

The fact that this insect has now been in this country for the last twenty years, and has not only held its own, but has multiplied to such an extent as to cause the entire destruction of the fruit-crop and also to defoliate the shade-trees in the infested region, is sufficient cause for alarm. The citizens of Medford are immediately interested, but the entire Commonwealth and country are threatened with one of the worst insect pests of all Europe. In 1817 the cork-oaks of southern France suffered severely from the attacks of this insect. One of the papers of that time stated that the beautiful cork-oaks which extended from Barbaste to the city of Podenas were nearly destroyed by the caterpillars of the gypsy-moth. After having devoured the leaves and young acorns, they attacked the fields of corn and millet, and also the grass-lands and fruit-trees.

In 1878 the plane trees of the public promenades of Lyons were nearly ruined by this same insect. Mr. Fernald states that only last summer he saw the moths in immense numbers on the trees in the Zoölogical Gardens of Berlin, where the caterpillars had done great injury; and the European works on entomology abound with instances of the destructiveness of this insect. When its long list of food-plants is considered, it will be seen how injurious this insect may become if allowed to spread over the country, and become established.

The opinion was expressed to him by prominent entomologists in Europe, that, if the gypsy-moth should get a foothold in this country, it would become a far greater pest than the Colorado potato-beetle, because it is so prolific, and feeds on so many different plants, while the potato-beetle confines itself to a small number.

In Europe eleven species of the *Ichnemonidae*, and seven species of flies (*Tachina*), have been known to attack the eggs and caterpillars of this moth; but it is not known that there are any parasitic insects in this country that destroy it. Undoubtedly our predaceous beetles and bugs destroy more or less of them, and

mud-wasps and spiders are also to be counted among their enemies.

All the masses of eggs should be scraped from the trees and other places where the females have deposited them, and burned. Crushing is not sufficient, as possibly some might escape uninjured. This should be done in the fall, winter, or early spring, before the eggs hatch. It is not at all probable that one will find all the egg-masses even with the most careful searching on the trees in a small orchard; but, when one remembers that this insect deposits its eggs on all kinds of shade and forest trees also, it appears a hopeless task to exterminate this pest by an attempt to destroy the eggs. It is a habit of these caterpillars, after they have emerged, to cluster together on the trunks or branches of the trees between the times of feeding, and this affords an opportunity of destroying vast numbers by crushing them; and after they have changed to pupæ they may be destroyed wherever they can be found. The female moths are so sluggish in their flight, and so conspicuous, that they may be easily captured and destroyed as soon as they emerge; yet any one or all of these methods which have been employed in Europe are not sufficient for their extermination. At best they will only reduce the numbers more or less, according to the thoroughness with which the work has been done. Mr. Fernald could not learn that any attempts have ever been made in Europe to destroy this insect by means of poisonous insecticides, and it is to this method that we may look for positive results in this country.

If all the trees in the infested region in Medford be thoroughly showered with Paris-green in water (one pound to a hundred and fifty gallons) soon after the hatching of the eggs in the spring, the young caterpillars will surely be destroyed; and, if any escape, it will be because of some neglect or ignorance in the use of the insecticide. It will be absolutely necessary to shower every tree and shrub in that region; for, if a single tree be neglected, it may yield a crop sufficiently large to eventually restock the region.

We can hardly feel confident that all these insects can be exterminated in one year; but if this work of showering the trees be continued during the months of April and May for two or three years under competent direction, we have no doubt but that they may be entirely destroyed.

This is, in the opinion of Mr. Fernald, the cheapest and surest method of exterminating this pest, but its effectiveness depends entirely upon the thoroughness and carefulness with which it is done; and those who do the work must have authority to shower the trees not only on public, but on private grounds.

As this insect was introduced into this country by an entomologist who carelessly allowed it to escape, the same thing may occur elsewhere if the people of Medford allow the eggs or caterpillars to be sent out of the town. The only proper thing to do with such a dangerous and destructive enemy is to burn it.

Several different common names have also been given to the insect in Europe, as the "sponge-moth," the "gypsy-moth," the "great-headed moth," the "fungus-moth," and others.

ELECTRICAL NEWS.

SPECIFIC INDUCTIVE CAPACITY. — Mr. W. A. Rudge writes on the above subject to *Nature* as follows: "On p. 669 of Ganot's 'Physics' (eleventh edition) the following statement is found: 'At a fixed distance above a gold leaf electroscope, let an electrified sphere be placed, by which a certain divergence of the leaves is produced. If, now, the charges remaining the same, a disk of sulphur or of shellac be interposed, the divergence increases, showing that inductive action takes place through the sulphur to a greater extent than through a layer of air of the same thickness.' If this statement were correct, there should be less electric action on the side of the ball farthest from the electroscope when the dielectric is interposed. To test this, I arranged an experiment as follows: The knob of a charged Leyden jar was placed midway between two insulated plates of metal, each plate being in connection with an electroscope. The leaves of each electroscope now diverged to an equal extent. A plate of ebonite was now placed between the knob of the jar and one of the plates. If the statement above quoted is correct, the leaves of the electroscope in connection with this plate should show an increased divergence, but the reverse

effect was observed. The leaves partially collapsed. In all experiments that I have made by inserting dielectrics between a charged body and an electroscope, less electric action has been the result. If, while the charged ball be near the electroscope, the plate of it be touched with the finger, the leaves collapse; and on removing the finger, and then the charged ball, they again diverge. Now let a dielectric be placed between the ball and the electroscope, touch the latter, and remove the finger and ball as before, and much greater divergence will be produced. In both cases the electroscope is charged by induction. Without putting the electroscope to earth, I fail to see theoretically why any greater divergence should occur. I suppose some one must have made the experiment as quoted; but, if a greater effect was produced, it must have been caused by the substance used for a dielectric being charged itself. I have found very great difficulty in preventing plates of ebonite, paraffine, sulphur, etc., becoming electrified when placed near a charged body. I should like to know if any one has experimented in this direction, because either the text-books or myself must be wrong. In Guthrie's book (p. 101) there is a statement similar to Gano's."

ELECTRIC LIGHTING AT BERLIN.—M. Wybau, a Belgian electrician, has recently read a paper before the Belgian Electrical Society on the electric lighting of Berlin, from which the following particulars of this important system are taken. At Berlin the electric light, as stated in *Engineering*, is supplied from a number of central stations, the two principal of which are situated in Markgrafenstrasse and the Mauerstrasse. Of the other stations, one lights the Kaiser Galerie, and the other a block of houses at the corner of Unter den Linden and Friedrichstrasse. A fifth station, of but small importance, supplies the lighting of Leipzigerstrasse. At the Markgrafenstrasse station there are eight steam-engines, each of 150 horse-power, which drive sixteen Edison dynamos. To this plant there have recently been added four compound inverted engines, each capable of indicating 300 horse-power, which drive direct four dynamos of 165 kilowatts each. These dynamos are of the multipolar type, and are slow-moving machines, their armatures making but eighty-six revolutions per minute in normal working. The boiler-house contains eight De Naeyer tubulous boilers, which supply the steam for the whole plant. In the switch-room is a rheostat of exceptionally large size, which is used to regulate the current in the distributing mains. These mains are eighty in number, most of which are with their coverings about 3 inches in diameter, and the greatest section of copper in any one of them is 800 square millimetres. At the Mauerstrasse station there are six boilers, three engines of 180 horse-power each, and three of 300 horse-power each. At the Friedrichstrasse station there are four engines of 60 horse-power each, and at the Kaiser Galerie four of 80 horse-power each. At the small station on the Leipzigerstrasse there are two engines of 80 horse-power. The floor space required in the above installations per 1,000 lamps for boilers and machinery is from 323 to 377 square feet. At the Edison station in New York about 194 square feet of floor space are required, but the dynamos and engines run at much higher speeds. The total length of cables laid in Berlin is about 170 kilometres, which are laid under the footpaths. In every case Siemens cables are used.

ELECTRICAL SUNSTROKE.—As a remedy against "electrical sunstroke," as the affection is called that attacks men exposed to the intense rays of the electric arc by means of which metals are fused and welded, is a veil or mask of glazed taffeta, supported by a wicker head-piece, and provided with goggles of gray glass.

THE HOUSTHOLM ELECTRIC LIGHTHOUSE.—This lighthouse, the most powerful electric lighthouse in the world, was opened a few weeks ago, and its working has given great satisfaction. Even in rainy weather its light has been distinctly visible at Blokhus, a straight distance of about thirty-five miles. The only undesirable incident attending the working of the new lighthouse is the immense number of birds which get killed, and which amount to thousands, comprising starlings, snipes, larks, etc., basketfuls being collected every morning in the vicinity of the lighthouse. As stated in *Engineering*, the lighthouse is 209 feet high, and the light-power in the beam is 2,000,000 candles. To guard against the stoppage of the light through any accident to the machinery, this is, as far as it has been possible, constructed on the twin

principle. There are two engines, three tubular boilers, one of which is a particularly quick-heating one, two electro-magnetic machines with a joint capacity of 45 volts, 250 ampères, from Meritens & Co., Paris, two electric lamps, with various reserve lamps, etc. In connection with the lighthouse, and at a distance of respectively about 2,000 and 16,000 feet, are two powerful sirens, which are fed with compressed air from two air-pumps in the engine-house, and which can be coupled together with the engines. At the siren stations there are reservoirs of compressed air, which are worked by means of electricity and clock-work, and great care and forethought seem to have been bestowed upon the whole installation in all its details.

ELECTRIFICATION DUE TO CONTACT OF GASES WITH LIQUIDS.—At the meeting of the London Physical Society, held on Nov. 15, Mr. Enright read a paper on "The Electrification due to Contact of Gases with Liquids." Repeating his experiments with zinc and hydrochloric acid, the author, by passing the gas into an insulated metallic vessel connected with the electrometer, proved that it was always charged with electricity of the opposite kind to that of the solution. The electrical phenomena of many other reactions have been investigated, with the result that the gas, whether H_2 , CO_2 , SO_2 , SH_2 , or Cl_2 , is always electrified positively when escaping from acids, and negatively when leaving a solution of the salt. In some cases, according to *Engineering*, distinct reversal is not obtainable, but all these seem explicable by considering the solubility and power of diffusion of the resulting salts. Various other results given in the paper tend to confirm this hypothesis. Seeking for an explanation of the observed phenomena, the author could arrive at no satisfactory one excepting "contact" between gases and liquids; and, if this be the true explanation, he hoped to prove it directly by passing hydrogen through acid. In this, however, he was unsuccessful, owing, he believes, to the impossibility of bringing the gas into actual contact with the liquid. True contact only seems possible when the gas is in the nascent state. Some difficulty was experienced in obtaining non-electrified gas, for the charge is retained several hours after its production, even if the gas be kept in metallic vessels connected to earth. Such vessels, when recently filled, form condensers, in which the electricity pervades an enclosed space, and whose charge is available on allowing the gas to escape. Soap-bubbles blown with newly generated hydrogen were also found to act as condensers, the liquid of which, when broken, exhibited a negative charge. This fact, the author suggested, may explain the so-called "fire-balls" sometimes seen during thunder-storms; for if, by any abnormal distribution of heat, a quantity of electrified air becomes enclosed by a film of moisture, its movements and behavior would closely resemble those of fire-balls. A similar explanation was proposed for the phenomenon mentioned in a recent number of *Nature*, where part of a thunder-cloud was seen to separate from the mass, descend to earth, and rise again. The latter part of the paper describes methods of measuring the contact potential differences between gases and liquids, the most satisfactory of which is a "water-dropper;" and by its means the potential difference between hydrogen and hydrochloric acid was found to be about 42 volts.

HEALTH MATTERS.

SALT AND MICROBES.—A foreign observer has carried out some instructive researches into the effect of salt on various pathogenic micro-organisms. He found, says the *Medical Press*, that the results varied a good deal, according to the particular microbe experimented upon. The cholera bacillus, for example, curled up and died in a few hours, while the bacillus of typhoid-fever and the micrococci of pus and erysipelas resisted its influence for weeks and even months. That part of his observations bearing on tuberculosis possesses a practical importance, owing to the custom in slaughter-houses of salting the flesh of animals recognized to be tuberculous, and exposing it for sale in the course of a few weeks. M. de Freytag has shown that the tubercle bacillus thrives in the presence of an excess of salt, and salting the tuberculous tissues of an ox in no wise prevented the infection of animals fed thereon: hence it is highly desirable that a stop should be put to a

practice which exposes those who partake of the diseased meat to such obvious risks of infection.

COOLING OF THE BODY BY SPRAY.—Dr. S. Placzek, following up some laboratory experiments by Preyer and Flashaar on the effect of spraying a considerable part of the body surface of animals with cold water, has applied the spray for the purpose of reducing febrile temperatures in human beings. In the case of a man suffering from phthisis, whose temperature was high, he found, that, by spraying about a pint of water at between 60° and 70° F. over his body, the temperature fell to normal, and continued so for several hours. Again, a similar method was satisfactorily applied in the case of a girl with diphtheria. In the healthy human subject, according to the *Lancet*, the spray lowered the temperature nearly two degrees, and, in animals which had been put into a condition of septic pyrexia by injections of bacteria, the temperature was reduced to normal by the spray. By keeping healthy guinea-pigs and rabbits some hours under spray, and using from half a pint to a pint of water at the temperature of the room (44° to 62°), the temperature of the animals fell several degrees.

DEATH BY ELECTRICITY.—At the meeting of the Medical Society held in this city Nov. 20. Dr. Phillip E. Donlin, deputy coroner, who read a paper on "The Pathology of Death by Electricity," in the course of which he said, "The popular idea that the electrical current passes along the nerves and produces shock by conducting the current to the brain, is, as you know, fallacious. Our knowledge of the great electrical conductive power of water, and the experiments of Dr. Richardson, which show the still greater electrical conductive power of blood, would lead one to suppose—and, in fact, it is proved by the greater damage done to the most vascular organs of the body—that the blood is the great conductor of electricity; and that in all cases of exposure to the electric current the blood is the first to suffer, and the nerve-centres and cells the last. Unquestionably our knowledge of the manner of death points out clearly, that, when death is not on the moment produced by the shock of the current, it must be produced by the electric current's action (conducted by the blood) upon the ganglia of the heart, causing spasm of the heart muscle, emptying the ventricles, and abnormally forcibly propelling the charged and fluid blood to the periphery, producing hyperæmic ecchymosis in the most vascular portions of the most vascular organs. Where death is not instantaneous, it must be produced by disorganization of the blood, interference with the circulation causing engorgement of some vital vascular organ. The lungs being the most vascular, death usually results from asphyxia either through the unoxygenated condition of the blood, or hyperæmia of these organs." In reply to a question as to the effect likely to be produced by the infliction of the death penalty by electricity, Dr. Donlin said that the immensity of the power of the machines constructed was such that the purely mechanical result would occasion death. It was possible with those appliances to drive the current of electricity through the tissues with such power as to destroy them, though the amount of power to be employed was clearly within the control of the electrician.

IS COLORADO'S CLIMATE CHANGING?—The inhabitants of Denver are asking what is the meaning of the unusual snow-fall and humidity of the past month. The newspapers of that city, as we learn from *Medical News*, have expressed the opinion that their climate is about to undergo a change, in consequence of surface changes of "building up" and improving the State. The present moist season has been especially disappointing to Eastern people, who have journeyed to Denver to escape the humidity of our seaboard winters. From a letter recently received, a few sentences are quoted: "Snow has fallen each night and morning, but the sun conquers by mid-day, making walking almost impossible. As a usual thing, the inhabitants expect about ten days of inclement weather during winter and spring, and have not looked upon the paving of streets and crossings as at all necessary. But they are now aroused to remedy this condition. The snow-fall is said by some to be already greater than the total for three ordinary winters." The total fall at the Denver station, in October, was 2.11 inches, and is the only October since 1871 when 1.49 inches have been exceeded, with the single exception of that of 1877,

when 2.15 inches were registered. There have been but nine cloudless days in the same month, while nineteen were partly cloudy. The mean temperature has been somewhat above that of the past decade. Fog—a condition hitherto almost unknown in Colorado—occurred during five mornings in October.

CARE OF THE TEETH.—At the meeting in Berlin last spring, of the German Association of American Dentists, the best means of preserving the teeth were discussed, and Dr. Richter of Breslau said, "We know that the whole method of correctly caring for the teeth can be expressed in two words, *brush, soap*. In these two things we have all that is needful for the preservation of the teeth. All the preparations not containing soap are not to be recommended; and if they contain soap, all other ingredients are useless except for the purpose of making their taste agreeable. Among the soaps, the white castile soap of the English market is especially to be recommended. A shower of tooth preparation is has been thrown on the market, but very few of which are to be recommended. Testing the composition of them, we find that about 90 per cent are not only unsuitable for their purpose, but that the greater part are actually harmful. All the preparations containing salicylic acid are, as the investigations of Fernier have shown, destructive of the teeth. He who will unceasingly preach to his patients to brush their teeth carefully shortly before bedtime, as a cleansing material to use castile soap, as a mouth wash a solution of oil of peppermint in water, and to cleanse the spaces between the teeth by careful use of a silken thread, will help them in preserving their teeth, and will win the gratitude and good words of the public."

THE DIGESTIBILITY OF BOILED MILK.—Though the importance of sterilizing milk for bottle-fed infants in cities has been proven beyond a doubt, the process seems to have some disadvantages. In a recent number of the *Zeitschrift für physiologische Chemie*, Dr. Randnitz publishes some striking experiments on the subject. He shows by analysis of the milk ingested, and of the feces and urine, that much less nitrogenous material is abstracted from boiled than from unboiled milk. If 15.6 grams of nitrogen in the form of unboiled milk were given to dogs for three days, analysis showed that 9.4 per cent was stored in the tissues of the animal. On the other hand, with the same amount of nitrogen in boiled milk, but 5.7 per cent was assimilated. If these results are confirmed, it is evident that an infant must need a larger quantity of sterilized than of raw milk.

ARTIFICIAL FOOD FOR INFANTS.—Dr. Escherich of Munich gave a lecture in the pædiatric section of the sixty-second meeting of German naturalists and physicians at Heidelberg, advocating a reform in the artificial feeding of infants. He bases his belief in the necessity of such a reform on the errors produced by Biedert's theory, which depends upon the difference between cow's milk and normal human milk. Biedert's view was, as stated in the *Lancet*, that all the troubles and diseases occurring in artificially fed infants were due to the indigestion of the caseine of the cow's milk, causing irritation of the mucous membrane of the bowels. He therefore considered, that, if the latter were diluted so as to contain one per cent only of caseine, the infant could not possibly take an injurious quantity of this noxious substance. Dr. Escherich considers that this theory, and the practice resulting from it, have gone far to prevent due care being exercised as to much more important conditions. Such are, according to the lecturer, germs and fermentation in improperly kept cow's milk, the number of meals, and the quantity of food given at a time in proportion to the capacity of the infantile stomach, the total quantity of nutritious matter and its proportion in the food, and finally the injurious effect which the water which has been added to the food has on the digestion and the metamorphosis of nutritious matter. Dr. Escherich holds it, above all, necessary to return to physiological principles, and so to approximate artificial feeding as much as possible to the mother's milk, as regards the absence of germs and the number and quantities of meals. The lecturer then pointed out that it is easy enough, by sterilization of small quantities of milk according to Soxhlet's plan, to comply at least theoretically with all these conditions, and at the same time to limit the quantity of caseine so as to fulfil Biedert's requirements.

NOTES AND NEWS.

The eighth congress of Russian naturalists and physicians will be held at St. Petersburg from Dec. 27, 1889, to Jan. 7, 1890.

— There are now thirty-nine crematories in various parts of the world. Italy has twenty-three; America has ten; while England, Germany, France, Switzerland, Denmark, and Sweden have one apiece. In Italy there were two cremations in 1876; the number rose to fifteen in 1877, and in 1888 the number was 226. Since 1876, 1,177 cremations have taken place in Italy, while the combined numbers in all other countries brings the total only to 1,269.

— The following is a list of the papers read at the meeting of the Royal Meteorological Society, London, Nov. 20: "Second Report of the Thunder-Storm Committee," being a discussion by Mr. Marriott on the distribution of days of thunder-storms over England and Wales during the seventeen years 1871-87; "On the Change of Temperature which accompanies Thunder Storms in Southern England," by Mr. G. M. Whipple; "Note on the Appearance of St. Elmo's Fire at Walton on the Naze, Sept. 3, 1889," by Mr. W. H. Dines; "Notes on Cirrus Formation," by Mr. H. Helm Clayton, who has made a special study of cloud-forms and their changes; "A Comparison between the Jordan and the Campbell Stokes Sunshine Recorder," by Mr. F. C. Bayard, being the result of a year's comparison between these two instruments; "Sunshine," by Mr. A. B. MacDowall, being a discussion of the hours of sunshine recorded at the stations of the Royal Meteorological Society; "On Climatological Observations at Ballyboley, County Antrim," by Professor S. A. Hill, the result of observations made during the five years 1884-88.

— A circular letter has been sent to the members of the National Electric Light Association by the secretary, Mr. Allan V. Garratt, asking them to state to him as briefly as possible the most difficult electrical problems they meet in their investigations or in the conduct of their electrical business. They are also requested to state what feature of their business is the least economical or efficient, and why, and where the greatest economy could be effected if the difficulty could be overcome. The answers to these queries will be digested, and the results submitted to Professor Henry A. Rowland of Johns Hopkins University. Professor Rowland has consented to address the next electric-light convention at Kansas City in February, basing his remarks upon the problems suggested by the members, and pointing out the direction in which their solution must be sought.

— From a memorandum appended to the last report of the United States consul at Shanghai, it appears that the greatest silk-producing province in China is Che-Kiang, and Kiang-Su comes second. The two great divisions in silk as exported from central China are known in all places of consumption as *tsallees* and *taysaams*. *Tsallee* is simply the Cantonese for *tseih lé* (or "seven li"); that is to say, an area of that dimension, taking Nanzang as the centre, where the best fine-sized silk was formerly produced. The radius has been extended, in consequence of the higher price paid for fine compared with coarse sorts; and *tsallees* now include some silks reeled from Sinsze and Seloo cocoons, which formerly were only employed for silks of the coarser thread. Considerable quantities of *taysaams* are still, however, being reeled in the two last-named districts. At the present time *tsallee* means silk produced at Nanzang, Chinza, Linglooh, Shwangling, Woochin, Leensze, Hoochow, and a portion of Sinsze and Seloo, besides the intermediate towns, all situated in Che-Kiang. *Taysaam* (meaning "a big worm") has really only the signification of silks of a coarse reeling, and under the denomination are classed silks from Kiahsing, Sinsze, Dongse, Shaouhing, Woosieh, and Laeyang, the last two districts being situated in Kiang-Su. Haining or Yuenfa, situate in Che-Kiang, produces silk reeled of the finest size known in China; and when native competition was crippled by the Tai-Ping rebellion, large quantities annually found a ready sale in Europe. Of late years, however, the export has dwindled down to almost nothing. Hang-Chow, also Che-Kiang, produces both fine and coarse sized silks, *tsallees* and *taysaams*, the size of the former from this district very nearly approaching to that of Kiahsing *taysaams*, and they are generally in favor both for export and for home use, while the coarse sorts are mostly taken by Chinese.

Shaouhing, in Che-Kiang, produces a very considerable quantity of silk, that, when reeled on foreign methods, is said to be equal to any in the empire, but which, as natives persist in reeling on a large wheel and without care, has gradually lost all interest to foreigners. Laehang, in Kiang-Su, produces from 3,000 to 4,000 bales annually, but the same remarks as those applied to the Shaouhing production must apply also to this district's production. The principal towns where throwing is carried on are Nanking, Soo-Chow, and Hang-Chow, and the business must be large to meet the requirements of the enormous piece-goods trade of China. Formerly foreigners used to export considerable quantities; but the improvements made in Europe which have not extended to China have extinguished the trade. The re-reeling of silks (for the purpose of rendering the manipulation of the silk easier to manufacture) is carried on in the centres of Nanzang and Chinza, and the outlying farms and hamlets. The production is considerable, and would be larger, it is said, if the Chinese would use greater care and abstain from adulterating the silk during the process.

— In response to a despatch from Emin Pacha, doubtless sent on to Zanzibar in advance of the main party, and thence cabled to Cairo, the Egyptian government steamer "Mansourah" has been sent to meet Stanley and Emin and their party at Zanzibar. This will hasten Stanley's return to Europe, and the completion of his adventurous three-years' task may be chronicled very soon. A long letter from Stanley to a friend, dated September, 1888, has just been published. It records his discoveries, and recounts the difficulties anticipated on his homeward journey. There is an account of the hostility of the King of the Kabburega, who stripped Casati, and turned him adrift to perish. He was fortunately found and rescued by Emin. Another letter gives a full account of his sojourn with Emin.

— The *Lancet*, commenting on the passage of the English infectious disease notification bill, says, "One thing is remarkable in this legislation, — the slight resistance which politicians of advanced views have been able to offer to its fundamental principle; viz., the right of the community to insist on knowing the affairs of individuals and families where these are likely to involve in any degree the health of others: in other words, the subordination of the individual to the community. This is, of course, the fundamental principle of society, but it is ever undergoing fresh development. National education, vaccination, isolation, and notification of disease, are all illustrations of the same principle. We have ourselves no hesitation in accepting the principle that individual liberty must give way where such doubtful advantages as the freedom to have small-pox and scarlet-fever are the only badges of liberty; and it will involve no misfortune to the world if many other rights claimed by well-meaning but discordant individuals are curtailed in the interests of society."

— The New York Electrical Society, the oldest body of the kind in the country, is the Electrical Section of the American Institute. The object of the society is to bring before its members such topics and new inventions as merit their study and attention. There is a large and rapidly growing class of those who wish to gain a greater familiarity with electricity, and it is to the education of this class that the society directs its work. There is another class, composed of those who, while not earning a livelihood from electrical work, are greatly interested in all the developments of electricity, and who are glad to attend the meetings of the society, because they there are given the opportunity to come into contact with practical electricians, from whom they may elicit instruction and information such as no book could impart. The appreciation of the work of the society in connection with this element of the community is shown by the growing attendance at the meetings, and by the readiness of the press to publish reports of the proceedings. During the present season the society will introduce to its members a number of the leading men in the electrical profession, who will handle the subjects with which they are most familiar, and of which they are acknowledged masters. From such a course of papers and lectures as has been arranged, there can be no doubt that a great stimulus will be given to the study and application of electricity in New York; and the society therefore confidently appeals to those in any way interested in electricity for all the support

that they can give. Among the papers and lectures already read this season are "Electrical Exhibitions, and a Description of Recent Electrical Developments in Europe," and "How to test Electric Motors." Among those yet to come are "Progress of Electric Railroads," "A Talk on Cables," "The Electrical Torpedo, — New York's Sole Defence," "Storage-Batteries," "The Incandescent Lamp," "The Telegraph," "The Telephone," "The Alternating Current," "The Galvanometer and its Uses," "Electricity in War," "Phantom Wires," "How to run an Electric-Light Station," "Transformers," "Power Transmission," "Laboratory Manipulations," "The Social Side of the Electric Street Railway," "The Solution of Every-day Electrical Problems," and "The Progress of the Year." The officers of the society are as follows: president, Francis B. Crocker; vice-presidents, Joseph Wetzler, Francis Forbes, and Dr. Otto A. Moses; secretary, George H. Guy; treasurer, H. A. Sinclair; trustees, J. M. Pendleton, C. O. Mailloux, and A. A. Knudson.

— It is well known, says *Nature*, that whales can remain a long time under water, but exact data as to the time have been rather lacking. In his northern travels, Dr. Kückenthal of Jena recently observed that a harpooned white whale continued under water forty-five minutes.

— For determination of the air-temperature at great heights, the Berlin Society for Ballooning, we learn from *Humboldt*, is going to try a method of Herr Siegfeld, who uses a thermometer, which, by closure of an electric circuit when certain temperatures are reached, gives a light-signal. Small balloons, each containing such a thermometer, will be sent up by night; and the light will affect photographically a so-called "phototheodolite," while the height then attained will be indicated in a mechanical way. It is hoped that more exact formulæ for the decrease of temperature with height may thus be obtained.

— From the *Journal of the Anthropological Society* in Vienna, we take the following conclusions of Dr. B. Hagen, respecting the Malay peoples: Their great predilection for the sea, which makes them pray to Allah that they may die on sea, seems to render the Malay race adapted for the Polynesian and Further Indian Archipelago. The centre from which they migrated is to be sought in the highlands of West Sumatra, particularly in the old kingdom of Menang-Kabau. Thence the peoples extended slowly eastwards, — at first probably the races now to be found only in the interior of the great islands (the Battas in Sumatra, the Sundanese in Java, the Dayaks in Borneo, the Alfurus in Celebes, etc.). These "aborigines" of the islands crushed out a population already in possession, as remains of which the Negritos may be taken. The Malays in the narrower sense, occupying Sumatra, Malacca, and North Borneo, are to be regarded as the last emigration from the centre referred to, occurring from the twelfth to the fifteenth century, A.D. With the Indians and Chinese, who have been long in intercourse with the archipelago, arose mixtures and crosses, in less measure also with the Arabs. One must not therefore expect the pure racial type, especially in the coast population. The crania of the anthropological collections are too imperfectly determined in respect of their *locale* to be of any service for a judgment of the Malay peoples. Of more value are the measurements of the living, begun by Dr. Weisbach and executed by Dr. Hagen, in four hundred cases. The latter's conclusions are: (1) The peoples in the interior of Sumatra — the Battas, the Allas, and the Malays of Menang-Kabau — compose a closely allied group always in direct contrast with the hither-Indian peoples, and yet showing just as little community with the Chinese. We must therefore take them for the pure original type, characterizable as follows: small, compact, vigorous figure, of less than 1.600 millimetres average size; long arms; very short legs; very long and broad mesocephalous skull of very great compass, with high forehead; a prognathous face 10 per cent broader than long, with large mouth, and uncommonly short, flat, and broad nose with large round nostrils opening mostly frontwise, and with broad nasal root. (2) The Malays of the east coast of Sumatra and those of the coasts of Malacca indicate a much greater affinity to the Indians than to their tribal peoples of Menang-Kabau. They are plainly, therefore, thoroughly mixed with Indian blood. (3) The Javanese peoples stand much

nearer to the original type of the Sumatrans than to the Malays just mentioned. They show, therefore, less mixture with Indian, but, on the other hand, more mixture with Chinese, blood; and the Javanese more so than the Sundanese.

— A London paper says that some experiments in judging distance by sound were carried out recently by one of the London brigades of the Metropolitan Volunteers. This branch of military tactics is quite a new departure. It was first explained to the men that sound travels at the rate of 1,100 yards in three seconds, and on this basis they were to estimate the distance at which some rifles were being discharged in the darkness. The answers at first were very wide of the mark, some of the men being as much as 150 yards out in their calculations. With a little practice, however, a great improvement was shown, many of the men guessing the distance exactly. The experiments are not as satisfactory as was hoped, and it is thought some time must elapse before judging distance by sound can be relied upon with any certainty.

— At the monthly meeting of the Royal Society of Tasmania on Sept. 9, the president (his Excellency Sir Robert G. C. Hamilton) said he desired to bring before the society a matter relating to the young salmon at the Salmon Ponds. These were the undoubted product of the ova brought out by Sir Thomas Brady, which had been stripped from the male and female fish and artificially fertilized, and the utmost care had been taken to keep them apart from any other fish bred in the ponds. He recently visited the ponds, accompanied by the chairman of the Fisheries Board, the secretary, and two of the members, when they carefully examined a number of the young salmon, among which they were surprised to find marked differences existing, not only in size, but in their characteristics. It has often been held, according to *Nature*, that the *Salmonidae* caught in Tasmanian waters cannot be true *Salmo salar*, because so many of them have spots on the dorsal fin, and a tinge of yellow or orange on the adipose fin; but nearly half of the young salmon they examined, which had never left the ponds, had these characteristics. Again, many of them were almost "bull-headed" in appearance, — another characteristic which is not supposed to distinguish the true *Salmo salar*. He would suggest to the chairman of the Fisheries Board, whom he saw present, that the secretary should be asked to make a formal report of the result of this visit, and to obtain some specimens of the young fish, which could be preserved in spirits, and perhaps sent to Sir Thomas Brady to be submitted for the consideration and opinion of naturalists at home.

— British Consul Pettus of Ningpo, in his last report, says that one of the principal and perhaps most profitable industries of his consular district is the *ming fu* or cuttlefish trade. For two months, from the latter part of April until the closing days of June, the number of small and somewhat barren islands of the Chusan archipelago, situated within a radius of fifty miles of Chinhae (at the mouth of the Yung River), swarm with men engaged in the occupations of cleaning and drying the fish for the Ningpo market, and the adjacent waters are covered with boats engaged in fishing. The cuttlefish boats are from twenty-five feet to thirty feet in length, with a beam of seven feet. They are furnished with a single lug-sail, usually made of foreign cloths tanned with mangrove-bark. They are worked with two, sometimes three, oars, with which the boats are propelled with immense speed. The boats, as a rule, work in pairs, a bamboo fastened at the bows of each to keep them separated, with a space of about twenty feet between. To the bamboo is attached the large net. Others, again, catch the fish by means of a square net, fastened at the corners to the ends of two slender bamboos which cross at right angles, and sewn together in the middle. These bamboos, with the attached net, are suspended from a stout beam which projects some distance over the bow, and has fastened to the inboard end a heavy weight for facilitating the raising of the net. This is used in shallow water, and principally at night, when a fire is kept burning in a pan in the bow of the boat to attract the fish. One or two men attend to the working of this net, while the rest of the crew are employed in scooping in the fish with hand-nets. The fish are then landed, cleaned, and sun-dried, the latter operation taking about three days. The cuttlefish is called by the Chinese

uri tsé ("black thief"): *ming fu* is the commercial name of the fish when dried. The black liquid secreted by the fish was used as a substitute for ink, but was abandoned, as it faded after a lapse of a few years.

— Many late and valuable reports of ocean-currents have been received at the United States Hydrographic Office, but lack of space forbids any extended reference to them. The graphic record of the tracks of derelicts, wrecks, buoys adrift, etc., published each month on the "Pilot Chart," is itself instructive as to the general set of currents, especially in the case of a large iron buoy like that from Port Royal, S.C. Attention is called, also, to the "bottle papers" issued by the Hydrographic Office, for masters of vessels to seal up in empty bottles and throw overboard, in order, that, when found and returned, data may be obtained regarding the general drift of surface currents. This is an old plan, but one that is still used, and is thought to give results of some value when a large number of such facts are available for study. Many of these papers have been returned to that office, and the latest may be mentioned here. One was thrown overboard Dec. 30, 1888, by Chief Officer Downie (British steamship "Crown Prince") off the north-west coast of Cuba: it was picked up on the beach at Matagorda Island, Texas, Aug. 10, 1889, by the keeper of the Saluria life-saving station. Another was thrown overboard March 27, 1889, by First Officer Conklin (American steamship "Cherokee") in latitude 36° 42' north, longitude 75° 06' west: it was picked up on Sept. 25 by Capt. Touguenant (French brig "Bonne Joséphine") in latitude 44° 30' north, longitude 52° 10' west. The forms issued for this purpose are printed in six languages, and efforts are being made to give them a wide distribution.

— A lake-dwelling has been discovered in the neighborhood of Somma Lombardo, north-west of Milan, through the draining of the large turf moor of La Lagozza. The Berlin correspondent of the *Standard*, who gives an account of the discovery, says that this "relic of civilization" was found under the peat-bog and the underlying layer of mud, the former being 1 metre in thickness, and the latter 35 centimetres. The building was rectangular, 80 metres long and 30 metres broad; and between the posts, which are still standing upright, lay beams and half-burnt planks, the latter having been made by splitting the trees, and without using a saw. Some trunks still retain the stumps of their lateral projecting branches, and they have probably served the purpose of ladders. The lower end of these posts, which have been driven into the clay soil, is more or less pointed, and it can be seen from the partly still well-preserved bark that the beams and planks are of white birch, pine, fir, and larch. Among other things, were found polished stone hatchets, a few arrow-heads, flint knives, and unworked stones with traces of the action of fire.

— According to recent work of Professor H. W. Wiley, the chemist of the United States Department of Agriculture, the value of sorghum-seed as a food for man and other animals is fully equal to that of maize and oats, and but little inferior to that of wheat. The essential constituents of the cereals as food are the albuminoids and the carbohydrates. Comparing these two constituents of sorghum-seed with the other great cereals, it contains more albuminoids than either unhulled oats or maize, and only about three-fourths of a per cent less than wheat. Its contents of carbohydrates is almost identical with that of the other cereals mentioned. The glumes of the sorghum-seeds contain a coloring-matter of great intensity, and it has been thought that this substance might prove injurious to the health of animals consuming it. Professor Wiley has therefore had a careful examination made of the properties of this coloring-matter, and finds it to be a vegetable coloring-matter without noxious principles, and, as far as the investigations have extended, wholly free from tannin. This study includes only the chemical re-actions of the color, and the characteristics which distinguish it from other companion colors of a vegetable origin. Owing to the small quantity of pure color obtained, and the difficulties of complete purification, no experiments were made with regard to its dyeing qualities. The richness of the color (a deep red) would certainly point to the desirability of such experiments. In the heavier and larger hulled seeds, such as those of Deutcher's Hybrid, Early Tennessee, and the Early Amber varieties, the color

seems to constitute between five and fifteen per cent of the alcoholic extract, which latter ranges from five to ten per cent of the seed. The yield of cane per acre appears to average from ten to twelve tons; and the seed-head, fifteen to twenty per cent of the cane. Assuming the seed to constitute seventy-five per cent of the head, we have three hundred pounds of seed to the ton of cane. This affords thirty pounds of extract, and three pounds of pure color, to the ton of cane, or thirty pounds per average acre. The higher the tonnage, and the darker and heavier the hull of the seed, the greater the yield of color.

— A curious instance of the vicissitudes of commerce is afforded by the change going on in the raisin trade between this country and Spain. In 1882 Malaga shipped to this country nearly a million boxes of raisins, which was about half its production for that year. Since that time the annual production in Malaga has steadily decreased, while that of California has as steadily increased, till in 1888, out of a total crop of 112,000 boxes, Malaga sent us only 700,000 boxes. It is now predicted by vine-growers that in a few years California will be shipping raisins to Spain.

— Iron buoys, being constructed so as to withstand the buffeting of the heaviest seas, are apt to remain long afloat when once they get adrift from their moorings. Although their movements are then governed by the combined influence of wind and current, the relative effects of each of these components of the force acting upon them vary more or less, according to the shape and immersion of the buoy. When a considerable portion of the moorings are still attached, the immersion is generally so great that the influence of the current largely outweighs that of the winds, and the drift of the buoy is a very fair indicator of the set of the current it has experienced. A notable instance is afforded by the mid-channel buoy from Port Royal, S.C., which went adrift in the latter part of November, 1886, and is still floating about in the North Atlantic, probably somewhere between the parallels of 35° and 45° north, and the meridians of 45° and 55° west. Eleven reports have been received thus far by the United States Hydrographic Office.

— The following is a list of the Saturday morning lectures to be given in the Law School building of Columbia College during the season of 1889-90: Nov. 16, "The Influence of Locality in American Fiction," by L. J. B. Lincoln, Esq.; Nov. 23, "Petroleum and Natural Gas" (with illustrations), by Dr. John S. Newberry; Nov. 30, "Cæsar and Cleopatra," by John William Weidemyer, Esq.; Dec. 7, "Benjamin Franklin, America's Practical Philosopher," by Dr. Henry M. Leipzig; Dec. 14, "The Avesta and the Religion of Zoroaster," by Dr. A. V. W. Jackson; Dec. 21, "The Geological History of Man" (with illustrations), by Dr. John S. Newberry; Dec. 28, "The Relation of the Higher Education of Women to Literature in America," by L. J. B. Lincoln, Esq.; Jan. 4, 1890, "Shakspeare and Corneille," by Professor Adolphe Cohn; Jan. 11, "The Cycloides," by Dr. Louis Dyer; Jan. 18, "The Career of Leon Gambetta," by Professor Adolphe Cohn; Jan. 25, "Progress of Education in the United States," by Dr. Henry M. Leipzig; Feb. 1, "Total Solar Eclipses and What We Learn from Them" (with illustrations), by Professor J. K. Rees; Feb. 8, "Where and How We remember," by Dr. M. Allen Starr; Feb. 15, "The Moon: A Study of her Surface" (with illustrations), by Professor J. K. Rees; Feb. 22, "Methods of teaching French," by Dr. B. O'Connor; March 1, "Emerson as an English Writer," by Professor T. W. Hunt; March 8, "Methods of Education," by Dr. B. O'Connor; March 15, "Words and their Abuse; from Philological, Rhetorical, and Moral View-Points," by Dr. J. D. Quackenbos; March 22, "The Poetic Edda," by Professor Charles Sprague Smith; March 29, the same subject continued; April 5, "Swinburne and the Later Lyrists," by Professor H. H. Boyesen; April 12, "George Eliot and the English Novel," by Professor H. H. Boyesen; April 19, "Shakspeare's Dramatic Construction: The Winter's Tale," by Professor T. R. Price; April 26, "Shakspeare's Verse Construction," by Professor T. R. Price; May 3, "Athenian Days," by Professor A. C. Merriam; May 10, "The Geographical Distribution of North American Plants" (illustrated by lantern projections), by Dr. N. L. Britton; May 17, "Daniel O'Connell," by Dr. William A. Dunning; May 24, "Shop-Girls and their Wages," by Dr. J. H. Hyslop.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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INFLUENCE OF FOOD, ANIMAL IDIOSYNCRASY, AND BREED ON THE COMPOSITION OF BUTTER.¹

ONE of the fundamental principles of dairying is regard for the influence which the care of the animal, supervision of the milking, separation of the cream, ripening of the cream, churning and washing, have on the quality of butter for table use. These processes also, together with the method of packing, have a notable influence upon the preservation of the butter in a sweet state. The discussion of the above problems, however, is a thing for the practical dairyman rather than the chemist. The chemical composition of butter-fat, as influenced by the character of food received by the animal, the race of the animal, and the peculiarities of the animal, has hitherto been little studied from a chemical point of view. To the latter subject I propose to devote the following paper.

Late in February this year, I received a letter from Professor H. H. Harrington, chemist of the Experimental Station of Texas, accompanied by two samples of butter, which he asked me to examine. The following extract from Professor Harrington's letter will indicate the motive which led him to send the samples:—

"Some work in our laboratory indicates that volatile acids from the cottonseed butter are much lower than has been generally supposed. I send two samples of butter,—one from cottonseed feed, and the other from feed containing no cottonseed. If you can do

¹ Abstract of a paper by H. W. Wiley, read before the Society for the Promotion of Agricultural Science at its annual meeting held in Toronto, Canada, Aug. 26, 27, 1889.

me the favor of analyzing this butter, I shall send more samples from the same cows on the same feed. We hope in the near future to follow up these analyses with complete analyses of butter from different feeds, feeding two cows on cottonseed, and then changing them to other feed."

The samples sent by Mr. Harrington were small, and a complete analysis could not be made; but the results obtained are of such interest that I will communicate them at the present time, and call attention to the peculiarities noticed.

	Butter from Cotton-seed.	Butter from Other Feed.
Volatile acids, No. cc N—10 BaO ₂ H ₂ for 5 grams.....	21.00	28.50
Percentage of iodine absorbed.....	33.40	31.89
Melting-point.....	45° C.	34½° C.
Reduction of silver by Bechi.....	distinct	none

The most remarkable points connected with the analyses are as follows: 1. The low percentage of volatile acids in butter from cottonseed; 2. The phenomenally high melting-point of the butter from cottonseed; 3. The persistence of the reducing agent of the butter from cottonseed, as indicated by its action upon nitrate of silver.

The melting-point of the butter is higher than that of pure lard. The particular point to be noticed in this matter is, that in butter designed for consumption in Southern countries, or produced in Southern countries, the mixture of cottonseed with the feed of cows will tend to raise the melting-point of the butter, and render it more suitable for consumption in hot climates.

The persistence of the reducing agent is also a matter of interest. It has passed, in the samples examined, through the digestive organism of the cow, and has re-appeared in the butter with almost undiminished activity. The selective action of the digestive organs on the different glycerides contained in the food of the animal is also a matter of importance. It would be expected *a priori* that the butter from a cow fed largely on cottonseed-oil would contain more oleine and have a lower melting-point than if ordinary food were used. On the contrary, it is seen that either the more solid glycerides have been absorbed during the process of digestion, or that the oleine has undergone some distinct change in the digestive organism by which it has assimilated the qualities of the other glycerides.

From an analytical point of view, the results are of great importance, since they show that a butter derived from a cow fed on cottonseed-meal or one excreting a fat of unusual quality might be condemned as adulterated when judged alone by the amount of volatile acids present. Since cottonseed-meal is destined to be a cattle-food of great importance, especially in the southern part of the United States, this is a fact of the greatest interest to analysts.

The observation of Mayer, soon to be mentioned, that the specific gravity of butter-fat varies with its content of volatile acids, I have also verified in some cases by the determination of the specific gravity of samples of butter-fat taken from the milk of the same cows kept on the same food, but taken the following day after the samples mentioned. The specific gravity for the cotton-meal fed sample was .8929 at 99°; that for the ordinary fed sample, .8991 at 99°.

Professor Mayer's experiments were made on a single cow of a North Holland breed. From time to time during the progress of the experiments the original food was used, in order to see what effect the period of lactation would produce. The cow was fed for twelve days on each separate ration before the samples were taken. After two days more, another set of samples was taken, and then the food changed for a new experiment.

In the butter-fat the melting and solidifying points were taken, and the volatile acids determined according to the method of Reichert. The specific gravity was also determined by the Westphal method at 100°.

The rations of the cow were composed of the following ma-

terials: ration No. 1, 15 kilograms of meadow-hay and 2 kilograms of linseed cake; No. 2, siloed grass *ad libitum*, and 2 kilograms of linseed cake; No. 3, 20 kilograms of beets, 8 kilograms of hay, and 2 kilograms of linseed cake; No. 4, pasture-grass *ad libitum*; No. 5, chopped clover with 14 per cent of other grasses *ad libitum*.

The highest melting-point observed, viz., 40.5, was from ration No. 1; and the lowest, viz., 32.5, from ration No. 5. The highest volatile acids were produced by No. 3; the lowest volatile acids were observed with ration No. 2.

The results of my analyses were obtained on the first samples of butter sent by Mr. Harrington, and were published in *Agricultural Science* for April 1, 1889, pp. 80 *et seq.* Not fully satisfied with the result of a single determination, I asked Professor Harrington to send me other samples of butter, which he did on two subsequent occasions. The analyses of the two last sets of samples sent did not fully bear out the results obtained in the first set.

The importance of a more careful study of this subject led me to institute some feeding experiments of my own, in order to unravel, if possible, the mysteries of the preceding analyses. I accordingly obtained authority from the secretary of agriculture to arrange for certain feeding experiments with Professor Alvord of the Maryland Agricultural Experiment Station. Three cows were selected for these experiments, described by Professor Alvord as follows: No. 1, full-bred Jersey; No. 2, full-bred Ayrshire; No. 3, cross-bred Jersey and Ayrshire.

These cows were kept on ordinary pasturage for ten days, and then the milk from each of the cows for three days was taken for the experiments. All the milk was subjected to the same conditions. It was set in earthen bowls in a refrigerator at 45° to 50° F., and skimmed after twelve hours. The cream was mixed and kept at 55° to 60° until the fourth day after the beginning of the milkings. The cream was then ripened in a room at 60° F. temperature for twenty-four hours. After cooling to 62° F., the cream was churned; the temperature rising from 62° F. at the beginning of the churning, to 65° at its close. The time required for each churning was twenty minutes. The three days on which the milk was saved were damp, hot days, very unfavorable for making good butter. In all cases the butter was thoroughly washed in cool well-water, made into rolls, and put in glass jars. One-half of each sample of the first lot was salted at the rate of two-thirds of an ounce of salt to one pound of butter.

After the conclusion of the first set of experiments, the cows were gradually changed to a ration of cottonseed-meal, using the commercial variety, such as is used for fertilizing purposes, and no unextracted cottonseed-meal could be obtained at this season of the year. The ration of cottonseed-meal was gradually increased, the cows finally being given all they would eat of it. The following are the facts as to the second lots. The feeding of cottonseed-meal was commenced on the 25th of July, giving but one pound at a feed at first, but constantly increasing the quantity.

During this trial the cows were turned into a small lot with very short pasturage, for exercise and access to running water. They were fed only the cottonseed-meal, and consumed the quantity stated. At the close of the trial, the Jersey and cross-bred cows were beginning to refuse the meal. The Ayrshire continued to eat all offered, and probably could have been fed twelve pounds a day; but I was afraid to give her over eleven pounds a day, and did that only twice. She later kept on at eight and ten pounds per day, while the others fed to one pound and two pounds.

In general, the data obtained corroborate the results of the first study of the samples sent by Professor Harrington. The melting-points of the butters from cows fed on cottonseed meal are markedly higher than from the other samples. There is also a markedly diminished content of volatile acids in these butters, and a lower iodine absorption power. The latter character is unlike the Harrington sample. Another characteristic phenomenon noticed in the first samples of butter is also here repeated; viz., the persistence of the reducing agent which is present in cottonseed-oil in the butter derived from animals fed thereon. The physiological importance of this phenomenon will be mentioned in another place. The most curious results, however, of these experiments is found in the increase in the butter of the glycerides having a high melting-point; in other words, the glycerides of the palmitic and stearic

series. While further experiment may be necessary to show that there is a uniform diminution of volatile acids in butters from cows fed on cottonseed-meal, the fact is now most clearly established that the melting-point of such butters is uniformly higher. In regard to the absorption of iodine by the butters from cottonseed-fed cows, the results obtained are somewhat at variance with those secured by Ladd, who states that butter from cows fed on linseed-meal contained 3.5 per cent more oleine than those samples which were obtained from cows fed on bran. This conclusion of Ladd's, however, may not be the true one, since linseed-oil has an iodine absorption of about 155 per cent, and this high coefficient may have had some influence upon the butter as regards iodine absorption. It is possible, therefore, that some of the linoleic glyceride, which has so high an iodine-absorbing power, may have found its way into the butter, thus increasing its iodine absorption.

Another important characteristic of the butters examined is seen in their abnormally low content of volatile acids. If we compare the samples from the Maryland station with those from Kansas, we have a very characteristic contrast between abnormal pure butter and normal pure butter. The two samples from Kansas show a percentage of volatile acids which is not unusually met with in samples of pure butter. On the other hand, the samples from the Maryland station show an abnormally low content of volatile acids. This percentage of volatile acids is indeed so low that these butters would be condemned as spurious if we relied upon the volatile acid test alone. It does not seem so strange, in the light of these facts, that Allen should have found abnormal Danish butters which, nevertheless, from their history, were certainly genuine.

In so far as the breed of the animal is concerned in the above experiments, it does not seem to have greatly influenced the composition of the butter. The low content of volatile acids may therefore be attributed either to the pasturage, or to the peculiarity of the animals themselves, or to the period of lactation. It would hardly seem probable, however, that three animals taken at random should have exhibited in almost the same degree the abnormal qualities indicated in the composition of the butters.

The physiological questions which are suggested by the above study are of the utmost consequence. In a paper entitled "Note on the Action of Digestive Fluids on Oil," published in *The Medical News* of July 28, 1888, I called attention to the remarkable influence exerted on a large quantity of oil in the human digestive organs. A pint of oil, presumably sweet-oil, but more likely cotton-oil, was administered to the patient for the relief of an obstruction in the gall-duct. This oil, in passing through the digestive organs, was completely decomposed mostly into fatty acid with some soap, forming an emulsion in the alimentary canal, and, being voided in the form of rounded masses of considerable consistence, was mistaken by the patient for gall-stones. This action of the digestive liquids was entirely unexpected, and seems to show that the commonly accepted notion that the fats are acted upon in the digestive organs by being emulsified, and thus absorbed into the circulatory fluids, is an erroneous one.

It is the common supposition that the facts have for a physiological function the maintenance of the animal heat of the body, and the nutrition and supply of the fatty portions thereof.

The experiments in feeding cows on cottonseed-meal would seem to indicate that the natural glycerides contained in cottonseed-meal do not appear in the butter of the cows fed thereon. If the cottonseed-oil in the food should pass unchanged into the butter, we might, it is true, have a lowering of the volatile acids; but this would be accompanied by a great increase in the iodine absorption and a marked lowering in the melting-point. It is quite certain that the glycerides of butter which yield on saponification volatile acids are not derived from similar glycerides in the food of the animal. It may also be quite true that none of the glycerides in the butter of the cow is derived from the fat of the food of the animal. It is more than likely that the fat of milk is a direct product of digestion, and is formed conjointly from the carbohydrates and the albuminoids in the cow's food. We need not, therefore, be perplexed any longer at the presence of so small a portion of stearine and so large a proportion of the butyric series of the glycerides in the fat of milk.

From the evidence already at hand, I think we would be justified

in saying that practically all the fats in milk are products of digestion, and none of them results of simple translation through the digestive organs of fats already present in food. On the other hand, we have undoubted evidence of the translation of other substances directly from the food of the cow to the butter-fat, as is shown in the presence of the aldehyde in cotton-oil, which reduces silver, in the butter of cows fed on these substances. Among other studies on the influence of the food on the composition of butter, I might cite the paper of Ladd, already noted; and also one by C. J. von Lookeren, published in the *Milch Zeitung* (No. 3, 1889, p. 47); and the paper of Mayer, published in *Die Landwirtschaftlichen Versuchs Stationen* (vol. xxxv. p. 261). These studies are of such practical interest, that it is my intention to continue them during the coming year on an extended series of feeding experiments, in which I hope to interest experimenters in different parts of the country.

THE STING OF THE JELLY-FISH.

DR. B. W. RICHARDSON writes on the above subject in the last number of the *Asclepiad*, giving a personal experience of his own. He says, —

"In my case I was caught by the shoulders and chest in the tentacles of a large medusa, and had really for a minute or two a difficulty in freeing myself. The surface of the skin touched by the tentacles began to smart at once, and, by the time I was out of the water and partly dressed, the skin was covered, over the surface attacked, with a bright erythema, accompanied with a sense of extreme heat and irritation. The sensation was much the same as that brought on by the application of a mustard poultice, except that it was not so uniformly diffused, but was rather in the form of wheals in slightly raised lines, with a considerable number of points at which the tingling and heat were most severe. Unfortunately, I had no clinical thermometer by me with which to take the local temperature, but, judging by the touch of the hand, the local temperature was raised at least two or three degrees. The redness and irritation lasted seven hours, and did not absolutely subside until after a night's rest; but, during the time it was on in the acute form, it was soothed considerably by the application of water, rendered alkaline by common washing soda in the proportion of an ounce of the soda to about two quarts of water.

"A friend of the writer suffered far more severely. He was bathing where a number of jelly-fish were present, and got so entangled amongst them, that, as he said, he was 'stung over almost all the surface of his body.' He suffered from an acute erythematous eruption, which lasted over sixteen hours, attended with two degrees of general fever, and followed by malaise that lasted three days.

"A still more important case happened in a very singular manner to another friend and patient. I had gone down to a bathing-place in the summer of 1872, not knowing that my friend was there. I had not been on the spot two hours, when a messenger came to me, asking if I would go at once to Mr. G., the friend in question, because he had been 'stung in the throat by a jelly-fish, and they were afraid he would not live.' On reaching my friend, who had accidentally heard I was near to him, I learned that about two hours before, while he had been floating on his back in the sea, with his mouth open, the tentacles of a jelly-fish swept into his mouth, and stung him severely in the back of the throat. There could be no doubt about the mischief, for the throat over the whole of the pharynx was intensely red, and the surface was rough and raised. With this condition there were considerable heat and irritation, amounting to acute pain, and attended with inability to swallow any thing except fluids cooled with iced water. The idea of extreme danger was present in the mind of the sufferer, and I believe my firm assurance that he would take no harm contributed as much to the recovery that succeeded as the simple alkaline remedies which formed the chief part of the medical treatment. In this case also there was a rise of two degrees of temperature, and during convalescence there was marked depression of both mind and body for a period of two or three days.

"In describing these phenomena," he adds, "I have used the

ordinary word 'sting' for the want of one more accurate. Really, I do not know whether it is a sting, like that of a wasp or a nettle, that is inflicted, or whether a secretion, acrid in kind, is thrown upon the surface, and acts directly as an irritant fluid. On the whole, I suspect it is a fluid, or organic acid, which is the cause of the irritation. For the resultant erythema, local alkaline treatment is particularly effective. In the throat case, bicarbonate of soda with *mel boracis* proved very grateful and useful."

MENTAL SCIENCE.

The Energy and Rapidity of Voluntary Movements.¹

M. FÉRÉ, whose volume upon the relations of sensation and movement, upon the phases of hypnotism and kindred topics, has given him a deserved reputation, has recently investigated the relation between the energy or physical power at the disposal of the individual and the rapidity of his re-actions to simple physical processes. His main thesis is, that great energy and great quickness of movements are concomitant, and vary in the same way under similar circumstances. He has studied this relation among the hysterical and epileptic (as typical instances of abnormal sensorimotor organisms) as well as in normal individuals.

M. Féré had shown that in hysteria the influence of certain emotions, pleasant in their nature, was to increase the maximum power of exertion, as tested by the "squeezing" of a dynamometer, which action he terms "sthenic;" while opposite emotions decrease such power, and are "asthenic."² He now studies the variations in the re-action times to an electrical shock under the same influences, and the concomitant variation in dynamometric power. In five subjects re-acting from the forehead and the back of the hand, both on the right side and on the left, the average re-action times were, T. 61, M. 61, V. 42, R. 28, and B. 27 of a second, when the dynamometer registered respectively, T, 24; M, 24; V, 28; R, 28; and B, 29. Furthermore, the side of the body from which the re-action is quickest (the subjects are affected with partial anæsthesia) also claims the hand with greatest dynamometric force.

If these subjects are put into the somnambulant stage of hypnotism, the effect upon the re-action time may be either to shorten it or lengthen it, or leave it unaltered; but in every case the power of the maximum contraction is affected in the same way. The re-action times are, for T. 61, for V. 61, for R. 35, for B. 25, for M. 20, of a second; and the strength of squeeze respectively, 24, 25, 30, 36, 40. Under the influence of an "asthenic" or strength-depriving unpleasant emotion, such as fear, B's re-action time increased from the normal of .29 to .44 of a second, and his muscular force decreased from 29 to 20; M's re-action time of .61 becomes .65 of a second, and his dynamometric record of 24 becomes 25. Similar changes for V are from .42 to .51 of a second, and from 28 to 24; for R, from .28 to .45 of a second, and from 28 to 16; for T, from .61 to .62 of a second, and from 24 to 30. We notice the individual variations, but in general the law is maintained. Under the influence of a "sthenic" or strength-giving emotion, the re-action times decreased and the squeeze increases as follows: for B, .13 of a second and 40; for M, .16 of a second and 46; for V, .28 of a second and 37; for R, .14 of a second and 42; for T, .19 of a second and 38. Essentially similar results are shown for two hysterical patients re-acting to sound instead of to touch impressions. M. Féré records the form of the contraction of the hand, and finds that, when the effort is powerful and the re-action quick, the curve of contraction rises suddenly, while in the opposite case it rises slowly. He notes, too, many other mainly physiological conditions into which we cannot here enter, but all of which go to show that the speed of re-action times depends upon the rate at which the nutritive processes of circulation, etc., proceed. Essentially similar results were obtained in epileptics. In one case the re-action time to a touch impression was .34 of a second; to a sound impression, .28 in the normal condition; one hour after an

¹ *Revue Philosophique*, No. 7, 1883.

² It is interesting to compare this action with the re-enforcement of the patellar-tendon reflex or knee-jerk by similar means. Any impressive sensation will cause an increase in the response to a simple blow below the knee. Both may be regarded as very sensitive and quickly registering indices of the effect of stimuli upon the nervous system, and have the extreme value that the great rarity of such indications gives them (see Lombard, in Vol. I. No. 1. of the *American Journal of Psychology*).

epileptic seizure it was .50 of a second for touch, and .37 for sound. In another patient the re-action times were .35 of a second for touch and .30 for hearing three hours after an attack, as against .21 of a second and .16 normally. A third patient, whose normal re-action times were .28 of a second (touch) and .34 of a second (sound), two hours after a seizure, re-acted in .40 of a second to touch and .37 of a second to a sound. The same patient, seventy-two hours after the last of fifteen successive attacks, required 1.11 seconds to re-act to touch, and 1.25 seconds to re-act to a sound. In an independent research, M. Féré had shown that in the average of twenty cases the dynamometric power was reduced to 45 per cent of its normal value immediately after a seizure, to 33 per cent after one-quarter of an hour, to 25 per cent after an interval of one half-hour, and to 17 per cent after an interval of three-quarters of an hour. Apart from special relations of the nature of the seizure to the diminution in muscular power, the general thesis of M. Féré is well borne out by these facts.

In normal individuals the same relations can be demonstrated, though the contrasts are not as sharp. Fatigue diminishes muscular force, and increases the times of re-action. Intelligent persons, speaking generally, have a short re-action time and a high dynamometric pressure. In order to study in closer detail the relation of re action time and motor power in special motor groups, M. Féré had constructed a dynamometer in which the pressure of each finger was recorded separately. With this apparatus M. Féré was able to establish that the movements of flexion were from three to ten times as powerful as those of extension; that the power of different fingers varies with different individuals, and stands in relation to the profession of the individual, the third and fourth fingers being especially strong in piano-players; and that intellectual persons have an especially strong thumb, an essentially human movement.

	Flexion.		Extension.	
	Dynamometer.	Re-action Time. Seconds.	Dynamometer.	Re-action Time. Seconds.
Thumb	4.2	.165	1.2	.100
Forefinger	4.0	.191	1.0	.261
Middle finger.	3.5	.193	.9	.230
Third finger	2.0	.201	.6	.299
Little finger	1.9	.203	.4	.310
Thumb	2.7	.230	1.0	.335
Forefinger	3.3	.160	1.1	.260
Middle finger.	2.2	.180	.4	.277
Third finger.	2.0	.295	.35	.296
Little finger	1.8	.246	.3	.309
Thumb	4.1	.170	1.1	.220
Forefinger	3.0	.191	.6	.210
Middle finger	3.2	.182	.7	.190
Third finger	2.2	.181	.7	.183
Little finger	5.1	.171	.5	.142
Thumb	2.8	.282	.6	.340
Forefinger	2.6	.359	.4	.516
Middle finger.	2.5	.346	.3	.515
Third finger	1.7	.436	.1	.639
Little finger	1.4	.513	.2	.517

The first three records were obtained from officials of the hospital, and exhibited very fairly the points in discussion, while the third subject is also a pianist, and shows a remarkable power of flexion of the little finger as well as a quick re-action time for both flexion and extension of this finger. The fourth record is of an intelligent epileptic patient. We see, that, while the dynamometer shows

movements of flexion far superior to those of extension, the re-action times show only a slight superiority, and that exercise seems to increase not only the power of flexion, but the speed of extension. If we make separate observations on the right and left hands, we will find that the preferred hand presses more strongly and re-acts more quickly than the other hand.

The same method can be applied to the movement of other organs. The energy of extension of the tongue has been measured, and varies in normal subjects from 500 to 850 grams. In deaf-mutes and patients afflicted with aphasia it may be as low as 100 grams. That the energy of this movement is related to the re-action time is shown in the following results: F (a normal subject) moves the tongue with a force of 850 grams, and performs this motion in .13 of a second; L (also normal), 400 grams and .15 of a second; J (partially aphasic), 300 grams and .30 of a second; F (a stammerer), 200 grams and .33 of a second.

That nutritive processes play an important part in these movements is more than likely. Cold retards and heat accelerates the re-action times. The following table shows the effect of warming upon the re-action time in movements of flexion and extension of the five fingers: —

	Flexion.		Extension.		The movements of extension, and especially those ordinarily the slowest, seem to be most benefited by this additional warmth.
	Before Warming.	After Warming.	Before Warming.	After Warming.	
Thumb . . . . .	.346	.223	.362	.194	
Forefinger . . . . .	.269	.234	.270	.186	
Middle finger. . . . .	.266	.261	.280	.201	
Third finger . . . . .	.255	.239	.320	.250	
Little finger . . . . .	.283	.237	.312	.220	

This research, though incomplete, and founded upon rather few experiments with each subject, yet admirably suggests the close relations that exist between the motor, sensory, and nutritive functions of the psycho-physical organism. As our knowledge of this relation becomes more and more exact, the possibilities of utilizing such knowledge for making the elementary processes of knowledge and action easier and quicker, become more and more real.

RAPIDITY OF MOVEMENTS. — A pianist, in playing a presto of Mendelssohn, played 5,595 notes in four minutes and three seconds. The striking of each of these notes, it has been estimated, involved two movements of the finger, and possibly more. Again, the movements of the wrists, elbows, and arms can scarcely be less than one movement for each note. As twenty-four notes were played each second, and each involves three movements, we would have seventy-two voluntary movements per second. Again, the place, the force, the time, and the duration of each of these movements, was controlled. All these motor re-actions were conditioned upon a knowledge of the position of each finger of each hand before it was moved, while moving it, as well as of the auditory effect in force and pitch, all of which involves at least equally rapid sensory transmissions. If we add to this the work of the memory in placing the notes in their proper position, as well as the fact that the performer at the same time participates in the emotions the selection describes, and feels the strength and weaknesses of the performance, we arrive at a truly bewildering network of afferent and efferent impulses, coursing along at inconceivably rapid rates. Such estimates show, too, that we are capable of doing many things at once. The mind is not a unit, but is composed of higher and lower centres, the available fund of attention being distributable among them.

BOOK-REVIEWS.

A Treatise on Linear Differential Equations. By THOMAS CRAIG. New York, Wiley, 8°.

The theory of differential equations has undergone within the last thirty years a most fundamental change. The object of the older theory was to integrate a given differential equation "in finite

form;" that is to say, by means of the elementary functions of analysis. But though the importance of this problem for practical purposes must be acknowledged, the problem itself, understood in this form, is in general an impossible one.

The modern theory, inaugurated by Briot and Bouquet's and Fuchs's discoveries, has reversed the whole problem. It considers the differential equation (together with a proper number of initial conditions) as defining a function, and proposes to derive directly from the differential equation the characteristic properties of its integrals, true to the general principle of the theory of functions, that the essential thing about a function is not its form, which usually may be varied in many ways, but the totality of its characteristic properties.

It is in particular the theory of linear differential equations that has been very fully considered from this standpoint; and there is scarcely any branch of mathematical science that has attracted a more general attention in our day, and in which more important discoveries have been made, than the theory of linear differential equations. Still every one who wished to become familiar with it, and who had to work his way through the vast and difficult literature on the subject, has keenly felt the want of a systematic exposition uniting the numerous researches scattered in the different mathematical journals and publications of learned societies.

To meet this want, and to give an account of the theory as it stands to-day, is the object of the "Treatise on Linear Differential Equations," by Professor Thomas Craig of Johns Hopkins University. The first volume, which is to be followed by a second one, is entitled "Equations with Uniform Co-efficients," and deals principally with Fuchs's theory and the investigations immediately connected with it. The rich material has been carefully sifted, and is presented in a clear and intelligible language in the most natural order of ideas.

An introductory chapter gives the general properties of a system of linear differential equations of a more formal character, among others the well-known theorems on systems of independent particular integrals.

Next follows an elegant exposition of the theory of linear differential equations with constant co-efficients, where the reader will find, besides Euler's solution, an account of various ingenious methods due to Cauchy, Hermite, and others.

After these preparations, we are led, in Chapter III., into the very centre of the modern theory; viz., the determination of the form of the integrals in the region of a critical point. It is first shown, that, if the differential equation be written in the form

$$\frac{dy}{dx} + p_1 \frac{dy}{dx^{n-1}} + \dots + p_n y = 0,$$

the critical points of any one of its integrals are always found among the critical points of the system of co-efficients, p_1, p_2, \dots, p_n . Then Fuchs's theorems concerning the form of the integrals in the region of a critical point are developed with all the details about "groups of integrals" added by Hamburger, Floquet, and others.

A particular integral is said to be regular in a critical point a , if it remains finite for $x=a$ after multiplication by some proper power of $x-a$; and, in order that all the integrals may be regular in a , it is necessary and sufficient that the $(x-a)^{\beta\alpha}$ ($\alpha=1, 2, \dots, n$) be holomorphic in a . Chapter IV. contains an account of Frobenius's elegant treatment of this case, and gives a simple criterion for the non-appearance of logarithms.

The next chapters are devoted to that important class of differential equations (called regular equations) all of whose integrals are regular in all the critical points; and the fertility of the general methods is abundantly shown in the application to the equation of the second order, in particular that with three critical points, which, on account of its high importance, is very fully treated, with many interesting results concerning Riemann's P-function, spherical harmonics, Bessel's functions, etc.

The differential equation of the hypergeometric series, to which the above equation can always be reduced, takes such a central place in recent mathematical researches that it well deserves to be considered with all detail, as is done in Chapter VII., which contains a reproduction of Goursat's "Thesis on the Hypergeometric Series."

The theory of irregular integrals is still in a very imperfect state. Chapter IX. gives an account of Frobenius's and Thomé's researches, and the same subject is treated in Chapter X. by the elegant method of decomposition of a differential quantic into symbolic prime factors. Interesting special classes of irregular equations will be found in the chapters on Halphen's equations, and on equations with doubly periodic co-efficients.

The two remaining chapters might, it seems to us, as well have been reserved for the second volume, where the same subjects will be more fully dwelt upon. Still the two conceptions of group and of invariant of a differential equation which they develop are of so fundamental importance that they can scarcely be introduced too soon.

If the co-efficients of a linear differential equation are uniform functions of x , any system of n independent particular integrals submit to a homogeneous linear substitution when the variable point x describes any closed path in its plane. The entire system of substitutions obtained in this way forms a group, called the "group of the differential equation."

The notion of "invariant" of a linear differential equation, on the other hand, arises when the given equation is transformed into another of the same form by the introduction of two new variables, and its definition is analogous to that of an invariant of an algebraic quantic.

We must confine ourselves to these few indications, and refer the reader to the book itself for further information. Only then will he obtain an adequate idea of the thoroughness and completeness with which the subject has been treated. As far as we are able to judge, no investigation of any importance has been omitted, and the justice and conscientiousness with which continually reference to the original papers is given are a characteristic feature of this most valuable book, which, we are sure, will contribute a great deal to spread the knowledge of this important discipline.

We look forward with much interest to the appearance of the second volume, which will contain, among other things, an exposition of the theory of linear differential equations with algebraic integrals, and of Poincaré's theory of Fuchsian groups and Fuchsian functions.

AMONG THE PUBLISHERS.

The Bulletin of the Ohio Agricultural Experiment Station for October, 1889, is Vol. I, No. 1 of a technical series, and contains three articles by Clarence M. Weed,—"Preparatory Stages of the 20-Spotted Ladybird," "Studies in Pond Life," and "A Partial Bibliography of Insects affecting Clover."

—The opening article in the December number of *Outing*, "Wabun Anung," by F. Houghton, is a clear description of a tour in the region of the Great Lakes. Another article is the "Merits and Defects of the National Guard," by Lieut. W. R. Hamilton. We note further the "Game of Curling," by James Hedley; "Wheeling through the Land of Evangeline;" "Game Protection;" "Instantaneous Photography," by W. I. Lincoln Adams; "Women and their Guns;" "The Yale Stroke;" "Alligator Shooting in Florida;" and "Na-ma-go-os," a fishing sketch.

—John Wiley & Sons have just published "A Hand-Book for Sugar Manufacturers and their Chemists," by Guilford L. Spencer of the United States Department of Agriculture. The volume contains practical instruction in sugar-house control, the diffusion process, selected methods of analysis, reference tables, etc. The essential requirements of a thorough chemical control and superintendence of a sugar-factory are carefully described, and only such analytical processes are given as relate to sugar-house products and the waste residues when necessary to a complete control. Technical chemical terms have as far as possible been avoided. The little book ought to stimulate our sugar-manufacturers and their chemists to more extensive investigations and more thorough work.

—Messrs. Ginn & Co. announce for publication early in December the first volume of a serial entitled "Harvard Studies in Classical Philology," edited by a committee of the classical instructors of Harvard University. It is the expectation that one volume,

Publications received at Editor's Office,
Nov. 25-30.

- BACNOT, Walter, *The Works of*. Ed. by Forrest Morgan, 5 vols. Hartford, Conn., Travelers Ins. Co. 262 p. 8°.
- BECKER, G. F. *Geology of the Quicksilver Deposits of the Pacific Slope*, with an Atlas. Washington, Government, 486 p. 4°.
- CHURCH, A. J. *The Story of Early Britain*. New York, Putnam; London, T. Fisher Unwin. 382 p. 12°. \$1.50.
- HUBBER, P. G., jun. *Liberty and a Living*. New York and London, Putnam. 239 p. 16°.
- JACOBS, H. B., and BROWER, A. L. *The Graphic System of Object Drawing*, Nos. 1-4. New York, A. Lovell & Co. 92 p. 7 by 8½ inches.
- Same, Nos. 5 and 6. New York, A. Lovell & Co. 43 p. 6½ by 11½ inches.
- Hand-Book to accompany *The Graphic System of Object Drawing*. New York, A. Lovell & Co. 50 p. 12°.
- Notes to accompany Books 5 and 6 of *The Graphic System of Object Drawing*. New York, A. Lovell & Co. 11 p. 12°.
- NEWBERRY, J. S. *Fossil Fishes and Fossil Plants of the Triassic Rocks of New Jersey and the Connecticut Valley*. Washington, Government, 122 p. 4°.
- POYSER, A. W. *Magnetism and Electricity*. London and New York, Longmans, Green, & Co. 247 p. 12°. 80 cents.
- RICKS, G. *Natural History Object Lessons*. Boston, Heath, 332 p. 12°. \$1.35.
- RIPPER, W. *Steam*. London and New York, Longmans, Green, & Co. 292 p. 12°. 80 cents.
- TABER, C. A. M. *Winds, Ocean Currents, and Ice Periods*. Boston, G. H. Ellis. 86 p. 12°.
- U. S. ARMY. *Annual Report of the Chief of Engineers*, 1889. Washington, Government, 429 p. 8°.
- WRIGHT, H. R. *Elementary Physics*. London and New York, Longmans, Green, & Co. 243 p. 12°. 80 cents.

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— With the December number the *Magazine of American History* completes its twenty-second volume. The frontispiece to the current issue is a portrait of Lord Brougham; and the opening paper by the editor is a sketch of his early career during the infancy of our Republic, with pen-pictures of his contemporaries and surroundings, the establishment of the *Edinburgh Review*, and the marriage of its editor in New York City. The second illustrated paper is a "Tribute to Hooper C. Van Voorst," the late president of the Holland Society, by George W. Van Siclen. The third contribution is "The Story of Brave, Beautiful Margaret Schuyler," an historic ballad from the pen of Judge Charles C. Nott of Washington. Curiously interesting is the article following, of R. W. Shufeldt, "The Drawings of a Navajo Artist," illustrated with the Indian pencil; as is also the "Acrostic by John Quincy Adams," in facsimile, from Ella M. M. Nave. "The Sciota Purchase in 1787," by Col. E. C. Dawes of Cincinnati, and the "Private Contract Provision in Ordinance of 1787," by Hon. W. P. Cutler, are important contributions to the number. These are ably written, and will doubtless serve to correct many errors in recent histories of Ohio. "Joseph Hawley, the Northampton Statesman," is the theme of a paper by Charles Lyman Shaw; "Fort Perrot, Wisconsin," is from T. H. Kirk; "First Editions of the Bible printed in America," from Clement Furgeson; and "Gen. Grant and the French," from Theodore Stanton of Paris. This magazine is steadily exerting an educational and healthful influence in all departments of literature and study.

LETTERS TO THE EDITOR.

* * * Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Intelligence of Ants.

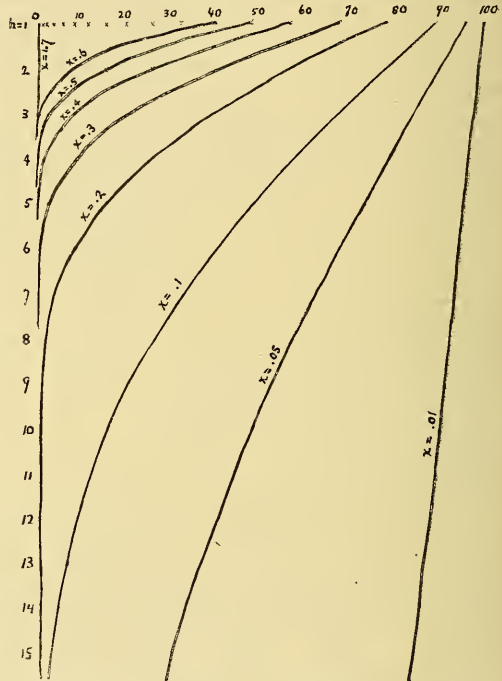
I SEND you the following regarding ants, by Mr. W. E. Bosworth of this city, written out at my request, which seems to me an interesting and at the same time somewhat rare observation. It is almost exactly similar to the account by McCook of the sleeping of harvesting ants, of Texas, as quoted in G. J. Romanes' "Animal Intelligence," p. 84. I do not recall any other instance given of the sleeping of ants. "At different times, and for more than one season, I was favorably situated to see the movements of quite a large colony of small black ants, as they passed to and fro in their busy haste over a board floor, going, as I supposed, for their supply of water, which was in the direction of a small stream close by. While watching their quick, eager movements, there were several along the line that attracted my attention, as they remained in one place so long that I concluded they must be dead; and although they were directly on the line of march, and in the way of the others, these passed on, paying no attention to them whatever. At another time I noticed that one of the ants supposed to be dead got up, and walked off as lively as the rest; and, while watching this one, another one close by began to slow up, seemed to totter in his gait, and finally came to a dead halt. After seeing this, it occurred to me that the one had just waked up, and the other had just gone to sleep. In order to test the matter, and gratify my curiosity, I concluded to experiment on some of them. With a fine straw they were gently rubbed on the back. This mild treatment did not make the slightest impression on them; but a sharp push seemed to take them completely by surprise, and to fully arouse them. For an instant they seemed lost, circulating around, running up and down, but finally starting off with the rest. This

was repeatedly tried with the same result. Their movements on being disturbed very forcibly reminded me of a child when suddenly waked out of sound sleep." JAS. LEWIS HOWE.

Louisville, Ky., Nov. 22.

Galton's Bodily Efficiency Diagram and the Marking System.

FRANCIS GALTON'S bodily efficiency diagrams (*Nature*, Oct. 31, 1889) can evidently be applied to the rating, on an arbitrary scale, of all sorts of things besides physical measurements and tests. For instance: the annexed diagram represents, by Galton's method, the rating of errors as the measure of precision gradually rises. The data were taken from the table on p. 12 of Merriman's "Least Squares" (first edition). The curves are drawn in general for values of x differing by .1; the ordinates in all cases being values of h , and the abscissas the rating on a scale of 100. The diagram shows at a glance how in all cases the rating of the same



error decreases as the measure of precision increases, but how, for very large and very small errors (see the curves $x = .01$ and $x = 1.7$), the measure of precision affects the rating little.

The rating of any errors which are distributed roughly according to the probability curve, as they are, for instance, in every school examination, ought to conform in general to these curves, and I think teachers usually strive to have it do so, either consciously or instinctively. If the error is flagrant, the question containing it is marked zero, or nearly so. The discrepancies in the marks of different teachers, or in the marks of the same teacher at different times, seem due to the different measures of precision mentally adopted. The curves show that these variations of the measure of precision affect most the rating of mediocre work, and this also accords with the experience of teachers. Now, of course the errors of each scholar have their own probability curve and their own value of h , which perhaps might be calculated from a long series of examination-papers. It would probably differ for different subjects. The custom, then, of marking good and poor scholars on different scales has a reason. The only question is, whether these scales can be so systematized as to be quite just, and whether it

would not be better to assume, in rating, the same measure of precision for all.

At any rate, the study of these curves cannot help being of interest to teachers.

ARTHUR E. BOSTWICK.

Montclair, N. J., Nov. 22.

Cave-Air for Ventilation.

COL. CRUMP'S effort to utilize cave-air has a personal interest. I warm my dwelling with furnace-heat, and in place of taking in air through a basement window, as is usual, I place an intake pipe or tube (I use stone pipe) under a porch upon the south side of the house, which passes under ground eight feet, around the building to the north side, beneath the cellar wall and below the cellar floor, to the furnace, — a length of about a hundred feet. The size of this pipe should be the same as the chimney. This must depend upon the size of the building to be warmed. My chimney is eighteen inches clear space. My house contains twelve rooms. This chimney is sufficient to ventilate the house, and carry off the smoke from the furnace. Sometimes it is necessary to build a small fire in the bottom of the chimney, where provision is made for such purpose. Ventilating-tubes are placed under the floor from the outside corners of the rooms, to draw off the cold air on the floor, which is constantly being replaced by the warmed air from the ceiling. Now, the advantage of this improvement in the use of cave-air is that in cold weather a modified air comes into the furnace. In hot weather, using the same apparatus to cool the air before coming into the house, the windows should be closed. The

difference of temperature is from ten to fifteen degrees in the shade.

I have used it successfully for two summers, and I know of no system so satisfactory.

W. H. LEONARD.

Minneapolis, Nov. 18.

INDUSTRIAL NOTES.

Elektron Manufacturing Company.

A FEW weeks ago fire destroyed the factory of the Elektron Manufacturing Company of Brooklyn, whose Perret motors and dynamos were described in *Science* recently. The company at once secured a larger factory, at 79 and 81 Washington Street, near the bridge, equipped it with a complete installation of special tools and machinery, and are doing their best to catch up with their orders, which had fallen far behind during their enforced idleness.

Electrical Accumulators.

IN the suit of The Electrical Accumulator Company vs. The Gibson Electric Company in the United States Circuit Court for the Southern District of New York, which was instituted in February last, the complainants have recently moved for a preliminary injunction, and Judge Lacombe on Friday last granted the motion, and the injunction issued. The complainants' testimony shows conclusively that the Gibson Company have continuously infringed the Faure patent, and that their various modifications are infringements.

CALENDAR OF SOCIETIES.

Biological Society, Washington.

Nov. 30. — Theobald Smith, Preliminary Observations on the Micro-organisms of Texas Fever; D. E. Salmon, General Remarks on Texas Fever, illustrated by Lantern-Slides; C. D. Walcott, Description of a New Genus and Species of Inarticulate Brachiopod from the Trenton Limestone; Frank Baker, An Undescribed Muscle of the Infraclavicular Region in Man.

Engineers' Club, Philadelphia.

Nov. 16. — Mr. William B. Spence exhibited a working model of the Rimmer oxidizer, a filtering-material, which he described, and for which he made various claims as to its utility in the purification of water by oxidation. He stated that the material used is an English invention, and that it is known as "magnetic carbide of iron." It consists of a mixture of granulated iron ore and carbon. The iron ore is said to be cleaned of all natural impurities by a patented process. It is then chemically treated at a certain temperature. It is claimed that this material will absorb and retain a large quantity of oxygen from the atmosphere. In use it is charged daily with atmospheric air, when, it is claimed, a re-action takes place with the impurities which have accumulated in the filtering material, and that the result passes off in the form of gas. It is claimed that metals in solution in the water will form insoluble oxides. The upper layer of the filtering plant consists of sand, for the removal of suspended matter by mechanical filtration, and the lower layer of the material above described for the chemical removal of impurities in solution. It is claimed that both vegetable and animal organic impurities and metallic contaminations are entirely removed by this process. The following

tests were made in the presence of the meeting. The filtering materials were contained in a large glass funnel. Water, as muddy as that of the Schuylkill River during freshets, was made apparently perfectly clear. A solution of sulphate of iron in water was made, and a portion thereof passed through the filter. The unfiltered and filtered portions were then tested with ferrocyanide of potassium. The former showed a distinct blue tint, while the latter remained perfectly clear, showing the elimination of the iron. Lead and copper tests seemed to show the same results. To illustrate the destruction of organic matter, sulphide of ammonia, sulphide of iron, and acetate of lead were added to water, making a compound which was almost black, and of strong and unpleasant odor. After filtration, it was clear, and tests seemed to fail to discover any trace of the impurities. A mixture of copying-ink and water was passed through the filter with the same results.


Boston Society of Natural History.

Dec. 4. — R. T. Jackson, Certain Points in the Development of the Mollusca; J. Walter Fewkes, A Remarkable Instance of Rock Excavation by Sea-Urchins.

Engineers' Club, St. Louis.

Nov. 20. — Mr. Robert Moore addressed the club on the subject of "Railway Culverts." This question was usually given too little attention. The speaker described the various forms of culverts used, with the advantages and disadvantages of each, also stated the methods of determining the size and best mode of construction. He stated that sewer-pipe, while admirably adapted for small culverts, should not be used over fifteen inches in diameter. For larger sizes, cast iron pipe answered well. Cast-iron pipe which had been condemned for heavy

pressures was being largely used for this purpose. Mr. Moore also presented a diagram, based on Kutter's formula, using a value of 17 for n , bearing in mind that one inch of rainfall per hour is equivalent to one cubic foot per acre per second. In the discussion, Mr. Ferguson described a number of practical points of difficulty he had met with. The discussion was also participated in by Messrs. J. A. and W. L. Seddon, M. L. Holman, and A. W. Hubbard. Mr. Holman stated that iron pipe for this purpose was being made as large as six feet in diameter and ten feet long, being lighter and of poorer quality than the pipe used for water-service.



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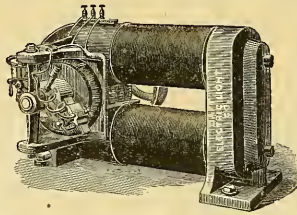
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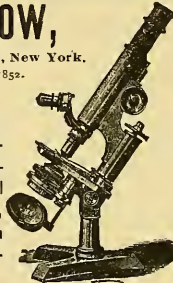
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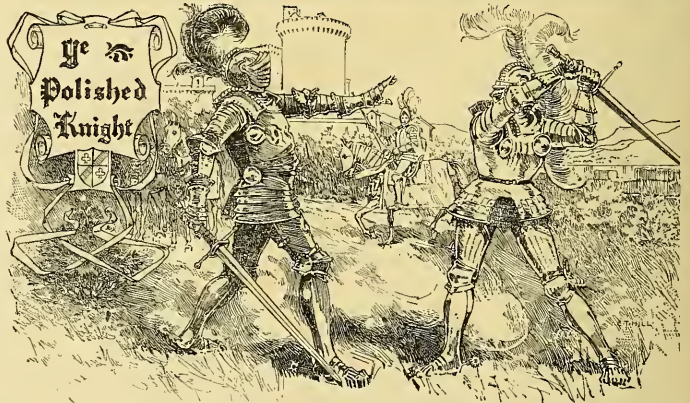
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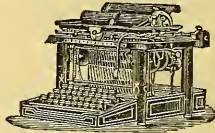
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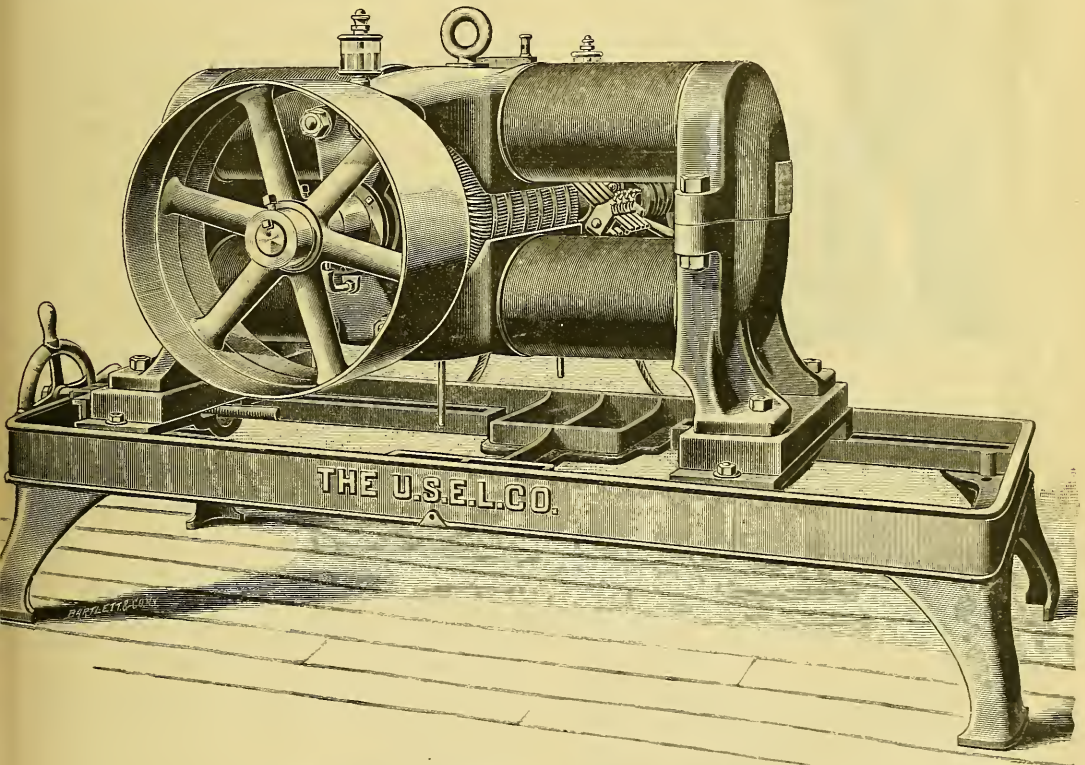


FIG. 1.—NEW DYNAMO WITH ELEVATED BASE.

performance. The new dynamo of the United States Electric Lighting Company, here illustrated, has had the benefit of many years of development. The patterns for it have recently been entirely remodelled, to take advantage of the best points in the antecedent dynamos of both the Westinghouse and United States Companies, and it is consequently a most practical and efficient generator.

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The United States electric-light projector is shown in Fig. 2. It has both a horizontal and vertical motion, so that the light can be thrown in any direction. It carries a focusing-lamp in a parabolic reflector. When out of service, the case is rigidly locked in position by clamps at the side and a catch at the base, protecting it against the jarring of a sea-way or otherwise. The glass face is in strips to avoid cracking from unequal expansion. Its hinges

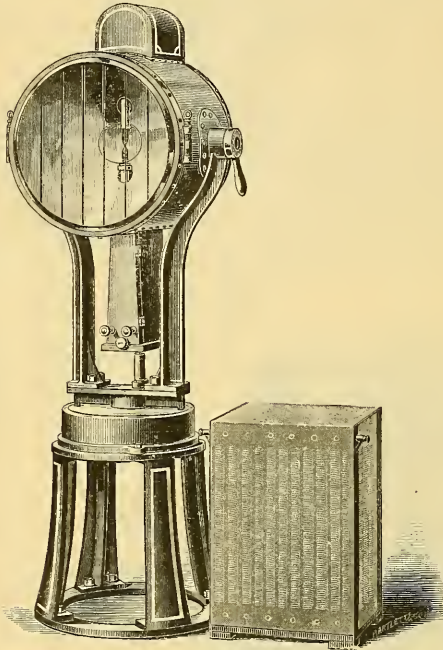


FIG. 2.—ELECTRIC PROJECTOR.

are made to act both as hinges and latch, so that by drawing a pin the face can be opened on either side at will. All adjustments are outside the case, so that the doors leading to the lamp-works need not be opened. The lamp requires forty volts, and the resistance-box shown in the cut adapts it to any circuit.

TWENTY YEARS.¹

A REMINDER that to-day is the twentieth anniversary of the first issue of *Nature* will not, perhaps, be without interest to our readers, and certainly affords food for reflection to those who in various capacities have been more or less closely connected with this journal from the first.

"When another half-century has passed," said Professor Huxley in our first number, "curious readers of the back numbers of *Nature* will probably look on our best 'not without a smile.'"

It will probably be so; but, though twenty years is hardly a sufficient interval to make our smiles at our earlier efforts supercilious, it is enough to test whether progress has been made, and whether the forward path is pursued with growing or with waning force.

As regards this journal itself, we may claim that it has not disappointed the hopes of its founders, nor failed in the task it undertook; and we make this claim all the more emphatically because we feel that what has been accomplished has not been due to our own efforts so much as to the unflinching help we have always received from the leaders in all branches of natural science. This help has not been limited to their contributions to our columns, but

has consisted also of advice and suggestions which have been freely asked and as freely given. Not the least part of our duty, and even privilege, to-day, is to state openly how small our own part has been, and to render grateful thanks to those to whom it is chiefly due that *Nature* has a recognized place in the machinery of science, and has secured an audience in all parts of the civilized world.

We do not wish, however, to narrow our retrospect of the last twenty years by confining our attention to the measure of success which these pages have won. It has been attained, as we have shown, by the aid of nearly all the best-known scientific writers and workers, not in Britain only, but in many countries old and new; and we cannot believe that they would thus have banded themselves together, if evidence had not been given of an honest desire for the good of science and for the "promotion of natural knowledge," or if the attainment of these objects had not been regarded by us as of more importance than a journalistic success. Thus, on its twentieth birthday, we would think not so much of the growth of *Nature* as of the advance which in the last twenty years it has chronicled.

A formal history of science for that period would be a formidable task, but it is already possible to discern what will probably appear to posterity to be the most salient characteristics of the last two decades.

In the physical sciences, the enormous development of the atomic theory, and the establishment of a connection between the theories of electricity and light, are perhaps the two main achievements of the years we are considering. Methods of accomplishing the at first sight impossible task of measuring atomic magnitudes have been devised. Our own volumes contain some of the most interesting papers of Sir William Thomson on this subject; and the close agreement in the results attained by very different methods is sufficient proof, that, if only approximations, they are approximations we may trust. The brilliant vortex atom theory of Sir William Thomson has not as yet achieved the position of a proved hypothesis, but has stimulated mathematical inquiry. A number of very powerful researches have added to our knowledge of a most difficult branch of mathematics, which may yet furnish the basis of a theory which shall deduce the nature of matter and the phenomena of radiation from a single group of assumptions.

The theory of gases has been extended in both directions. The able attempt of Van der Waals to bring both vapor and liquid within the grasp of a single theory is complementary to the extension by Crookes, Hittorf, and Osborne Reynolds, of our knowledge of phenomena which are best studied in gases of great tenacity.

The gradual expansion of thermodynamics, and in general of the domain of dynamics from molar to molecular phenomena, has been carried on by Willard Gibbs, J. J. Thomson, and others, until, in many cases, theory seems to have outrun not only our present experimental powers, but almost any conceivable extension which they may hereafter undergo.

The pregnant suggestion of Maxwell that light is an electromagnetic phenomenon has borne good fruit. Gradually the theory is taking form and shape; and the epoch-making experiments of Hertz, together with the recent work of Lodge, J. J. Thomson, and Glazebrook, furnish a complete proof of its fundamental hypotheses. The great development of the technical applications of electricity has stimulated the public interest in this science, and has necessitated a more detailed study of magnetism and of the laws of periodic currents. The telephone and the microphone have eclipsed the wonders of the telegraph, and furnish new means of wresting fresh secrets from nature.

Science has become more than ever cosmopolitan, owing chiefly to the imperative necessity for an early agreement as to the values of various units for a common nomenclature, and for simultaneous observations in widely separated localities. International conferences are the order of the day, and the new units which have been defined are based upon experiments by many first-rate observers in many lands, among whom the name of Lord Rayleigh stands second to none.

On the side of chemistry, the periodic law of Mendeleeff has become established as a generalization of the first importance, and the extraordinary feat of foretelling the physical properties of an as yet

¹ From *Nature*, Nov. 7, 1889.

undiscovered element has attracted to it the attention of the whole scientific world.

The once permanent gases are permanent no more. Dulong and Petit's law has found a complement in the methods of Raoult. The old doctrine of valency is giving way to more elastic hypotheses. The extraordinary progress of organic chemistry, which originated in the work and influence of Liebig and the Giessen school, has continued at an accelerated rate. The practical value of even the most recondite investigations of pure science has again been exemplified by the enormous development of the coal-tar industry, and by the numerous syntheses of organic products which have added to the material resources of the community.

The increase of our knowledge of the sun by means of localized spectroscopic observation, the application of photography to astronomy, and, more recently still, the extension and generalization of the nebular hypothesis, are perhaps the most remarkable developments of those branches of science which relate to astronomy. Stars which no human eye will ever see are now known to us as surely as those which are clearly visible. The efforts to reduce nebulae, comets, and stars under one common law, as various cases of the collision or aggregation of meteoritic swarms, and the striking investigations of Professor Darwin on the effects of tidal action and on the application of the laws of gases to a meteoritic plenum, give promise of a fuller knowledge of the birth and death of worlds.

In the biological sciences, the progress during the last twenty years has consisted chiefly in the firm establishment of the Darwinian doctrine, and the application of it and its subordinate conceptions in a variety of fields of investigation. The progress of experimental physiology has been marked by increasing exactitude in the application of physical methods to the study of the properties of living bodies; but it has not as yet benefited, as have other branches of biology, from the fecundating influence of Darwin's writings: hence there is no very prominent physiological discovery to be recorded. The generation of scientific men which is now coming to middle age has been brought up in familiarity with Mr. Darwin's teaching, and is not affected by any thing like hostility or *a priori* antagonism to such views. The result is seen in the vast number of embryological researches (stimulated by the theory that the development of the individual is an epitome of the development of the race) which these twenty years have produced, and in the daily increasing attention to that study of the organism as a living thing definitely related to its conditions which Darwin himself set on foot. The marine laboratories of Naples, Newport, Beaufort, and Plymouth, have come into existence (as in earlier years their forerunners on the coast of France), and served to organize and facilitate the study of living plants and animals. The "Challenger" and other deep-sea exploring expeditions have sailed forth and returned with their booty, which has been described with a detail and precision unknown in former times. The precise methods of microscopic study by means of section-cutting—due originally to Stricker of Vienna—have within these twenty years made the study of cell-structure and cell-activity as an essential part of morphology as it had already become of physiology. These, and the frank adoption of the theory of descent, have swept away old ideas of classification and affinities, and have relegated the ascidian "polyps" of old days to the group of *Vertebrata*, and the sponges to the *coelenterates*. The nucleus of the protoplasmic cell—which twenty years ago had fallen from the high position of importance accorded to it by Schwann—has, through the researches of Bütschli, Flemming, and Van Beneden, been reinstated, and is now shown to be the seat of all-important activities in connection with cell-division and the fertilization of the egg. The discovery of the phenomena of karyokinesis and their relation to fertilization will be reckoned hereafter as one of the most, if not the most, important of the biological discoveries of the past twenty years.

Apart from Darwinism, the most remarkable development of biological studies during these "twice ten tedious years" is undoubtedly the sudden rise and gigantic progress of our knowledge of the bacteria. Though the foundations were laid fifty years ago by Schwann and Henle, and great advances were made by Pasteur and by Lister just before our period, yet it is within this span that the microscope and precise methods of culture have been applied

to the study of the "vibrions," or "microbes," and the so-called "bacteriology" established. We now know, through the labors of Toussaint, Chauveau, Pasteur, and Koch, of a number of diseases which are definitely caused by bacteria. We also have learned from Pasteur how to control the attack of some of these dangerous parasites. Within these twenty years the antiseptic surgery founded by Sir Joseph Lister has received its full measure of trial and confirmation, while his opportunities and those of his fellow-countrymen for making further discovery of a like kind have been ignorantly destroyed by an act of Parliament.

To particularize some of the more striking zoölogical discoveries which come within our twenty years, we may cite the dipnoous fish-like creature *Ceratodus* of the Queensland rivers, discovered by Kreffit; the jumping wheel-animalcule *Pedalion*, of Hudson; the development and the anatomy of the archaic arthropod *Peripatus* worked out by Moseley, Balfour, and Sedgwick; the *Hydrocorallina* of Moseley, an entirely new group of compound animals; the fresh-water jelly-fish *Limnocoelium* of the Regent's Park lily-tank; the Silurian scorpion of Gotland and Lanarkshire; the protozoon *Chlamydomyxa* discovered by Archer in the Irish bogs; the *Odontornithes* and the *Dinocerata* of the American paleontologists; the intracellular digestion obtaining in animals higher than *Protozoa*, and the significance of the "diapedesis" of blood-corpuscles in inflammation, and the general theory of phagocytes due to Meczniow; the establishment of the principle of degeneration as of equal generality with that of progressive development, by Anton Dohrn; the demonstration by Weismann and others that we have no right to mix our Darwinism with Lamarckism, since no one has been able to bring forward a single case of the transmission of acquired characters. Perhaps the attempt to purify the Darwinian doctrine from Lamarckian assumption will hereafter be regarded, whether it be successful or not, as the most characteristic feature of biological movement at the end of our double decade. Its earlier portion was distinguished by the publication of some of Darwin's later works. Its greatest event was his death.

In botany, twenty years ago, the teaching in our universities was practically sterile. In one of our earliest numbers, Professor James Stewart defended with some vigor the propriety of intrusting botany to a lecturer at Cambridge who was also charged with the duty of lecturing on electricity and magnetism. It is startling to compare a past, in which botany was regarded as a subject which might be tacked on anywhere, with its present condition, in which there is scarcely a seat of learning in the three kingdoms which is not turning out serious work. The younger English school would be ungrateful if it did not acknowledge its debt to the eminent German teachers from whom it has derived so much in the tradition and method of investigation. Sachs and De Bary have left an indelible mark on our younger professors. But it would be a mistake to suppose that English modern botany has simply derived from Germany. It has developed a character of its own, in which the indirect influence of Darwin's later work can be not indistinctly traced. There has been a gradual revolt in England, the ultimate consequences of which have still to be developed, against the too physical conception of the phenomena of plant-life which has been prevalent on the Continent. Darwin, by his researches on insectivorous plants and plant movements from a purely biological point of view, prepared the way for this; Gardiner followed with a masterly demonstration of the physical continuity of protoplasm in plant-tissues. This has thrown a new light on the phenomena studied by Darwin; and we need not, therefore, be surprised that his son, F. Darwin, has started what is virtually a new conception of the process of growth, by showing that its controlling element is to be sought in the living protoplasm of the cell rather than in the investing cell-wall. On the whole, English botanists have shown a marked disposition to see in the study of protoplasm the real key to the interpretation of the phenomena of plant-life. The complete analogy between the processes of secretion in animals and vegetables established by Gardiner, and the essential part played by ferments in vegetable nutrition, illustrated by Green, are examples of the results of this line of inquiry. To Germany we owe a flood of information as to the function of the cell-nucleus, which, it is singular, has met with general acceptance but little detailed corroboration in this country.

In morphology a review would be ineffective which did not go somewhat deeply into detail. The splendid hypothesis of Schwender, of the composite nature of lichens as a commensal union of *Alga* and *Fungi*, has gradually won its way into acceptance. In England there is little of the first rank which calls for note except the researches of Bower on the production of sexual organs on the leafy plant in ferns without the intervention of an intermediate generation.

In vegetable physiology there seems a pause. The purely physical line of inquiry, as already suggested, seems to have yielded its utmost. The more biological line of inquiry has only yet begun to yield a foretaste of the results which will undoubtedly ultimately flow from it.

Something must be added as to systematic and geographical botany. The "Genera Plantarum" of Bentham and Hooker, the work of a quarter of a century at Kew, affords a complete review of the higher vegetation of the world, and has been accepted generally as a standard authority. To Bentham also we owe the completion of the "Flora Australiensis," the first complete account of the flora of any great continent.

In geographical botany, perhaps the most interesting results have been the gradual elaboration of a theory as to the distribution of plants in Africa, and the botanical exploration of China, of the vegetable productions of which, twenty years ago, almost nothing was known.

In the classification of the lower plants, perhaps the most interesting result has been the happy observations of Lankester upon a colored bacterium, which enabled him to show that many forms previously believed to be distinct might be phases of the same life-history.

In geology probably the greatest advance has been in the application of the microscope to the investigation of rock-structure, which has given rise to a really rational petrology. All except the coarser-grained rocks were only capable of being described in vague terms. With modern methods, their crystalline constituents are determinable, however minute, and the conditions under which they were formed can be inferred.

It is impossible, even in a brief review of this kind, to think only of what has been won, and to ignore the loss of leaders who were once foremost in the fray. In England three names which will never be forgotten have been removed from the muster-roll. Darwin, Joule, and Maxwell can hardly be at once replaced by successors of equal eminence. As the need arises, however, men will no doubt be found adequate to the emergency, and it is at least satisfactory to know that they will appeal to a public more capable than heretofore of appreciating their efforts.

The support afforded by the governments of western Europe to scientific investigation has been markedly increased within the period which we survey. France has largely extended her subsidies to scientific research, while Germany has made use of a large part of her increased imperial revenue to improve the arrangements for similar objects existing in her universities. The British Government has shown a decided inclination in the same direction: the grant to the Royal Society for the promotion of scientific research has been increased from £1,000 to £4,000 a year; while subsidies have been voted to the Marine Laboratory at Plymouth, to the Committee on Solar Physics, to the Meteorological Council, and quite recently to the university colleges throughout the country; of which last it is to be hoped that a fair proportion will be devoted to the promotion of research rather than to the reduction of class fees.

Twenty years ago, England was in the birth-throes of a national system of primary instruction. This year has seen the state recognition of the necessity of a secondary and essentially a scientific system of education, and the Technical Instruction Act marks an era in the scientific annals of the nation.

The extension of scientific teaching has gone on rapidly within and without our universities. Twenty years ago the Clarendon Laboratory at Oxford was approaching completion, and was the only laboratory in the country which was specially designed for physical work. Now, not only has Cambridge also its Cavendish Laboratory, but both universities have rebuilt their chemical laboratories, both have erected buildings devoted to the study of biology,

and the instruction of students in both zoölogy and botany has taken a characteristic practical form which we owe to the system of concentrating attention on a series of selected "types" introduced by Rolleston and by Huxley. Oxford has been furnished with an astronomical observatory by the liberality of Warren de la Rue, and Cambridge has accepted the noble gift of the Newall telescope. Nor have such proofs of the vitality of science been confined to the universities.

Twenty years ago the Owens College was a unique institution. Now, united with two thriving colleges in Leeds and Liverpool, it forms the Victoria University; while science is studied in appropriate buildings in Birmingham, Newcastle, Nottingham, and half a dozen towns beside.

A race is thus springing up which has sufficient knowledge of science to enforce due recognition of its importance; and public opinion can now, far more than in the past, be relied on to support its demands. Fortunately, too, these can be authoritatively expressed. The Royal Society wields, if it chooses to exercise it, an enormous power for good. Admitted on all hands to be the supreme scientific authority in this country, its decisions are accepted with a deference which can spring only from respect for the knowledge and scrupulous fairness by which they are dictated. If sometimes it moves slowly, it is delightful to turn from the babble of the politicians to the study of an institution which does its work well, and perhaps too noiselessly. But even the House of Commons, hitherto ignorant and therefore apathetic in matters scientific, is awakening to the fact that there are forces to be reckoned with, and impulses to be stimulated and controlled, which are of more enduring import to the national welfare than mere party politics. And the people, too, are beginning to see that it is to the economic working of these forces, and to the right direction of these impulses, that their representatives are bound to give attention. True it is that another generation may possibly pass away before either the House of Commons or even ministers are sufficiently instructed in science to recognize fully their responsibility in this direction.

Whatever, then, the future may bring, the last twenty years have been characterized by progress both steady and rapid. The tide flows on with no sign of check, and we accept the success of *Nature* in no spirit of self-gratulation, but as a straw by which the speed of the current may be gauged.

HEALTH MATTERS.

Ozone in the Treatment of Phthisis.

RANSOME records the treatment of thirteen cases of pulmonary tuberculosis by the inhalation of ozone. Each cylinder used contained seven litres of pure oxygen ozonized up to nine per cent. No other treatment was employed. The cases represented various stages of the disease, and were all under observation for more than one year. The author says that the results obtained were a continuous freedom from fever, absence of night-sweats, diminished expectoration, and great gain in weight and strength.

The author believes that ozone does not act as a direct germicide, and that the control over the disease does not seem to come from any direct action upon the tubercle bacillus. It acts by restoring tone to diseased portions, and has a beneficial effect on the general health.

In the paper the daily notes are given of each case. As the *Brooklyn Medical Journal* observes, one can hardly find the author's conclusions in these notes. In one case, certainly, the inhalations caused a fresh bronchitis, and emesis also occurred in others. These patients, perhaps, would have improved quite as much if no ozone had been given, as they received good care and good food. The author offers the treatment as giving the best results as yet obtained.

NEW JERSEY SANITARY ASSOCIATION.—The New Jersey Sanitary Association met in the State House, Trenton, on Nov. 22 and 23. The officers were Dr. Dowling Benjamin of Camden, president; and Dr. D. C. English of New Brunswick, secretary. Papers were read on the following subjects: "The East Orange Sewage Disposal Works," by C. P. Bassett, C.E.; "The Passaic

River Drainage," by G. W. Howell, C.E.; "The Improvement of Sanitary Conditions in the Health and Pleasure Resorts of New Jersey," by Dr. Henry Mitchell; "The Climatic Treatment of Gastro-intestinal Diseases in Children," by Dr. Boardman Reed; "The Need of Medical Officers in School Districts," by Dr. G. F. Wilbur; "Physical Culture in the Schools in its Hygienic Bearings," by Professor James M. Green; "The Relation of Conduits to the Healthfulness of Water," by Dr. W. K. Newton; "Tuberculosis," and "Typhoid-Fever in Munich," by Professor S. G. Dixon of the University of Pennsylvania; "The Present Special Sanitary Needs of our Cities," by James C. Bayles, formerly president of the New York City Board of Health. The annual address by the president was on "The Thermometry of Hygiene."

HIGH ALTITUDE TREATMENT OF PHTHISIS.—Tyson offers certain considerations on this topic from climates marked by (1) extreme purity of the air, (2) aerial rarefaction, (3) low relative humidity, and (4) immunity from wind, fog, and miasmatic emanations. The cases sent to such climates should be carefully selected. No case should be sent in which there is senile change, laryngeal ulceration, gout, rheumatism, organic nerve-disease, or hysteria. When there is no marked emaciation, severe pyrexia, or kidney complication, Mr. Tyson finds that the cases do well. An important rule is that the patient should live continually in the chosen place, and not return, even for short visits, to lower altitudes. This length of time, as we learn from the *Brooklyn Medical Journal*, he believes should be fully two years. Cold, dry air is stimulating. It is detrimental to all fungous growth. The secretion from a cavity has a tendency to dry up. Its rarefaction increases the number of respirations, and has a considerable influence in permanently expanding the lungs. Slight oozing of blood from the mouth, nose, and throat is common when patients first arrive. It may be that the mucous membranes near the surface of the body become dry, and there may be blood stasis, especially when the air is cold. In the lungs, however, the supply of watery fluid is so great that dryness is impossible, and, at the same time, the air is warm before it reaches the lungs. The removal of watery vapors would even relieve the congestion without bleeding. It may be, however, that the diminished air-pressure tends to draw the blood to the surface, and so cause the bleeding. Mr. Tyson finds that these slight hemorrhages do not harm, and that the membranes soon become accustomed to the changes in the air.

THE ACIDS OF THE STOMACH.—There is no doubt that the chief acid found in the stomach during natural digestion is free hydrochloric acid. According to *The British Medical Journal*, this has been abundantly proved by Bidder and Schmidt, and numerous observers succeeding them. The methods used are, however, too long and too complicated to employ in clinical work. The physician wishes to know what, in a particular case of disease, are the chemical changes going on in the stomach; whether, for example, hydrochloric acid is present, as well as pepsin and organic acids. Now, in the examination of the contents of a diseased stomach, three forms of acid may be present, — hydrochloric acid, a mineral acid; organic acids, such as lactic acid, butyric, etc.; and, thirdly, acid phosphates. It is chiefly of importance to determine the presence of hydrochloric acid and of organic acids. Many methods have been proposed for doing this: they consist mainly in testing the effect of the stomach contents on various colored solutions. Thus a solution of methyl-violet is decolorized by hydrochloric acid, so that, if this re-action is obtained, the free acid is present in the liquid tested. Lactic acid turns the violet a dirty yellow. Tropæolin also is turned deep reddish-brown by free hydrochloric acid. Unfortunately these tests, simple as they appear, are not accurate, since the re-actions are interfered with by the presence of peptones and of some neutral salts; and, as these are usually present in the stomach contents, no reliable results can be obtained by using methyl-violet and tropæolin. They have been superseded by congo-red, which is turned blue by free hydrochloric acid, and by a solution of vanillin and phloroglucin in alcohol, which is turned a deep red by the same acid. These simple clinical tests are, however, rendered useless by the fact that they are interfered with by the presence of peptone, ammonium salts, chlorides, and phosphates. In the present state of our knowledge, therefore, there is

no reliable indicator for the presence of free hydrochloric acid in the stomach contents. Other methods which may be used are too complicated for clinical use. Thus ether has the property of dissolving organic acids from a liquid, leaving the mineral acids in solution. It may thus be used for separating the lactic, butyric, and other acids from the hydrochloric acid; and if, in a liquid obtained from the stomach, it is found that ether removes the whole of the acids present, it may be concluded that no free hydrochloric acid is present. In many cases this conclusion would be an important one as a clear indication for a line of treatment. Dr. Leo has lately published a new method for the indication of free hydrochloric acid which may prove useful. Leo considers the case where it is only a question of the presence of free hydric chloride and of an acid phosphate. To a few drops of the stomach contents a pinch of carbonate of calcium is added. If the acidity, as tested by litmus-paper, disappears, only a free acid is present; but, if the liquid is still acid after the addition of the chalk, an acid salt is present. If, moreover, organic acids be present, they must be first removed by shaking with ether before the chalk is added. It does not seem that Leo's method is one that can be applied at the bedside, because the detection of free hydrochloric acid is chiefly requisite in those cases in which organic acids are also present, as in cases of dilated stomach. At present, indeed, a ready method, suitable in clinical practice for the detection of free hydrochloric acid in organic liquids, is a desideratum.

CHOLERA IN PERSIA.—A correspondent of the *Bulletin Medical*, writing from Teheran, says that cholera in a virulent form exists throughout the valley of the Euphrates, and it is feared that it will become epidemic in Persia.

CREMATION IN PARIS.—The cremation furnace in Père-la-Chaise Cemetery, in Paris, is now complete, says *The Medical Record*, and the prefect of the Seine has approved the scale of charge to be enforced thereat. The charge for the use of the cremation furnace is to be fifty francs, which sum includes the keeping in the columbarium of the funeral urn containing the ashes for a period of five years.

BICARBONATE OF SODIUM IN MILK.—Hitherto it has been deemed permissible to add soda bicarbonate to milk to assist in its preservation, but now the Council of Hygiene of the Seine has condemned the practice as one of danger. The transformation of milk-sugar into lactic acid, in milk so adulterated, gives rise to a lactate of soda which is purgative, and frequently a source of almost uncontrollable diarrhœa in infants: consequently the council, in its bulletin, decides that "soda shall no longer be permitted in milk, which is an ailment of the first order, and very often prescribed for invalids and children."

ELECTRICAL NEWS.

The Transmission of Visual Images by Electricity.

A FRENCH electrician endeavors to solve the question of seeing at a distance by electricity, by means of a combination consisting of a selenium cell, a gas-telephone, and revolving mirrors, forming a special apparatus which he designates a "phoroscope," and which he discusses in *La Lumière Electrique* as follows.

The question of seeing at a distance by electricity is governed by the two following fundamental principles. In order to get the impression of the form, outlines, and details of one or several objects, it is not necessary (1) that the eye should receive all the rays proceeding from it; (2) that it should receive, at the same time, the luminous rays necessary for vision.

Some very simple examples will demonstrate the first principle. We can see an object very clearly through wire gauze, and the image is perfect if the interstices are large and the wire fine. Carpets and mosaic seen at a certain distance do not seem to be formed of a number of parallel lines, nor by the juxtaposition of little stones. An engraving, a picture, or especially a chromo-lithograph, show at a distance no discontinuity in the work, although the engraving is composed of lines, and the chromo-lithograph of separate little dots. We see thus that it is possible to have a sufficiently clear

perception of an object by the vision of a system of more or less luminous lines forming a kind of pattern.

The second principle is quite as well known, and is deduced from the duration of the luminous impressions upon the retina, a period of about one-tenth of a second. A series of impressions succeeding one another in a very short time produces the effect of simultaneous impressions; and it follows, that, in order to perceive the image which we have called the pattern, it is sufficient to receive the luminous impressions of the different lines that constitute it in an interval of time less than one-tenth of a second.

It was by taking this principle as a basis that Lissajous studied from an optical point of view the vibratory movements of bodies. His experiments are so well known that we need not enter into them here. Lissajous's curves are produced in a rectangular portion of a picture. If, on the other hand, this object possesses the power of illumination, all the rays proceeding from the space occupied by the curve will, in an exceedingly short space of time, converge at one point after having been subjected to a double reflection on the mirrors of the two tuning-forks that were employed for this experiment.

We may substitute for these forks any movable system whatever, bearing a series of mirrors arranged in such a manner that the displacement of each of them brings upon the same straight line all the rays projected from a portion of an illuminated object. Let us suppose these mirrors to be placed on a circle turning upon an axis perpendicular to its plane, and each of them making a different angle near 90° with this plane. To each mirror there will be a corresponding series of parallel lines in the picture; and, if the rotation is sufficiently rapid, all the rays proceeding from the object represented in the picture will meet at the same time, in as short an interval of time as required. It is thus possible to bring to one point all the luminous rays proceeding from a pattern; and, each portion of the image thus producing its impression upon the retina in succession, it is sufficient that the interval in which these impressions succeed one another should be sufficiently short for them to be rendered simultaneous.

The transformation of the luminous waves into electric currents is performed by means of a radiophonic receiver forming part of an electric circuit. This receiver may be a cell of selenium, lamp-black, hydrogenated palladium, etc., the resistance of which varies with the quantity of light received. The different portions of the pattern will act differently, according to the quantity of light emanating from them, and in an interval of time less than one-tenth of a second. The variations of resistance of the circuit will correspond to the image observed.

In order to solve the opposite problem, i.e., to produce this image from the circuit at the receiving station, the writer proposes to employ the gas-telephone, which is an instrument of extreme sensitiveness. It consists of an ordinary telephone in which the portion comprised between the plate, the bobbin, and the inner sides, is in communication with a gas-pipe. The vibrating membrane is pierced in the centre with a little hole, through which escapes the gas, which is lighted. This little flame will undergo a variation in brilliancy at each movement of the membrane, and it will produce a continuous succession of rays similar to those converging upon the radiophonic receiver. In order to show them, and form an image similar to the pattern, a system of mirrors is employed similar to that used at the first station, but acting in the reverse way. It is evident that these two apparatus must act synchronously, like the Hughes and Baudot regulators employed in telegraphy. Station 2 will reproduce upon a sheet the lines taken upon the image at Station 1.

To sum up, the operation of this theoretical "phoroscope," as it is called, is as follows. The different parts which have been described being properly combined, the image to be transmitted is broken up into a series of parallel lines, the different points of which act in succession upon a selenium cell, varying the intensity of the current connecting the two stations. These variations in electrical intensity are transformed by the gas-telephone into variations of luminous intensity, and the successive changes of brilliancy of the little flame are projected upon a sheet at points corresponding to the various points of this sheet. Theoretically, nothing can prevent this double transformation of luminous intensity into elec-

tric intensity, but the realization of the experiment is surrounded with difficulties which make us fear that it will be long before a practical phoroscope is produced; but this should not discourage enterprising and persevering physicists.

NOTES AND NEWS.

LYDIA W. SHATTUCK, for over forty years teacher of botany in Mount Holyoke Seminary, died recently at an advanced age.

— Professor Daniel Kirkwood, for many years a professor of astronomy in the Indiana State University at Bloomington, has removed his residence to near Riverside, in southern California.

— Dr. George M. Sternberg of the army will deliver a lecture before the Brooklyn Institute on Dec. 26. He has selected for his subject "The Methods of Research in Bacteriology," to be illustrated by living forms of bacterial life thrown upon the screen.

— C. F. Wheeler of Hubbardston, Mich., has been appointed assistant in the botanical department of the Experiment Station at the Michigan Agricultural College, in place of Eugene Davenport, who has been elected professor of agriculture in the same institution.

— At the Johns Hopkins University a society of medical students has been organized on the plan of those in Berlin, the object being to bring the men of the various departments into closer connection, to stimulate original research, and to protect the claims of priority of work done by the members.

— Mr. Austin Corbin's game-forest on Croydon Mountain, New Hampshire, has been enriched, says *The American Field*, by the arrival there last week of a carload of buffaloes, two elks, a moose, deer, and a small band of antelopes. The buffaloes were shipped from Winnipeg, Man., by Buffalo Jones, who herds them there.

— The great astronomical event of this month will be the total eclipse of the sun, Dec. 22. Various governments have sent out parties to observe the eclipse itself, the United States steamship "Pensacola" having taken a well-equipped party from the United States to St. Paul de Loando, on the west coast of Africa, for this purpose.

— The greatest depth found by Capt. Spratt in the western Mediterranean basin was between Sicily, Sardinia, and Africa (about 10,600 feet). According to *Nature*, recent measurements in the eastern basin by Commander Magnaghi of the Italian Navy have yielded, as maximum depth, 13,556 feet, between the Islands of Malta and Candia.

— A brief outline of the rapid advancement that the practical application of electricity has made in the last few years is presented in "Everybody's Hand-Book of Electricity," by Edward Trevert, published by Dammrell & Upham, Boston. The book is a paper-covered twenty-five cent volume, and treats briefly of electricity and magnetism, dynamos, electric lamps and motors, electric railways, electric welding, measuring instruments, galvanic batteries, and electric bells. It also contains a good glossary of electrical terms, and some useful tables for incandescent wiring.

— In June of the present year a series of observations on the velocity of the wind at the top of the Eiffel Tower was commenced. For this purpose there was erected on the tower, at a height of 995 feet above the ground, an autographic anemometer, constructed by Messrs. Richard Brothers of Paris, another of these instruments being at the same time put up at a station situated 1,650 feet from the foot of the tower, the height in this case being about 69 feet above the ground. Up to the 1st of October last, *Engineering* states, complete observations had been obtained for 101 days; and from these it appears that, on an average, the velocity of the wind is about 3.1 times as great at the more lofty station as it is at the lower. Moreover, the breeze at the top is always fairly strong, as, during the whole of the summer months in which observations were taken, the average velocity of the breeze throughout any given day always exceeded 23 feet per second, and during 21 per cent of the whole period of the observations this average daily velocity was upwards of 33 feet per second. No great storm seems to have occurred during the time over which the observations extend, and we do not know the maximum wind-velocity registered during this time.

— It is said that roaches may be exterminated if a powder thoroughly mixed, consisting of 37 parts of borax, 9 parts of starch, and 4 parts of cocoa, is liberally sprinkled in the cracks and corners of their rendezvous.

— The following free course of educational lectures, especially designed to interest the teachers of New York City and vicinity, has been arranged for, and will be given in the Assembly Hall of the College for the Training of Teachers, 9 University Place, on successive Tuesday afternoons at 4 P.M., beginning on Jan. 7, 1890: Jan. 7, "Rousseau's Pedagogic Theories and their Influence upon Educational Method," by James MacAlister, Ph.D., superintendent of schools, Philadelphia; Jan. 14, "The Teacher and the Time," by Miss Caroline B. LeRow, author of "The Young Idea;" Jan. 21, "The Teaching of English Literature," by Truman J. Backus, LL.D., president of the Packer Collegiate Institute, Brooklyn; Jan. 28, "The Voice as an Element in School Management," by E. H. Cook, Ph.D., head master of the Rutgers College Grammar School, New Brunswick, N.J.; Feb. 4, "The Function of a National Bureau of Education," by William T. Harris, LL.D., United States commissioner of education; Feb. 11, "The Duty of the State in the Matter of Training Teachers," by W. H. Maxwell, Ph.D., superintendent of schools, Brooklyn; Feb. 18, "Higher Education in the State of New York," by Melvil Dewey, A.M., secretary of the University of the State of New York; Feb. 25, "Physical Training in the Public Schools," by Addison B. Poland, A.M., superintendent of schools, Jersey City, N.J.; March 4, "Intentional Geometry," by Edward R. Shaw, Esq., principal of the Yonkers (N.Y.) High School; March 11, "Suggestions in the Teaching of Color," by Mrs. Hannah Johnson Carter, professor of form study and drawing, New York College for the Training of Teachers; March 18, "Education in the Nineteenth Century," by Henry M. Leipziger, Ph.D., principal of the Hebrew Technical Institute, New York; March 25, "An Observation Lesson," by John F. Woodhull, A.B., professor of natural science, New York College for the Training of Teachers; April 1, "Form Study and Drawing, and their Relations to General Education," by Mrs. Mary Dana Hicks, director of Prang's normal drawing classes, Boston, Mass.

— Col. Woodthorpe recently delivered at Simla a lecture on the Aka Expedition of 1883. It may be remembered that this tribe, which inhabits the hills north of Assam, owing to some forest disputes and a supposed interference with their trade in rubber, seized two English forest officers, and carried them off. To recover these men, a small expedition was despatched, under the command of Col. Woodthorpe. The Aka houses, according to *Nature*, are built on piles raised above the ground, with a large space at one end, where the children play. The dress consists of a tunic of Tibetan cloth, and trousers, reaching to the feet, made of thin white material. Long trousers are worn to keep off the *dandim*, a troublesome little fly or mosquito. Bows and arrows, and knives with blades easily detachable from a bamboo handle, are the chief weapons. The barbs of the arrows are dipped in aconite, and are so treated that, when any attempt is made to pluck out the arrow, the barb breaks off, and remains in the wound. The poison is so deadly, that even a buffalo usually falls, after running a few yards, when he has been struck by one. Some of the superstitions of the Akas are curious. If a river runs between an Aka's house and his burying-place, his soul can never go home after death. This inability of the spirit to cross water is, however, overcome, and every year Akas may be seen stretching a string across the stream that divides the grave from the house of the departed. The ghost can easily cross when the slightest foothold is given him.

— It is sometimes said about old trees (e.g., an old lime in the new Gardens at Potsdam) that the present branches are properly roots; and it has been reported that trees may be planted, and will grow, in the inverted position. A scientific inquiry into this matter has been made by Herr Kny, in Germany, taking a number of plants of wild vine (*Ampelopsis*) and ivy about 3.5 metres high. *Nature* states that in 1884 he planted these with both ends in the ground; and in the spring of 1885, after the tops had rooted, he cut the arch at its highest point. In the first year, two of the plants died, but the others (twelve vine and fourteen ivy) grew vigorously, and were still alive this last spring. To test the extent

of the inversion, he cut slips from the inverted plants, and planted them in a greenhouse, some with their natural, and some with their artificial upper end uppermost. It appeared that the callus, from which the roots spring, was formed at both ends, but more readily at the naturally lower end, whether this was above or below, in the experiment. Herr Kny considers, that, notwithstanding several years' successful culture, the inversion was not thoroughly completed. He proposes to continue his investigation, and invites people who have gardens to make like experiments with other plants, recommending willows, poplars, and roses.

— Dr. Quesneville, the French chemist, died on Nov. 14, at the age of eighty. He took his degree of doctor of medicine in 1834, having studied chemistry under Chevreul. In 1840 he started the *Revue Scientifique*, a monthly periodical, which he afterwards called the *Moniteur Scientifique*. This periodical came to an end in October last, Dr. Quesneville explaining that the task was rendered too severe by the infirmities of old age.

— Professor Meiklejohn has been lecturing at Perth, Scotland, on literature *versus* books, and, after an able and humorous dissertation, concluded by assuring his hearers that they had thousands of teachers, but what they needed to be taught most was to feel. Let them resolve to read as little as they possibly could, and to re-read what was the best, what was worth storing in our memory, what was worth learning by heart. Let them shun the stupefying influence of the modern demand for aimless, promiscuous, debilitating, and rapid reading. Let them look for that which forms, sustains, and perennially delights. Clear feeling, deep enjoyment, were what they wanted. With these they had literature; without these they had only a semblance of speech. Let them in literature shun mere acquaintances: let them form friendships. No man could expect to have a hundred friends; and so no man, especially in these crowded times, could know thoroughly and well more than five or six good books.

— According to a circular which has recently been sent to the leading physicists, electricians, and others interested in the history of English science, it is proposed to establish a Gilbert club, the inaugural meeting of which was convened Nov. 28 in the rooms of the Society of Arts, London, at 4.30 P.M. The object of the club, as we learn from *Nature*, is to do justice to the memory of the illustrious president of the College of Physicians, who was in the possession of, and was actually carrying on, the true experimental method of scientific inquiry at a time when Bacon was only talking and writing about it. There can be no doubt that the claims of William Gilbert of Colchester have been to a great extent overshadowed by the fame of the renowned lord-chancellor, and it is much to be regretted that we have not had handed down to us more of the results of Gilbert's labors than are to be found in his celebrated work "De Magnete," published in the year 1600. Such as it is, this work may, however, be justly regarded as the earliest English scientific classic, and its author must be recognized as the first truly philosophical investigator in the now all-important subjects of electricity and magnetism. The club has been organized for the object of bringing out an English edition of "De Magnete," as nearly as possible in the style of the original folio edition, and to arrange for a befitting celebration of the tercentenary of this work in the year 1900. To quote the circular, "The publication of 'De Magnete' not only marked an epoch in the science of magnetism, but constituted the absolute starting-point of the science of electricity. It has been hitherto a reproach to British electricians that they too little recognized the merits of the founder of the science." The preliminary list of members already includes the names of Sir William Thomson, Lord Rayleigh, Professor Tyndall, Sir John Lubbock, Professor Rucker, Professor Lodge, Mr. Preece, Professor Reinold, Professor Perry, Professor G. Forbes, Professor D. E. Hughes, Sir F. A. Abel, Sir F. Bramwell, Sir Douglas Galton, Sir H. Mance, Col. Festing, Capt. Abney, Professor Carey Foster, Professor W. G. Adams, Professor J. C. Adams, Professor Roberts-Austen, Professor Thorpe, Professor G. H. Darwin, Professor Liveing, Professor Dewar, Professor W. N. Shaw, Professor Poynting, Professor Ray Lankester, Mr. Crookes, Mr. J. Hopkinson, Mr. Glazebrook, Mr. G. J. Symons, Dr. J. H. Gladstone, Dr. B. W. Richardson, Professor Victor Horsley, Mr. Latimer Clark, etc.

— The fifth winter meeting of the Indiana Academy of Science will be held at Indianapolis, Dec. 30 and 31. It is desired that the first session convene at 10 A.M., Dec. 30. At the coming meeting a part of the work will be done in sections, of which two are to be organized: A, Zoology, Botany, Geology, and Geography; B, Chemistry, Physics, and Mathematics. The programme committee is composed of John M. Coulter, chairman, Crawfordsville, Ind.; and W. V. Brown, Greencastle, Ind.

— The production of essential oil of geranium in the island of Re-union in the Indian Ocean is assuming considerable proportions. The exports in 1887 were 2,786 pounds; and in 1888, 3,992 pounds; while during the present season they are estimated at 5,720 pounds; and for 1890, the plantations having been largely extended, at 13,000 pounds or more. The new flowers are now being distilled. In Africa, on the other hand, this season's yield of geranium-oil is said to have been much below the average.

— Early last month the newly appointed occupant of the Greek chair at Glasgow University, Professor Murray, delivered his introductory address in the Bute Hall of the college, before a very large attendance of students and the general public. Taking for his subject, as we learn from *The Educational Times*, "The Place of Greek in Education," Professor Murray said that the old classical system of education was attacked by two diverse enemies, — one what they might call the cultivated standpoint, and the other the mercantile standpoint. Those who led the battle from the cultivated or scientific standpoint would say, "Why should a boy spend all his time on one comparatively small branch of knowledge?" while the other enemy which classics had would think as follows: "Greek and Latin are dead languages. No one travelling abroad wants to speak them; no house of business will engage a clerk because he can write Greek; no great inventions, no railway or electric light, ever came from a knowledge of Greek; no great fortune was ever made by a knowledge of Greek." These two criticisms were of exactly opposite kinds. The former — the strength of which seemed to him irresistible, and he would not, if he could, battle with it — sought for a fuller and better education: the latter was the secret enemy of any education at all. He would point out, however, that as all departments of knowledge were equally honorable in themselves, and all equally deserved to be studied, so, on the other hand, they could not possibly be all studied by the same people. Some few subjects ought to be studied by everybody. He did not think Greek was one of them. Greek was a language of unusual difficulty, and a man could undoubtedly reach very high points of culture without any knowledge of Greek; but for the student of history, of political philosophy, of ethics, of logic, of archaeology, and also for the student of most forms of art, the floods of light that ancient Greece could shed upon these subjects were something incalculable and beyond price. Heaven forbid that he should unduly magnify his office or cry up his wares in the spirit of a charlatan, but he believed that there was but one nation, uniquely gifted and uniquely interested, to be found in all the annals of mankind; and if they were to choose some one period of history, some one department of the great world of knowledge, to educate their youth with, he believed, that, for those minds which were naturally attracted to it, the study of Greece was an education as full and as stimulating as lay within man's reach at the present time.

— One of the most interesting and valuable results of recent French horticultural effort is found in the new race of dwarf cannas, with large and brilliantly colored flowers, produced by M. Crozy of Lyons. A large bed of these plants in the garden of the Trocadéro, in Paris, was surrounded all summer by crowds of people. Too much has not been said of the beauty of these plants, and of their value for decorative purposes, whether planted in the open ground or grown in pots or tubs. The colors of the flowers of some of the varieties, says *Garden and Forest*, are surprisingly brilliant. There seems no good reason, however, for calling the plants "dwarf," except that they begin to flower when they are not more than twenty inches high; for they grow, especially in this country, when generously treated, to a height of six or eight feet. Seventeen of the new varieties exhibited at Paris for the first time (which, on the whole, are no better than those sent out by M.

Crozy during the past two years) are described in a recent issue of the *Revue Horticole*. No one who has not seen a collection of M. Crozy's cannas in good condition can form the faintest idea even of the beauty and the brilliancy of the flowers of the plants.

— From a thousand prune-trees five years old, Capt. Guy E. Grosse of Santa Rosa, Cal., has this season dried five tons of fruit, which he is delivering, according to *Garden and Forest*, at the Southern Pacific station for eastern shipment at four and a half cents a pound. The rapid maturing of a prune-orchard, after arriving at the fourth year, is shown by the increase in the crop of this year over that of last year, when the yield was but twelve hundred pounds. Next year it is expected the crop will be trebled. At four and a half cents a pound, the proceeds from the thousand trees this year equals four hundred and fifty dollars. In two years more it should be nearly three thousand dollars.

— The registrations of the sunshine recorder at Ben Nevis Observatory, according to a report read at the British Association at Newcastle, showed 970 hours of sunshine during the year; the smallest number of hours for any month being 8 for November, and the largest 250 in June, being nearly half the possible sunshine. The numbers of hours for the four years now observed, beginning with 1885, were 680, 576, 898, and 970. The contrast of the sunshine of 1886 with that of 1888 is thus very striking. The amount of the rainfall for the year was 132.46 inches; the month of least rainfall (3.76 inches) being June, and the greatest (20.60 inches) being November. The number of days on which precipitation was *nil*, or less than the hundredth of an inch, was 118. The numbers of rainless days for the last three years have been 159, 128, and 118. From all the observations yet made, it is seen that a fall equalling at least one inch a day has occurred on an average of one day in nine. Atmospheric pressure was this year again above the annual average, the mean level being 29.889, or .055 higher. The lowest mean at the observatory (25.035 inches) occurred in March, and the highest (25.595 inches) in September, the difference being .555 of an inch. At sea-level at Fort William, the extreme monthly means were 29.636 inches in November, and 30.132 in September, the difference being .496 of an inch.

— Some investigations have lately been made into the question of the vibration in buildings caused by machinery in motion. These were made in connection with the Westinghouse engine, in cases where it was necessary to place engines of this type on upper floors. The theory based upon these investigations is, that, if the slight motion which every engine has is exactly in time with the natural vibration of the floor-beam, each pulsation of the engine will increase the scope of the vibration of the floor, resulting in a most disastrous shaking; while, if the pulsations of the engine are in discord with the floor, comparative quiet will exist. As floor-beams are usually long, and their time of vibration correspondingly long, it is usually found that a fast-running engine will give less of its vibration to the floor-beams than a slow-running one. It is also worthy of note that the vibrations of a fast-running engine are more numerous and less forcible, hence easier resisted by the mass of the floor. An interesting example of preventing vibration by discord was shown in the case, reported in *The Railroad and Engineering Journal*, of a Westinghouse 10 horse-power engine, which, on an upper story of a silverware-manufactory, created such a commotion as to rattle the silverware on the shelves a hundred feet distant. A change of 25 revolutions, increasing the speed, entirely stopped the vibrations. In another case — the factory of Arbuckle Brothers in Brooklyn — two Westinghouse engines of 125 horse-power each, and one of 45 horse-power, are located on the fifth floor. These engines were erected on the heavy floor-timbers, the floor-boards being cut away, and extra timbers being inserted between the joists. Across said timbers were placed oak stringers, which have been seasoning since the war in some unfinished vessels in the Brooklyn Navy Yard. On these the engines were mounted with plain fly-wheels, and experiments were conducted to determine the speed at which it would be best to run. It was found that at 204 revolutions the vibration was at the minimum, and was very slight, being as little as that caused by any of the ordinary driven machinery. The speed was therefore fixed at this point, and the wheels then made to give the proper belt speed.

— The annual reports of the superintendents of the several fish-hatcheries (six in number) were made at a meeting of the commissioners recently held in New York, as reported in *The American Field*, and show great prosperity and efficiency. The distribution of fry last year exceeded twenty millions in number, and the supply of spawn for this winter's operations is larger than in any previous year. Six millions of salmon-trout eggs have been gathered at the upper Great Lakes. The Adirondack, Fulton Chain, and Sacandaga hatcheries have collected from the wild trout of their respective localities all that their troughs will contain, besides the large supply of salmon-trout eggs to be hatched. At Caledonia one hundred thousand are taken daily by stripping the stock fish. The commission will this year work the private hatchery of M. B. Hill at Clayton. Here wall-eyed pike, whitefish, andiscoes are to be hatched. At the Chautauqua Lake station experiments are to be continued with muscalonge. The three Adirondack hatcheries have now an output sufficient for all the accessible wilderness region, leaving the large production of Caledonia principally for the supply of the Catskill, Beaverkill, Neversink, and upper Delaware regions, which are so much frequented by tourists. An additional shad-hatching station is to be established on the Hudson River, so that the supply of this choice market fish may be increased. It is expected that the total output of fry of all kinds next year will be fully thirty millions.

— Experiments have been made recently in this city and Newark with a South American bean called the "angola," with the view of substituting it for gambier, but the *Oil, Paint, and Drug Reporter* announces that the tests were not satisfactory. This new material has been offered at one cent per pound less than gambier, and New Jersey tanners imagined that they had been put in possession of a valuable addition to their raw materials until the trials demonstrated that gambier could not be substituted so easily. The importation of the peculiar beans has practically ceased in consequence, and South American houses have been requested to pursue their investigations further, in the hope of obtaining some new product which would be of value in this line, as there are times when it is desired to prevent the fluctuations in gambier by pushing an article to take its place. Some attention is being directed to canaigre-root, which was described in the *Reporter* of Sept. 4, but great difficulty has been experienced in obtaining supplies from Mexico. The inquiries come from tanners, but thus far they have not been satisfied; and it is questionable if a cheaper article than gambier can be found to meet the same requirements.

— Mr. H. L. Bolley, in a bulletin of the Agricultural Experiment Station of Indiana, arrives at the following conclusions regarding wheat-rust: 1. The rusting of wheat is due to the attacks of several species of minute fungi. 2. The disease is propagated by means of various spores, one form of which is developed upon various determined and undetermined plants, mostly weeds. This side form is not as yet proved to be essential to the continued life of the parasites, but its destruction decreases the danger from serious attacks of the disease. 3. One species (*P. rubigo-vera*), in its uredo stage, is able to pass the winter in the tissues of the young wheat-plant. 4. In warm weather any conditions of the soil or atmosphere which tend to keep the wheat-leaves constantly wet are conducive to the rapid spread of the disease. 5. Low-lying, rich soils are most subject to the disease. 6. No variety of wheat is known to be rust-proof, yet some possess greater powers of resistance than others. 7. Though not proved, an excess of nitrogen in the soil is to be considered probably as liable to produce wheat easily affected by rust. If fertilizers are to be applied to such lands, those containing only inorganic elements are most advantageous, so far as immunity against rust is concerned. 8. In districts liable to severe visitations of the disease, early-ripening wheats are to be preferred.

— The *Delhi Courant* states that search for petroleum along the banks of the Lapan River, in Langkat, in Netherlands-India, has resulted in the discovery of large deposits of that oil. Raw petroleum oozes out of the ground at many places where the natives have consequently dug pits. The output from most of the latter has never been considerable, and shows fluctuation. At Telega Tunggal, where the boring reached a depth of about three hun-

dred and fifty feet, more important results have been arrived at. Appearances indicate that the main reservoir has been tapped there. The oil met with in the other pits and deposits proved to have found its way above ground from that storing-place. The oil tested yields thirty-five per cent of lamp-oil of good quality. It does not contain harmful ingredients, and offers advantages as a lubricator. The exact depth of the other deposits remains to be determined before an estimate of working expenses can be accurately made.

— The fifteenth annual meeting of the New Jersey State Horticultural Society will be held at Trenton on Wednesday and Thursday, Dec. 18 and 19.

— A very important announcement is made in the *Medical and Surgical Reporter* in regard to the University of Pennsylvania; namely, that Dr. John S. Billings has, with the approval of the secretary of war and of the surgeon-general, accepted the position of medical director of the University Hospital, to which he was recently elected, and that the duties of this new position will be so arranged as not to interfere with his duties as medical officer of the army at the surgeon-general's office. It is also announced that the University of Pennsylvania is soon to have a new laboratory of hygiene, to cost about \$200,000, and that \$100,000 have been already collected for this purpose. The department of hygiene has been under the supervision of Dr. Samuel G. Dixon since the death of Dr. N. A. Randolph, who was recently one of the editors of the *Medical and Surgical Reporter*. It was rumored at first that Dr. Billings was to supersede Dr. Dixon; but the provost of the university promptly denied this rumor, and stated that Dr. Dixon was still professor of hygiene in the university, and in charge of the laboratory of hygiene, which has been equipped through his exertions and liberality. It does not yet appear just what Dr. Billings will do at the university, but the probability is that he will be at the head of the department of hygiene. For this he is abundantly fitted, as he is recognized as an authority upon the subjects of hygiene and hospital construction and administration. The elaboration of the plans for the construction of the Johns Hopkins Hospital, and his coming, will be a valuable accession to the teaching force of the University of Pennsylvania.

— The Glendon Iron Company of Easton, Penn., operating one of the largest blast-furnaces on the Atlantic coast, have for a number of years followed a somewhat novel plan of getting out their limestone for furnace purposes. Their quarry, located at Glendon, Penn., has a perpendicular face, varying from 120 to 160 feet in height; and instead of drilling down a few feet back from the face of the quarry at the top, and taking the stone off in benches, as is done in other quarries in the East, they drive a tunnel back at the foot of the quarry, and from that horizontally in both directions on a parallel line with the base. The powder is loaded in chambers located in this latter tunnel, and sunk a few feet below the base-level. The tunnels are then filled up to the opening, and the explosives fired by electricity. Such a blast as this was fired with most successful results on the 27th of September last, and, as described in *The Engineering and Mining Journal*, it appears that the tunnel from the face-line was driven directly back 50 feet, the length of the horizontal tunnel being 135 feet. Four chambers were located on this tunnel 5 feet deep, the diameters being from 4 × 6 to 4 × 7 feet. In these was loaded Judson R. R. P. powder, divided respectively into lots of 8,000, 5,000, 3,000, and 4,000 pounds. The blast was fired by the superintendent of the Glendon Iron Company, Mr. M. P. Janney, and it was estimated that 60,000 tons of limestone were dislodged. About once each year this company fire one of these blasts, having always met with uniform success. While the cost of Judson powder is somewhat higher than that of black powder, the smaller quantity required, and the fact that it breaks the stone up finer, making it easier to handle, and requiring less drilling for block-holing, show a decided economy in its favor. On the Pacific coast this method of tunnelling beneath the burden, and firing in large charges, is generally adopted by railroad contractors and others, where large quantities of earth or rock are to be removed; but, with the exception of the Glendon Quarry, we do not know that the plan has come into vogue in the eastern part of the United States.

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Communications will be welcomed from any quarter. Abstracts of scientific papers are solicited, and twenty copies of the issue containing such will be mailed the author on request in advance. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents.

Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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ANCIENT ARABIA.¹

If there is any country which has seemed to lie completely outside the stream of ancient history, it is Arabia. In spite of its vast extent; in spite, too, of its position in the very centre of the civilized empires of the ancient East, midway between Egypt and Babylon, Palestine and India,—its history has seemed almost a blank. For a brief moment, indeed, it played a conspicuous part in human affairs, inspiring the Koran of Mohammed, and forging the swords of his followers; then the veil was drawn over it again, which had previously covered it for untold centuries. We think of Arabia only as a country of dreary deserts and uncultured nomads, whose momentary influence on the history of the world was a strange and exceptional phenomenon.

But the restless spirit of modern research is beginning to discover that such a conception is wide of the truth. The advent of Mohammed had long been prepared for. Arabia had long had a history, though the records of it were lost or forgotten. The explorer and decipherer have been at work during the last few years; and the results they have obtained, fragmentary though they still may be, are yet sufficiently surprising. Not only has Arabia taken its place among the historical nations of antiquity, its monuments turn out to be among the earliest relics of alphabetic writing which we possess.

Arab legend told of the mysterious races of 'Ad and Thamud, who, in the plenitude of their pride and power, refused to listen to

the warnings of the prophets of God, and were overwhelmed by divine vengeance. In the south the magnificent palaces of 'Ad might still be seen in vision by the belated traveller, while the rock-cut dwellings of Thamud were pointed out among the cliffs of the north; but the first authentic information about the interior of Arabia came to Europe from the ill-fated expedition of Ælius Gallus, the Roman governor of Egypt, in B.C. 24. The spice-bearing regions of southern Arabia had long carried on an active trade with East and West, and the wealth their commerce had poured into them for centuries had made them the seats of powerful kingdoms. Their ports commanded the trade with India and the further East. Already in the tenth chapter of Genesis we learn that Ophir, the emporium of the products of India, was a brother of Hazarmaveth or Hadramaut. Western merchants carried back exaggerated reports of the riches of "Araby the Blest," and Augustus coveted the possession of a country which commanded the trade with India as well as being itself a land of gold and spicery. Accordingly, with the help of the Nabatheans of Petra, a Roman army was landed on the western coast of Arabia, and marched inland as far as the kingdom of Sheba or the Sabæans. But disease decimated the invaders, their guides proved treacherous, and Ælius Gallus had to retreat under a burning sun and through a waterless land. The wrecks of his army found their way with difficulty to Egypt, and the disaster made such an impression at Rome that the conquest of Arabia was abandoned forever. From that time forward to the rise of Mohammedanism, the Roman and Byzantine courts contented themselves with supporting the native enemies of the Sabæan kings, or using Christianity as a means for weakening their power.

As far back as 1810, Seetzen, while travelling in southern Arabia, discovered and copied certain inscriptions written in characters previously unknown; later travellers brought to light other inscriptions of the same kind; and eventually, with the help of an Arabic manuscript, the inscriptions were deciphered, first by Gesenius, and then by Roediger (1841). They received the name of "Himyaritic" from that of the district in which they were found,—Himyar, the country of the Homerites of classical geography. The language disclosed by them was Semitic, while their alphabet was closely related to the so called Ethiopic or Geez. In certain dialects still spoken on the southern Arabian coast, notably that of Mahrah, between Hadramaut and Oman, the peculiarities of the old Himyaritic language are still to be detected.

In 1841 Arnaud succeeded, for the first time, in penetrating inland to the ancient seat of the Sabæans, and in bringing back with him a large spoil of important inscriptions. Later, in 1869, another adventurous journey was made by M. Halévy, on behalf of the French Academy, who was rewarded by the discovery of more than 800 texts. But it is to Dr. Glaser that we owe the better part of our present knowledge of the geography and ancient history of southern Arabia. Three times, at the risk of his life, he has explored a country of which our modern geographers still know so little, and, almost alone among Europeans, has stood among the ruins of Mârib, or Mariaba, called by Strabo the Metropolis of the Sabæans. He has collected no less than 1,031 inscriptions, many of them of the highest historical interest. The first-fruits of his discoveries have been published in his "Skizze der Geschichte Arabiens," of which the first part has just appeared at Munich.

For some time past it has been known that the Himyaritic inscriptions fall into two groups, distinguished from one another by phonological and grammatical differences. One of the dialects is philologically older than the other, containing fuller and more primitive grammatical forms. The inscriptions in this dialect belong to a kingdom the capital of which was at Ma'in, and which represents the country of the Mineans of the ancients. The inscriptions in the other dialect were engraved by the princes and people of Sabâ, the Sheba of the Old Testament, the Sabæans of classical geography. The Sabæan kingdom lasted to the time of Mohammed, when it was destroyed by the advancing forces of Islam. Its rulers for several generations had been converts to Judaism, and had been engaged in almost constant warfare with the Ethiopic kingdom of Axum, which was backed by the influence and subsidies of Rome and Byzantium. Dr. Glaser seeks to show that the founders of this Ethiopic kingdom were the Habâsa, or

¹ From the Contemporary Review for December.

Abyssinians, who migrated from Himyar to Africa in the second or first century B.C. When we first hear of them in the inscriptions, they are still the inhabitants of northern Yemen and Mahrah. More than once the Axumites made themselves masters of southern Arabia. About A.D. 300 they occupied its ports and islands, and from 350 to 378 even the Sabæan kingdom was tributary to them. Their last successes were gained in 525, when, with Byzantine help, they conquered the whole of Yemen. But the Sabæan kingdom, in spite of its temporary subjection to Ethiopia, had long been a formidable state. Jewish colonies settled in it, and one of its princes became a convert to the Jewish faith. His successors gradually extended their dominion as far as Ormuz, and, after the successful revolt from Axum in 378, brought not only the whole of the southern coast under their sway, but the western coast as well, as far north as Mecca. Jewish influence made itself felt in the future birthplace of Mohammed, and thus introduced those ideas and beliefs which subsequently had so profound an effect upon the birth of Islam. The Byzantines and Axumites endeavored to counteract the influence of Judaism by means of Christian colonies and proselytism. The result was a conflict between Sabâ and its assailants, which took the form of a conflict between the members of the two religions. A violent persecution was directed against the Christians of Yemen, avenged by the Ethiopian conquest of the country and the removal of its capital to San'a. The intervention of Persia in the struggle was soon followed by the appearance of Mohammedanism upon the scene, and Jew, Christian, and Parsi were alike overwhelmed by the flowing tide of the new creed.

The epigraphic evidence makes it clear that the origin of the kingdom of Sabâ went back to a distant date. Dr. Glaser traces its history from the time when its princes were still but *Makârîb*, or "priests," like Jethro the priest of Midian, through the ages when they were "kings of Sabâ," and later still "kings of Sabâ and Raidân," to the days when they claimed imperial supremacy over all the principalities of southern Arabia. It was in this later period that they dated their inscriptions by an era, which, as Halévy first discovered, corresponds to 115 B.C. One of the kings of Sabâ is mentioned in an inscription of the Assyrian king Sargon (B.C. 715), and Dr. Glaser believes that he has found his name in a "Himyaritic" text. When the last priest, Samah'al Darrah, became king of Sabâ, we do not yet know; but the age must be sufficiently remote, if the kingdom of Sabâ already existed when the Queen of Sheba came from Ophir to visit Solomon.

The visit need no longer cause astonishment, notwithstanding the long journey by land which lay between Palestine and the south of Arabia. One of the Minæan inscriptions discovered by Dr. Glaser mentions Gaza; and we now have abundant evidence, as we shall see, that the power and culture of the Sabæans extended to the frontiers of Edom. From the earliest times the caravans of Dedan and Tema had traversed the highways which led from Syria to the spice-bearing regions of Yemen. Three thousand years ago it was easier to travel through the length of Arabia than it is to-day. A culture and civilization existed there of which only echoes remain in Mohammedan tradition.

As we have seen, the inscriptions of Ma'in set before us a dialect of more primitive character than that of Sabâ. Hitherto it has been supposed, however, that the two dialects were spoken contemporaneously, and that the Minæan and Sabæan kingdoms existed side by side. But geography offered difficulties in the way of such a belief, since the seats of Minæan power were embedded in the midst of the Sabæan kingdom, much as the fragments of Cromarty are embedded in the midst of other counties. Dr. Glaser has now made it clear that the old supposition was incorrect, and that the Minæan kingdom preceded the rise of Sabâ. We can now understand why it is that neither in the Old Testament nor in the Assyrian inscriptions do we hear of any princes of Ma'in; and that, though the classical writers are acquainted with the Minæan people, they know nothing of a Minæan kingdom.¹ The Minæan kingdom, in fact, with its culture and monuments, the relics of which still survive, must have flourished in the gray dawn of history, at an epoch at which, as we have hitherto imagined, Arabia was the home only

of nomad barbarism; and yet in this remote age alphabetic writing was already known and practised, the alphabet being a modification of the Phœnician written vertically and not horizontally. To what an early date are we referred for the origin of the Phœnician alphabet itself!

The Minæan kingdom must have had a long existence. The names of thirty-three of its kings are already known to us, three of them occurring not only on monuments of southern Arabia, but on those of northern Arabia as well.

Northern Arabia has been as much a *terra incognita* to Europeans as the fertile fields and ruins of Arabia Felix. But here, too, the veil has been lifted by recent exploration. First, Mr. Doughty made his way to the ruins of Teima, the Tema of the Bible (Isa. xxi. 14; Jer. xxv. 23; Job vi. 19), and the rock-cut tombs of Medâin Salih, wandering in Bedouin dress, at the risk of his life, through a large part of central Arabia. He brought back with him a number of inscriptions, which proved that this part of the Arabian continent had once been in the hands of Nabatheans who spoke an Aramaic language, and that the Ishmaelites of Scripture, instead of being the ancestors of the tribe of Koreish, as Mohammedan writers imagine, were an Aramaic population, whose language was that of Aram, and not of Arabia. The Sinaitic inscriptions had already shown that in the Sinaitic peninsula Arabic is as much an imported language as it is in Egypt and Syria. There, too, in pre-Christian times, inscriptions were engraved upon the rocks in the Nabathean characters and language of Petra, — inscriptions in which a fertile imagination once discovered a record of the miracles wrought by Moses in the wilderness.

Since Mr. Doughty's adventurous wanderings, Teima and its neighborhood have been explored by the famous German epigraphist, Professor Euting, in company with a Frenchman, M. Huber. M. Huber's life was sacrificed to Arab fanaticism, but Professor Euting returned with a valuable stock of inscriptions. Some of these are in Aramaic Nabathean, the most important being on a stèle discovered at Teima, which is now in the Museum of the Louvre. About 750 are in an alphabet and language which have been termed "Proto-arabic," and are still for the most part unpublished. Others are in a closely allied language and alphabet, called "Lihyanian" by Professor D. H. Müller, since the kings by whose reigns the inscriptions are dated are entitled kings of Lihyân, though it is more than probable that Lihyân represents the Thamud of the Arabic genealogists. The rest are in the language and alphabet of Ma'in, and mention Minæan sovereigns, whose names are found on the monuments of southern Arabia.¹

The Minæan and Lihyanian texts have been mainly discovered in El-Ola and El-Higr, between Teima and El-Wej, — a port that until recently belonged to Egypt, — on the line of the pilgrims' road to Mecca. The Proto-arabic inscriptions, on the other hand, are met with in all parts of the country, and, according to Professor Müller, form the intermediate link between the Phœnician and Minæan alphabets. Like the Lihyanian, the language they embody is distinctly Arabic, though presenting curious points of contact with the Semitic languages of the north; as, for example, in the possession of an article *ha*. The antiquity of Lihyanian writing may be judged from the fact that Professor Müller has detected a Lihyanian inscription on a Babylonian cylinder in the British Museum, the age of which is approximately given as 1000 B.C.

We gather, therefore, that, as far back as the time of Solomon, a rich and cultured Sabæan kingdom flourished in the south of Arabia, the influence of which, if not its authority, extended to the borders of Palestine, and between which and Syria an active commercial intercourse was carried on by land as well as by sea. The kingdom of Sabâ had been preceded by the kingdom of Ma'in, equally civilized and equally powerful, whose garrisons and colonies were stationed on the high-road which led past Mecca to the countries of the Mediterranean. Throughout this vast extent of territory alphabetic writing in various forms was known and practised, the Phœnician alphabet being the source from which it was

¹ It is possible that a Minæan population is meant by the Maonites of Judges x. 12, the "Mehunims" of 2 Chron. xxxv. 7.

¹ The Minæan and Lihyanian texts have been edited and translated, with an important introduction, by Professor D. H. Müller: "Epigraphische Denkmäler aus Arabien," in the "Denkschriften d. K. Akademie d. Wissenschaften zu Wien," vol. xxxvii., 1839.

derived. The belief, accordingly, that pre-Mohammedan Arabia was a land of illiterate nomads, must be abandoned: it was not Islam that introduced writing into it, but the princes and merchants of Ma'in and Thamud, centuries upon centuries before. If Mohammedan Arabia knew nothing of its past, it was not because the past had left no records behind it.

A power which reached to the borders of Palestine must necessarily have come into contact with the great monarchies of the ancient world. The army of Ælius Gallus was doubtless not the first which had sought to gain possession of the cities and spice-gardens of the south. One such invasion is alluded to in an inscription which was copied by M. Halévy. The inscription belongs to the closing days of the Minzean kingdom, and after describing how the gods had delivered its dedicators from a raiding attack on the part of the tribes of Sabâ and Khaulân, or Havilah, goes on to speak of their further deliverance from danger in "the midst of Misr," or Egypt, when there was war between the latter country and the land of Mazi, which Dr. Glaser would identify with the Edomite tribe of Mizzah (Gen. xxxvi. 13). There was yet a third occasion, however, on which the dedicators had been rescued by their deities 'Athtar, Wadd, and Nikráh: this was when war had broken out between the rulers of the south and of the north. If the rulers of the south were the princes of Ma'in, whose power extended to Gaza, the rulers of the north ought to be found in Egypt or Palestine. Future research may tell us who they were and when they lived.

But the epigraphy of ancient Arabia is still in its infancy. The inscriptions already known to us represent but a small proportion of those that are yet to be discovered. Vast tracts have never yet been traversed by the foot of an explorer, and there are ancient ruins which have never yet been seen by the eye of the European. What has been accomplished already with the scanty means still at our disposal is an earnest of what remains to be done. The dark past of the Arabian peninsula has been suddenly lighted up; and we find that long before the days of Mohammed it was a land of culture and literature, a seat of powerful kingdoms and wealthy commerce, which cannot fail to have exercised an influence upon the general history of the world.

A. H. SAYCE.

MR. MACKINDER ON GEOGRAPHY-TEACHING.

THE reader in geography in the University of Oxford has been delivering a course of four lectures at the English College of Preceptors. The introductory lecture was given on Nov. 8, before a crowded audience, consisting mainly of women teachers.

We must first settle, said Mr. Mackinder (as given in the London *Journal of Education* of recent date), what are our aims in geographical teaching, else we shall be like men blindfold, trying to find their way out of a field with but one gate. If we succeed, it will be by a *θεία τύχη*. All teaching aims at discipline, or information, or both. Geography, as hitherto taught, has aimed solely at information. Even the leading authorities have supported this view. Thus a general, a distinguished member of the Geographical Society, lately complained to the lecturer of the brutal ignorance displayed by society in general, because at a large dinner-party his wife was the only guest who knew where Nassau, New Providence, was. Such geographical lore the lecturer said he heartily despised. It might have been of use before the invention of gazetteers: now it is utterly useless. Yet some geographical information is worth having, though discipline is the main thing. Thus the question turns up, "Where is Allahabad?" A reference to the gazetteer will tell us, "Allahabad is the capital of the North-West Provinces of India, situate at the junction of the Jumna and the Ganges." To the uneducated person these statements will convey nothing more than the vague impression that Allahabad is somewhere in the north of India. One who has been trained in geography will at once picture to himself the centre of a great and populous province, standing in the great plain which lies at the foot of the Himalayas. If the teacher has thus given a skeleton into which details may be fitted, he has not merely supplied information, but also developed capacity. Acquaintance with great facts, vividly and familiarly known, so that they are part and parcel of the mind's

furniture, is indeed discipline; for it involves the grasping of contrasts, analysis, learning to deal with ideas.

The basis of geography-teaching must undoubtedly be *Heimatskunde* ("knowledge of the pupil's home and surroundings"); but this sound pedagogic principle has of late been pressed to the verge of absurdity. Professor Geikie, in "The Teaching of Geography," went so far as to leave all the geography out, and teach every thing else under the sun. We are told that the professor must teach his class the homologies of the limbs of animals, and the various styles of architecture. Such general knowledge is most valuable, but there is a danger of not seeing the wood for the trees. In the same way, if the reform advocated for elementary schools to combine geography and natural science were carried, geography would be pretty certain to go to the wall. True, geography, with one exception, is a late subject, and must be based on physiography; but it is best to keep the two names separate. "Physiography" is an old term, brought into fashion again by Professor Huxley. The Science and Art Department has just given it a more extended meaning than it bears in Professor Huxley's book with that title, and includes under its astronomical phenomena the laws of gravitation, etc. Such physiography we do not need as a preparation for geography. All a child need know is the meaning of the common world around him, the air he breathes, the water he drinks, ice, snow, rain, clouds. These facts of common life might be imparted at a very early age, and were best imparted by parents. At present parents are too ignorant to teach them, and they must be taught first at school. The exception above referred to is the instilling of those rudimentary facts which are to geography what the multiplication-table is to arithmetic. Without these facts, such as the outlines of continents and oceans, which cannot be taught inductively, no comparison, no generalization, is possible; and if they are to be indelibly impressed on the mind, and form part of the groundwork, they must be learned very early. The *why* of geography cannot come till considerable portions of history and science have been answered. These outlines, our multiplication-table, must be taught by maps; they are purely a question of eye-memory. We want neither maps full of details (the old error), nor a single map of a country with only twenty names in it (the modern error), but a number of maps, each one accentuating some single feature, and showing the country in some new connection. Such maps could be produced very cheaply, and we might have a whole series of them. Even grown-up people rarely know the look of a country except in one connection, and are unable, in turning over an atlas, to recognize a map at a glance without the help of the name in the corner. So, in map-drawing, we require far too great elaboration. What we want is, to enable a child to reproduce from memory a rapid outline of Italy as a peninsula of south-western Europe, again as part of the Mediterranean coast-line, and so on. The old school of teachers, who insist on lists of names by heart, argue that "we are bound to train the memory," and that "the memory is strongest in the young." They do not perceive that they are arguing in a vicious circle. If the memory is strong, what need to cultivate it specially? What is needed is to supply it with facts worth remembering. "Give plenty of facts, and some are sure to stick." "Granted," replied the lecturer, "but these are likely to be the least important. From my school lessons on the geography of Italy, I retain the one fact that twelve miles north of Milan there is a village famous for its cheese-making."

Text-books are useful as a guide to the teacher, and as a record of what has been taught to the pupil. The old way of using them—"Get up the next three pages; now shut your books; name the departments of France and their capitals"—is a parody of teaching. Nor is the modern fashion of lecturing, by itself, much better. A lecturer can stimulate and direct study; he cannot supply accurate information; he cannot educe knowledge or test its soundness.

Teachers, by blindly following text-books, fall into the vicious method of taking one country at a time. They should go over the same ground again and again, each time in a new connection, showing the physical, commercial, political connection of one country with other countries. For this we need variety of apparatus,—maps, sections, models, views, magic-lantern slides, and, above all,

the blackboard. Lastly, the pupil must have practical experience in the field. When he has been taught how to observe and record the natural features of his own immediate vicinity, he should be taken to another district, and be taught by contrast. Such is the practice of German schools, but in England we are told that the thing is impossible, that excursionist teaching would end in anarchy. Yet head masters find no difficulty in taking cricket and football teams to play distant schools. If they themselves knew or cared for geography, the difficulty would vanish. "Such," said Mr. Mackinder, "is, in briefest outline, my ideal of geography-teaching in schools; but the lecturer can only propose: it is the examiner who disposes."

SPEED OF RAILROAD TRAINS IN EUROPE.

THE German technical press is at present discussing the speed of express trains. In answer to petitions addressed to him by a number of persons interested, says the *Railroad and Engineering Journal*, the minister of public works declared recently that it would be very difficult to respond to demands of this kind, since the speed of express trains on the Prussian railroads was already greater than in any other European country. If it should be increased, the public would not patronize the railroads.

This assertion, it is shown from statistics recently collected, is not by any means correct. The following table shows the average speed of fast trains in different European countries, and shows that Germany does not by any means occupy the first rank.

Country.	Speed per hour in miles.	
	Including stops.	Without stops.
Great Britain.....	41.7	44.0
France.....	32.8	36.2
Holland.....	32.5	35.0
Belgium.....	31.8	33.5
North Germany.....	31.8	34.3
South Germany.....	31.2	33.0
Austria-Hungary.....	30.0	32.0
Italy.....	29.5	31.8
Russia.....	29.0	31.7

The inferiority of Germany in this point of view finds a marked expression, if we compare the speed of the great Oriental Express, which runs between Paris and Constantinople, passing over the railroads of a number of European countries, including Germany. This train is the fastest long-distance express train run in Europe, and from the time-table the average speed in the different countries is as follows: in France, 40.5 miles per hour; in Germany the speed varies in different sections, being in Alsace-Lorraine, 32.5 miles; in Baden, 35.5 miles; in Würtemberg, 30 miles; in Bavaria, 33.7 miles. In Austria the average speed is 33.5 miles; in Hungary, 34 miles; and in Roumania, 32 miles. This comparison, it will be seen, is not altogether to the advantage of the German lines.

In this connection some comparison may be made of the passenger tariffs in different countries. From this it appears that the lowest charges, both for first and second class passages, are in Belgium, Holland coming next, then Germany, then France, then Austria-Hungary. England and Italy charge the same fare for first-class passages, but the English second-class is considerably lower than the Italian. The highest fares in Europe are in Russia. Third and fourth class fares are not included in this system, as those classes of passengers are not generally carried on the fast express trains.

AMONG THE PUBLISHERS.

BEGINNING with Jan. 1, 1890, Mrs. Fuentesy Capdeville, Madrid, Spain, will publish a new scientific illustrated weekly magazine entitled *La Naturaleza*.

— J. F. Whiteaves has published in the "Transactions of the Royal Society of Canada" (Vol. VII., Section IV., 1889) "Descriptions of Eight New Species of Fossils from the Cambro-Silurian Rocks of Manitoba," illustrated by six plates.

— D. Appleton & Co. have ready "Appletons' Handbook of Winter Resorts." They have in press a book by Frank Vincent, entitled "Around and About South America." Mr. Vincent circumnavigated South America, and visited the various places of in-

terest in the different countries, including many in Brazil. The volume will be fully illustrated. They have in press a valuable historical work in "James G. Birney and the Genesis of the Republican Party," by Gen. William Birney.

— In the Christmas number of *The Ladies' Home Journal*, Theodore R. Davis gives a glimpse inside the White House and of the State dinners under several administrations, and Edward W. Bok tells what are the literary tastes of two such men as Gladstone and Bismarck.

— John Howard Appleton, professor of chemistry, Providence, R.I., author of "Beginner's Handbook of Chemistry," "The Young Chemist," "Qualitative Analysis," "Quantitative Analysis," "Laboratory Yearbook," has issued his "Laboratory Yearbook for 1890." This publication is now in its eighth year.

— Charles Scribner's Sons have just published "Among the Cannibals," which is an account by Carl Lumholtz of his four years' travel in Australia, and of camp-life with the aborigines of Queensland, considered to be the lowest race of *homo sapiens* known to exist.

— Robert M. Lindsay, Philadelphia, Penn., announces to be published in December an etched portrait of Charles Darwin, after the painting by W. W. Ouless of the Royal Academy, London, and etched by G. Mercier of Paris, pupil and collaborateur of the eminent Rajon, recently deceased. The size of the plate is about twelve by fifteen inches.

— The January number of *Scribner's Magazine* will appear with additional space, and a new department at the end of the number, conducted under the title "The Point of View." An opportunity is here given to the best writers for a brief and familiar discussion of subjects of both passing and permanent interest. In the January number the subjects touched are "The Barye Exhibition," "Thackeray's Life," "Social Life in Print," and "The French as Artists." The success of the magazine has been such that the publishers feel justified in adding these new pages to a magazine already low in price.

— E. & F. N. Spon have just published "Inventor's Manual: How to Make a Patent Pay," by an experienced and successful inventor. Thousands of useful inventions are every year patented, but on which the inventor does not realize any thing, simply for want of information how best to proceed to introduce or dispose of his invention. Among the subjects treated in this work are how to invent; how to secure a good patent; value of a good invention; how to exhibit an invention; how to interest capital; how to estimate the value of a patent; value of design patents; value of foreign patents; value of small inventions; advice on selling patents; advice on the formation of stock companies; advice on the formation of limited liability companies; advice on disposing of old patents; advice as to patent attorneys; advice as to selling agents; forms for assignments, licenses, and contracts; State laws concerning patent rights.

— Messrs. Putnam have issued in the Story of the Nations Series a volume on "Early Britain," by Alfred J. Church. It begins with the earliest authentic records, and closes with the Norman Conquest. Being intended for popular reading, it of course has not the philosophical character that a work on such a subject might have, but from its own point of view it has considerable merit. The author has followed the best authorities, though always with independent judgment; and he has probably given as clear an account of the most stirring events in early English history as his space and materials permitted. The main fault of the work, as of the majority of historical books, is the excessive attention given to military affairs to the neglect of other matters of greater importance. Mr. Church evidently thinks the Roman occupation of Britain of more consequence than some writers do, for he devotes one-fourth of his book to it; and he is not disposed, like some, to think that all that is valuable in English life is due to the Teutonic settlers. On the whole, he has made a judicious and readable book. We are sorry to have to add that, like one other volume in this series which we had occasion to notice some time ago, it contains a number of grammatical blunders, such as singular nouns with plural verbs, adverbs used for adjectives, and so forth, which ought never to be seen in a respectable publication.

— The contents of the *Modern Science Essayist* for October, November, and December are, respectively, "Evolution as Related to Religious Thought," by John W. Chadwick; "The Philosophy of Evolution," by Starr Hoyt Nichols; and "The Effects of Evolution on the coming civilization," by Minot J. Savage. The *Essayist* is published by the New Ideal Publishing Company of Boston, Mass. The publication of this series of fifteen essays on evolution (which were delivered as lectures under the auspices of the Brooklyn Ethical Association) was undertaken in response to a demand for a correct statement, in popular form, of the leading ideas, inferences, and tendencies involved in the acceptance of the evolution philosophy, together with a clear statement of the main lines of evidence or proof by which the conception of evolution is sustained. The plan of the series involved not only the treatment of the physical and biological phases of the subject, but also its ethical, social, religious, and philosophical aspects; the whole being introduced by biographical sketches of the two men of our time whose names are most intimately associated with the evolution hypothesis, — Spencer and Darwin. The three numbers mentioned above complete the series of fifteen. They will be followed by other essays of a similar tenor.

— The December number of the *Political Science Quarterly* opens with an article on the deferred constitutional convention of New York State, by the Hon. Seth Low, president of Columbia College. George Gunton attacks the economic basis of socialism; namely, Karl Marx's theory of "surplus value;" the Rev. Samuel W. Dike reviews the new and important government report on marriage and divorce; Worthington C. Ford (late of the State Department) criticizes and opposes the scheme of substituting silver for legal tender notes; Professor F. W. Maitland of Cambridge, England, completes his valuable survey of the materials of English legal history; and Professor F. J. Goodnow of Columbia College begins a description of the recent re-organization of local government in Prussia. Twenty-two recent American, English, German, French, and Italian works are reviewed. Among the reviewers, besides the editors, are Professors Hadley of Yale, Giddings of Bryn Mawr, and Ashley of Toronto University; J. B. Moore, assistant secretary of State; and Sir George Baden-Powell, M.P. The "Record of Political Events" (previously published in the *New Princeton Review*) is continued to Nov. 1.

— Messrs. Putnam have published a work on the pleasures of country life by Philip G. Hubert, jun., entitled "Liberty and a Living." The author had been engaged in constant work as a journalist, but abandoned a portion of his work, and took a small country home on Long Island, where he lives for eight months of the year occupied with gardening, fishing, etc. He still does some writing, however, and in the winter spends four months in the city in journalistic work. Thus his income still comes mainly from his pen, his country work being carried on chiefly for pleasure; and the life he thus leads he holds up as the true ideal. He sings its praises with no little fervor; and, so far as mere enjoyment is concerned, there is something to be said for it. But then, we are not placed in this world for selfish enjoyment, but to serve humanity; and the life that Mr. Hubert describes is wholly destitute of any such object. It is a life of idleness and sport, with only so much work as is necessary to support existence; and such a life is even less honorable than that of the money-getter whom Mr. Hubert so much despises.

— A work will shortly be issued anonymously by the J. B. Lipincott Company, Philadelphia, which may excite widespread interest in political circles. It is entitled "Justice and Jurisprudence: An Inquiry concerning the Constitutional Limitations of the Thirtieth, Fourteenth, and Fifteenth Amendments." Advance sheets show an inside political knowledge of events and allusions which indicate a close connection between the author and the present administration, and it bids fair to have an important bearing upon the policy and future of parties in this country. The book is free from partisanship or sectionalism, and is a bold and original treatment of the race question. As a legal argument on one of the most important subjects of the day in America, and as a criticism of the decisions of the highest judicial tribunal of the land, the work will commend itself. An appendix contains a state-

ment of all legislation, National and State, and a digest with table of every case, Federal and State, touching the race question or civil rights. The volume may become an authority upon constitutional liberty, and a guide for foreign as well as American statesmen, not less than an educational work for the general public, for whose benefit ostensibly it has been prepared.

— Messrs. Munn & Co. announce as now ready "Experimental Science," by George M. Hopkins. This book treats on the various topics of physics in a popular and practical way. It describes the apparatus in detail, and explains the experiments in full; so that teachers, students, and others interested in physics, may readily make the apparatus, and perform the experiments without difficulty. The aim of the writer has been to render physical experimentation so simple and attractive as to induce both old and young to engage in it for pleasure and profit. A few simple arithmetical problems comprise all of the mathematics of the book. Many new experiments are here described for the first time.

— We glean the following news items from *The Publishers' Weekly*. Egmont Hake has edited the diary kept by Gen. Gordon during the Tai-ping rebellion. It will be published shortly, illustrated with portraits, maps, and plans. R. D. Blackmore's recent appearance in court as complainant against a man who had stolen twenty-five dollars worth of his pears brings out the fact that the author of "Lorna Doone" is better known at his home in Teddington as a market-gardener than as the author of some of the most charming of contemporary works of fiction. Emile Ollivier, the ex-minister of the French Empire, has in press his new work, "1789 and 1889." The volume treats of the Revolution, and the social, political, and religious work of the movement of 1789, concluding with a programme of reforms to be effected in the political organization of latter-day France, and notably in the management of universal suffrage and the present parliamentary system. Douglas Sladen, the Australian poet, who has been making a tour of Canada from Halifax to the Pacific, is now in Victoria, B.C., collecting information for a book which he intends writing on Canada. The volume will contain his personal impressions of the Dominion, statistics of her trade, her relations with the mother-country and reciprocal benefits derived from the connection, besides the advantages offered by Canada as a trade route between England and the colonies of the Pacific. Gustav Freytag's "Der Kronprinz und die deutsche Kaiserkrone" was printed in full in the *Belletristisches Journal* of this city of Nov. 14. It will be issued at once by George Bell & Sons, in an English translation, under the title of "The Crown Prince and the German Imperial Crown." A reply to this book, by Dr. Otto Arendt, will be published shortly by Walther & Assolant of Berlin. Freytag is a Conservative; Dr. Arendt, a Liberal; and it is expected that the latter's reply will make considerable sensation in the German political world. A number of gentlemen interested in the University of Pennsylvania have established a publishing company under the name of the University Press. Their purpose is to control the present publications of the university, and to establish such new periodicals as the needs of the institution may suggest. At least four new magazines will be issued by the company soon after Jan. 1. *The Arena* is the title of a new monthly magazine, published in Boston, which intends to devote itself to the serious discussion of serious public questions. The first issue, published in November, and the December number, contained contributions from the Rev. M. J. Savage, W. H. H. Murray, Mary A. Livermore, Helen Campbell, O. B. Frothingham, N. P. Gilman, and others. For the January number, articles by Col. Ingersoll, Henry George, and Dion Boucicault are promised. The American edition of *Artistic Japan*, published by the Artistic Japanese Agency, 220 Fifth Avenue, will hereafter be published simultaneously with the English, French, and German editions issued abroad. The edition printed for this country contains precisely the same engraved and colored plates as the European editions, which are printed in color by M. Gillot of Paris, under M. S. Bing's personal direction. The series of plates issued with this journal will form a valuable collection on various subjects, desirable for amateurs, architects, decorators, and artists, as well as all industrial workers needing suggestions in design, color, motive, or form.

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—“Evolution of Sound’ Evolved” is a review of the article entitled “The Nature of Sound,” in “The Problem of Human Life,” by Marcellus Thompson, professor of natural sciences in Garfield University, Wichita, Kan. To this work is appended an account of some original experiments in electricity which Professor Thompson conducted when a candidate for the master’s degree at the University of Michigan. This work has been warmly received, as witness testimonials from John W. Langley, professor of general chemistry in the University of Michigan; Alfred Fairhurst, professor of natural sciences in Kentucky University; B. J. Radford, associate editor of the *Christian Standard*; John B. De Motte, professor of physics in DePauw University; O. P. Hay, professor of biology in Butler University; David S. Jordan, president of Indiana State University; A. E. Dolbear, professor of physics in Tufts College; C. Williams Parks, professor of physics in Rensselaer Polytechnic Institute.

LETTERS TO THE EDITOR.

**Correspondents are requested to be as brief as possible. The writer’s name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

A Belated Dandelion.

THE day before Thanksgiving I found in full bloom a fine dandelion-head measuring one and one-half inches in diameter; yet the record of temperatures for the November just past shows a lower average than that of any November in Kansas since 1880.

E. B. KNERR.

Atchison, Kan., Dec. 5.

Is Man Left-Legged?

LAST Sunday, while walking on the beach at Nahant, we tried some experiments bearing on the subject. We found that, walking either forward or backward with the eyes shut, we bore to the right, but in running either forward or backward we bore to the left. This last fact surprised us somewhat at first; but we thought it might be explained from the fact that, the left leg being the stronger, there would be a stronger spring from the left foot in running, which would make the right leg take the longer step. We should be glad to hear if others have tried these experiments, whether with the same or different results.

FRED’K A. LOVEJOY.
FRANCIS H. ALLEN.

West Roxbury, Mass., Dec. 8.

INDUSTRIAL NOTES.

The Crocker-Wheeler Electric Motor.

THE Crocker-Wheeler Electric Motor Company of this city are now putting on the market a series of electric motors which show a considerable advance in design, construction, and efficiency. Two of their smaller motors are shown in the illustrations on this page. Fig. 1 shows a ½-horse-power motor belted to a small three-piston suction and force pump, which is capable of lifting a thousand gallons of water per day a height of a hundred feet, and other quantities a correspondingly greater or less height. When desired, the motor is connected to the pump by toothed or friction gearing instead of by a belt.

By means of an automatic attachment to the ordinary float in the water-tank, the electric current is cut off from the motor when the tank is full, thus stopping the pump until enough water has been used from the tank to allow the float to fall, thus starting the motor and pump again by switching on the electric current. This cycle of operations being entirely automatic, the water-supply is never exhausted, and no more electric energy is absorbed than is just sufficient to pump enough water to supply the demand.

Fig. 2 shows one of the new Crocker-Wheeler arc motors with fan, and a regulator which effects any desired change in the speed and power of the machine by simply moving the armature out of

the field. By this simple device the necessity of a switch, complicated windings, and attendant evils are entirely overcome.

The motors are built of very few pieces, and are strong and durable. They are designed with a broad base and a low centre of gravity, in order to render them perfectly steady and quiet in their operation. In their care they require a minimum of attend-

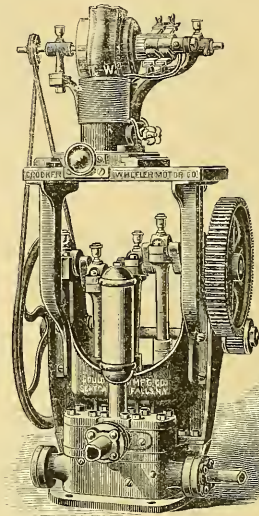


FIG. 1. — NEW C-W. ELECTRIC PUMP.

ance. They are arranged to be controlled by either of three methods of regulation, — for constant load, for variable speed, and for constant speed, — any one of which is obtained by attaching the corresponding regulating fixture.

The motors are arranged so that they can be reversed by simply inverting the brush-holders upon the clamping-rods, so that the upper brushes are placed below, and the lower ones above. By

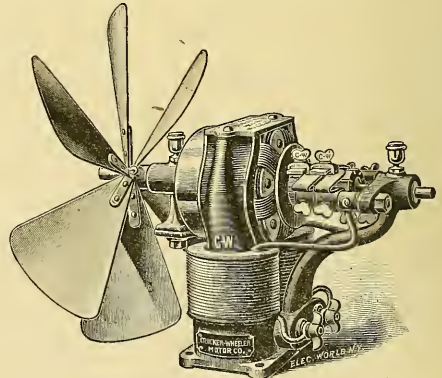


FIG. 2. — NEW C-W. ELECTRIC FAN.

this device the machines can be run either right-handed or left-handed without taking apart or changing any connections. They are wound for every kind of circuit, and those of different windings are always compared to see if the same efficiency and proportion of ampère-turns are maintained. On the smallest size, about 2,500 ampère-turns are used to magnetize the field, the total loss in the machine due to resistance never being permitted to exceed about 47 watts.

Publications received at Editor's Office,

Dec. 2-7.

CHAPIN, F. H. Mountaineering in Colorado. Boston, Appalachian Mountain Club, 198 p. 19¢.
 CRAIG, T. A Treatise on Linear Differential Equations. Vol. I. Equations with Uniform Coefficients. New York, Wiley, 416 p. 82¢.
 GANONG, W. F. The Economic Mollusca of Acadia. St. John, N. B., Barnes & Co. 116 p. 12¢. 50 cents.
 NEW SOUTH WALES, Annual Report of the Department of Mines, for the Year 1888. Sydney, Government, 245 p.
 PHELPS, H. Practical Marine Surveying. New York, Wiley, 217 p. 80¢. \$2.50.
 RICKETTS, P. de F., and RUSSELL, S. H. Skeleton Notes upon Inorganic Chemistry. Part II. Metallic Elements. New York, Wiley, 52 p. 12¢. \$1.50.
 THOMPSON, M. J. "Evolution of Sound" evolved. Cincinnati, Standard Publ. Co. 190 p. 12¢.
 WOOD, A. Lessons in the Structure, Life, and Growth of Plants, Ed. by O. R. Willis. New York and Chicago, A. S. Barnes & Co. 220 p. 12¢.

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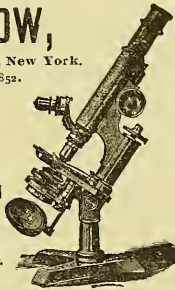
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A GRADUATE OF THE JOHNS HOPKINS UNIVERSITY desires a position as teacher of physical science. Specialty, chemistry, for which he refers to Prof. Remsen by permission. Address B. H. H., care of Science.

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WANTED a young man with some knowledge of mineralogy to assist in our Mineral Department. A. E. FOOTE, 1223 Belmont Av., Philada., Pa.

COLLEGE ALUMNI AND PHYSICIANS.—The American Academy of Medicine is endeavoring to make as complete a list as possible of the Alumni of Literary Colleges, in the United States and Canada, who have received the degree of M.D. All recipients of both degrees, literary and medical, are requested to forward their names at once to Dr. R. J. Dunglison, Secretary, 314 N. 16th Street, Philadelphia, Pa.

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CALENDAR OF SOCIETIES.

Anthropological Society, Washington.

Dec. 3.—James Mooney, The Cherokee Ball Play; J. W. Powell, Remarks on American Archaeology.

Natural Science Association, Staten Island.

Nov. 14.—The following officers were elected for the ensuing year: president, Dr. N. L. Britton; recording secretary, Charles F. Simons; corresponding secretary, Arthur Hollick; treasurer, Eberhard Faber; curator, J. C. Thompson. Apple-blossoms were shown, picked during the week ending Nov. 16, and the fact was noted that pear-trees had blossomed so universally throughout the island during the past three months as almost to have ceased exciting attention. A horse-chestnut and a few branches of a silver-maple are in blossom near St. George at the present time, and *Forsythia*, Japan quince, Missouri currant, lilacs, and other garden shrubs, have blossomed more or less freely a second time. The growth of *Protococcus* has been extraordinary everywhere. It is unusually conspicuous on the trees and fences, and in New York many of the brown-stone houses facing north appear as if they had received a coat of green paint. The almost constant wet weather since early summer was quoted as the probable cause of these phenomena.

Appalachian Mountain Club, Boston.

Dec. 9.—The Rangeley Lake Camping Trip. Arrangements have been made for a winter trip to the Ravine House, Randolph, White Mountains. If the snow is in suitable condition, the party will go Dec. 26. It is probable, however, that the excursion will be Feb. 22–28. Members wishing further information are requested to send their names to the recording secretary, Rosewell B. Lawrence, 23 Court Street, Room 409, Boston, Mass.

American Academy of Arts and Sciences, Boston.

Dec. 11.—S. C. Chandler, On the Lexell-Brooks Comet.

Engineers' Club, St. Louis.

Dec. 4.—Mr. Robert Moore submitted a report from the standing committee on collection of local engineering data. The information furnished the committee was of great and permanent value. Those contributing were T. B. McMath, C. V. Merseureau, S. F. Burnet, T. J. Caldwell, R. E. McMath, F. E. Nipher, J. A. Seddon, E. D. Meier, and M. L. Holman. Some data on fuels was in preparation by Professor Potter, but had not been completed in time for this report. It was ordered that the committee be continued, and requested to present a final report as soon as convenient. The special committee on nominations of officers for the coming year reported as follows: for president, F. E. Nipher; vice-president, George Burnet; secretary, W. H. Bryan; treasurer, Charles W. Melcher; for directors, E. D. Meier and S. B. Russell; librarian and manager, J. B. Johnson; manager, J. A. Seddon. The report was accepted, and the

following additional nominations were made: for vice-president, S. B. Russell; for director, F. H. Pond. Professor Nipher announced that Professor T. C. Mendenhall, superintendent of the Coast Survey, would visit St. Louis soon. It was ordered that the president extend an invitation to Professor Mendenhall to address the club on any subject that he might choose; also that the club extend to Professor Mendenhall a banquet while in St. Louis, and that a committee of three be appointed to arrange for this banquet. Mr. N. W. Perkins, jun., then addressed the club on the subject of "Adding-Machines." His paper treated particularly of the invention of W. S. Burroughs of St. Louis, one of which was shown. A full description of the construction and operation was given. Several parts of the machine were also shown, and its powers were demonstrated by a practical test. The subject was discussed by Messrs. Robert Moore, W. W. Penney, Ed. Flad, George Burnet, J. A. Seddon, and M. L. Holman. The machine was specially intended for use in banks, clearing-houses, etc. It appeared, however, to be of limited use to engineers, whose work requires but little computation of this kind. Mr. Holman stated as his experience, that no calculating-machine had yet been found to be of real advantage to engineers, from the fact that the problems considered were of so varied a nature, and the number of times which any given process had to be repeated, in identically the same manner, did not justify the use of mechanical devices.

CATARRH.

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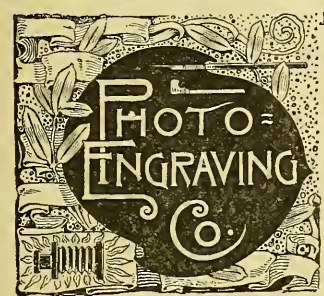
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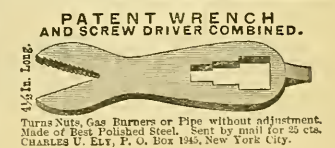
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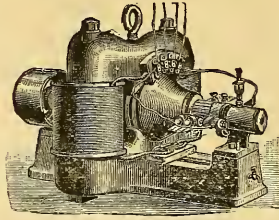


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VOL. XIV. No. 359.

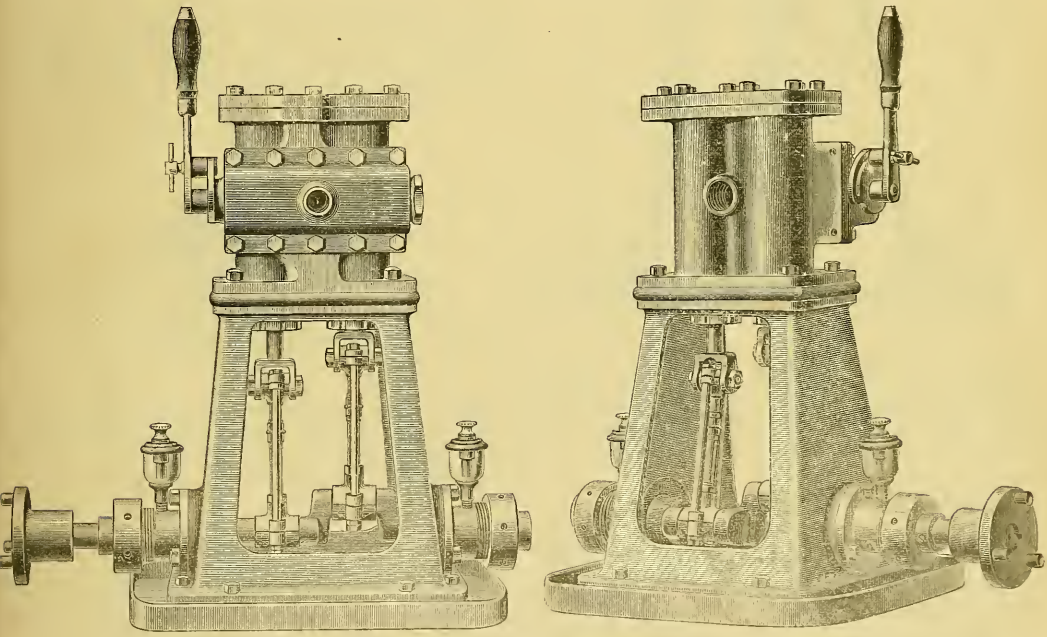
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THE SHORTT HIGH-SPEED ENGINE.

THE new type of steam-engine illustrated on this and the following page possesses several points that will naturally attract the attention of engineers and steam-users generally. There are features about it that will specially commend it to marine engineers and yacht-owners, as well as to others interested in compact high-speed reversible engines giving a maximum of efficiency with a minimum of fuel, and as free from complication of parts as possible.

results as to strength and stiffness are got from a given weight of metal. The pistons are double-acting; that is, steam is admitted to them at each end of the stroke. An engine of this type, with cylinders two inches in diameter and two-inch stroke, will develop two horse-power under ordinary conditions, but with high steam-pressure it is capable of doing much more. A launch engine of this size and power, running at four hundred revolutions a minute, has been used to run a twenty-five foot launch during the past year with excellent results. Though the model of the boat is not one



FIGS. 1 AND 2.—THE SHORTT DUPLEX HIGH-SPEED ENGINE.

The engine shown in the illustrations is known as the Shortt duplex high-speed engine, and it is being placed on the market by the Hussey Re-heater and Steam Plant Improvement Company of this city. Figs. 1 and 2 are perspective views of a reversing engine designed more especially for steam-launch and yacht service. Fig. 3 is a section showing the frame, cylinder and piston, steam-valve, connecting-rod, etc. It will be observed that there are two cylinders and a double crank, the crank-pins being set at an angle of ninety degrees with each other, thus preventing the engine from ever being on a dead-centre. The cylinders are made in one casting, and are supported on a frame of A-pattern, in which the best

calculated for speed, it is said to have run along easily and continuously at a rate of ten miles an hour.

The valves, though cylindrical in form, are the same as the regular slide-valve in action and principle. They take their motion from the pistons, the piston and valve of the right-hand cylinder controlling the admission and cut-off of steam to the left-hand cylinder, and *vice versa*, the steam ports being crossed. Fig. 4 is a diagram of the valve-seat and ports. The dotted lines showing the crossed steam-passages. The steam-ports are designated by the letter *D*, and the exhaust ports by *C*. The valves are shown in Fig. 5, *E* being the reversing-valve, and *F* the main valves. The

steam-passages are shown at *G*, and the exhaust-passages at *H*. The reversing-valve acts inside the main valve, the reversal of the engine being effected by giving the inner valve a half-revolution in

These engines are made by special tools in such a way as to insure that all like parts are interchangeable, thus facilitating repairs. The plain non-reversible engine made by the same manufacturers is the same as the engine shown, except that it has no reversing-

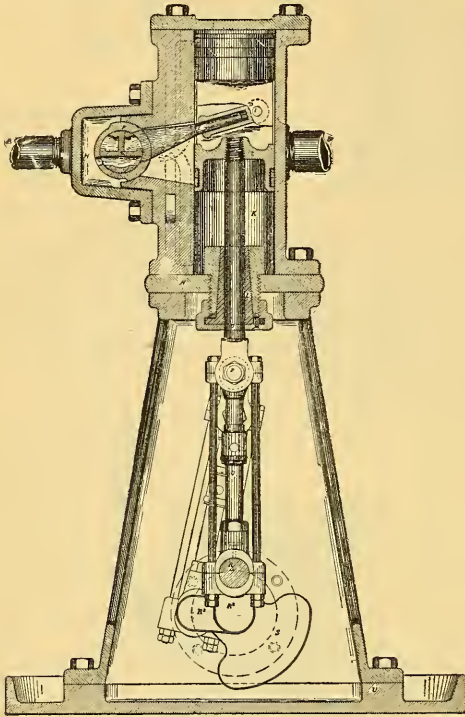


FIG. 3.

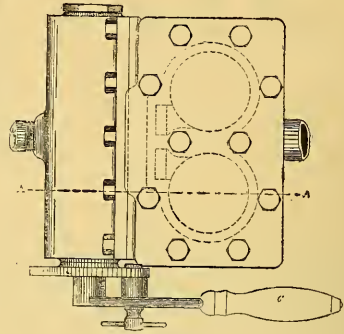


FIG. 6.

valve, and is provided with a pulley on the shaft instead of a coupling. In the larger sizes of these engines they will be made compound, and also automatic, special attention being paid to their adaptability for electric lighting and similar purposes. Among the advantages claimed for this engine are that it is economical,

the outer valve, thereby changing the register of the steam-passages. The reversing-lever is shown in the plan of the valve-seat, Fig. 6. A cross-section of one of the main bearings with anti-friction metallic bushing is shown at Fig. 7. These bearings are

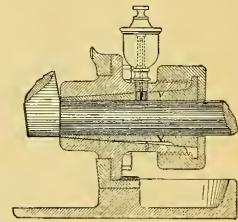


FIG. 7.

light, durable, simple in construction, and easy to operate, having no links, eccentrics, valve-stems, stuffing-boxes, nor dead-centres. It is said to afford greater power in smaller space than any other engine ever constructed, and to have the most positive valve-gear ever designed.

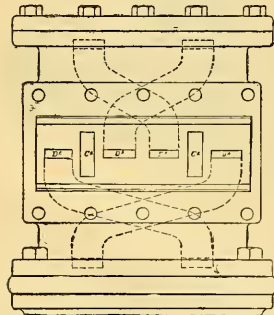


FIG. 4.

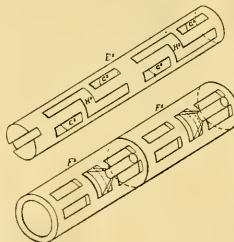


FIG. 5.

conical, and milled through, so that all wear may be easily and quickly taken up by turning the adjusting nut on the bearing casing. The connecting-rods are of the skeleton pattern, with self-oiling bronze boxes lined with anti-friction metal.

ELECTRICAL NEWS.

NEW INSULATING COMPOUND. — A new insulating compound which finds favor among manufacturers of electrical instruments and machinery in France consists of one part of Greek pitch and two parts of burnt plaster by weight, the latter being pure gypsum raised to a high temperature and plunged in water. The mixture, when hot, is a paste, and can be applied by a brush or cast in moulds. It is amber-colored, and can be turned and polished. Its advantage is said to be endurance of great heat and moisture without injury to its insulating properties.

ELECTRIC TRACTION. — A large and appreciative audience listened to the reading of a paper by S. Dana Greene, on the "Development of Electric Street-Car Traction," at a meeting of the New York Electrical Society on Dec. 11. In Mr. Greene's opinion, the storage-battery system of electric traction is the ideal one for roads of easy grades, though it is yet far from perfect. He predicts, however, that a few years more will develop a wonderful increase in its efficiency and reliability.

AGRICULTURAL RESEARCH ON THE PACIFIC
COAST.

DURING the past summer Professor W. A. Henry, director of the Wisconsin Agricultural Experiment Station, was sent by the secretary of agriculture to the Pacific coast to report upon certain matters connected with agricultural research in that part of the country, and incidentally to look into the work of the agents of the department, and to ascertain the popular feeling regarding the character and importance of their work. The report has just been submitted to Secretary Rusk, and much of it will be of general interest, more especially as Professor Henry is a man of established reputation as an original investigator in practical agriculture.

In his report, Professor Henry states that several days were spent in visiting fruit-farms at various points in the vicinity of Los Angeles, and noting the destructive effects of the white scale and red scale, and the efforts in progress to check their ravages. At Orange, in Orange County, the destruction of citrus-trees by the red scale has been great, and only a few more years would suffice to leave that section without any such trees if remedies to check the destruction had not been put in operation the present season. The Santa Anna vine-disease has destroyed most of the grape-vines, and every orange-orchard shows in a greater or less degree the attacks from the red scale. Every stage, from thriftiness to death itself, was noted. In some orchards only the yellow-spotted character of the leaves showed the presence of the scale just beginning its fatal work; in others the ends of the branches were leafless and dead, the interior portions of the top yet carrying leaves, though little or no fruit. Still other orchards had but the stumps of the orange-trees left, all of the limbs to the size of one's arm having been killed by the scale, and removed with the saw. From these stumps green shoots showed signs of life, and, if care was given, promised to renew the value of the orchard. The careless treatment of the land showed as plainly as the trees themselves the discouragement of the people.

Usually an orange-orchard in southern California receives the best of care, and the carefully tilled soil lying loose, without a weed in sight, and as level as a floor, delights the lover of thrift and good tillage. In many orchards weeds cover the ground, and form thickets five or six feet high, so dense that a man can hardly get through them. The dead and dying orange-trees among these weeds stand like monuments marking the deadly march of the insidious, insignificant, but wonderfully fatal scale. Professor Henry visited an orchard in which Mr. Coquillett was conducting spraying experiments with resin-soap solutions, and he also visited many other groves in all stages of thrift and decay, from those bearing heavy crops to those with nothing but the stumps standing. It was very apparent that those who had fought this scale the most vigorously, even though very imperfectly heretofore, are coming out the best in the end, and that those who early gave up and neglected their orchards will suffer far the most heavily. One orchard near the California Central Railroad station, at Orange, of 850 seedling trees, showed the ends of the branches already dead; and there were scales enough on the leaves to so reduce the vitality of the trees the present season that by next spring most of the trees would have to be cut back to mere stumps. A few weeks before the visit the owner plucked up courage, and sprayed the trees with the resin-soap compound in a very thorough and systematic manner, the whole operation costing, for the 850 trees, \$200. Professor Henry spent an hour in observing the effects of the wash, and estimated that more than 95 per cent of the scale had been destroyed, while not one leaf in ten thousand had been injured in the least by the wash. Mr. Hamilton stated that resin was now being brought to Orange by the car-load for the purpose of making the resin soap. For the first time people are really taking heart, and are going at their orchards in dead earnest to make them profitable once more. The plough had been set to work to reduce the weeds and bring back the old-time thrift in many cases, though some orchards were yet as desolate as ever. Before speaking further in regard to remedies for the red scale, the destruction of the cottony-cushion scale should be noted.

In studying this insect, Professor Henry first visited the place of Mr. William Niles, in Los Angeles, where the "lady-bug" (*P-*

dalia cardinalis) was being propagated by the county insect commission for dissemination among the orange-groves infested with the cottony-cushion or white scale. He found five orange-trees standing about eighteen feet high, enclosed by walls of cheap muslin supported by a light framework of wood. The orange-trees inside this canvas covering had originally been covered with the white scale, but the *Vedalia* which had been placed on these trees were rapidly consuming the last of the pests. Entering one of these canvas houses, he found the *Vedalia*, both larva and adults, busily consuming the scale. Here and there on the canvas were the beetles endeavoring to escape to other trees. These insectaries were in charge of Mr. Kircheval, one of the county insect commissioners, who kept a record of the distribution of the beetle. It was indeed a most interesting sight to see the people come, singly and in groups, with pill-boxes, spool-cotton boxes, or some sort of receptacle in which to place the *Vedalias*. On application, they were allowed within the insectaries, and each was permitted to help himself to the beetles, which were placed in the boxes and carried away, to be placed on trees and vines infested by the white scale at their homes. Mr. Kircheval kept a record of the parties and the number of beetles carried off. The number coming for the *Vedalia* was surprisingly large, — scores in a day, — and each secured at least a few of the helpful beetles. That the supply should hold out under such a drain was a great surprise, and speaks better than words the rapidity with which the *Vedalia* multiplies when there are scale insects enough to nurture the young.

Professor Henry also visited other points, Lamanda Park, Santa Anita, Sierra Madre Villa, Pasadena, etc. At the time of his visit to Sierra Madre Villa, Aug. 23, the white scale had already disappeared before the *Vedalia*. At Santa Anita, the ranch of Mr. E. J. Baldwin, he examined a 350-acre orange-orchard, in which the white scale had started a most destructive course. Mr. Baldwin began an equally vigorous defence, going personally into the orchard and superintending the work of fighting the white scale. There was every sign, however, that the scale was going to be the victor. Some of the trees were almost ruined by the severity of the application made. Happily, before the pest had gone far in its work, the *Vedalia* was heard from, and Mr. Baldwin secured a number, which were placed in the hands of one man specially detailed to look after its welfare. This individual spent six weeks in colonizing the *Vedalia* in various parts of the orchard. After that time, a careful examination showed the superintendent that the work of colonizing was so complete that further effort in that line was unprofitable. It was predicted at the time of the visit that a few weeks more would leave the orchard entirely free from the white scale. At Chapman's he found the citrus-orchard, formerly so famous, entering the death stages from the white scale, which was now fortunately being so effectually checked. At Pasadena, on the grounds of Professor Ezra Carr, he found that some of the shrubbery had been seriously injured by the white scale, but, thanks to the *Vedalia*, not a single pest was alive at the time of his visit.

A word in relation to the grand work of the department in the introduction of this one predaceous insect. Professor Henry thinks it is without doubt the best stroke ever made by the Agricultural Department at Washington. Doubtless other efforts have been productive of greater good, but they were of such character that the people could not clearly see and appreciate the benefits, so that the department did not receive the credit it deserved. Here is the finest illustration possible of the value of the department to give people aid in time of distress; and the distress was very great indeed. Of all scale pests, the white scale seems the most difficult to cope with; and, had no remedy been found, it would probably have destroyed the citrus industry of the State, for its spreading to every grove would probably be only a matter of time.

At Sierra Madre Villa, in the orchard of W. D. Cogswell, a chalcid fly was found to be parasitic on what is there called the red scale. In company with the county insect commissioners and Mr. Coquillett, Professor Henry visited this orchard. It was quite evident that the so-called red scale of this orchard has been greatly checked, and may yet be entirely destroyed, by the chalcid. At E. J. Baldwin's the commission also found the same scale being destroyed by the same parasite. In this case each parasite destroys

but a single insect, and the commissioners were very solicitous and also sceptical as to its ability to rapidly destroy the red scale. Furthermore, they questioned whether the chalcid would destroy the true red scale, as they did not believe that the scale on the orchards mentioned was identical with that about Orange. The *Vedalia* has brought the people a simple, rapid, and effective remedy for the white scale, and the commission was very solicitous lest the people should give up the use of washes for the red scale, and wait for the spread of the chalcid parasite. If the parasite should multiply but slowly, which seems probable, the red scale would be enabled to spread and do great harm before overtaken. It is of the highest importance, at this time, that a constant fight against this scale should be made; and there should be no halting, even if imperfect means of holding the pest in check are only at hand.

Professor Henry carefully examined the experiments conducted by Mr. Coquillett with resin washes, and considers that he has used excellent judgment in the manner in which he has conducted them, and thinks he plans his spraying experiments carefully and with good judgment, and carries them through with thoroughness to the end.

It seems of the highest importance that experiments with washes be prosecuted, and that the great advance of the last year be followed up vigorously. With the resin washes for the red scale, and the *Vedalia* for the white scale, the citrus industry will again move forward, and people have the confidence in it of former days.

CAUSATION OF HOG-CHOLERA.

INVESTIGATIONS of the epizootic diseases of swine, occurring in the neighborhood of Baltimore, have been made by Professor William H. Welch, M.D., with the co-operation of A. W. Clement, V.S., and F. L. Russell, V.S., in the Pathological Laboratory of the Johns Hopkins University during the past two years. They examined about fifty hogs, from six herds, affected with hog-cholera, as well as several isolated cases. Only a summary of the most important results will be given here, a fuller report being in preparation for the volume of studies from the Pathological Laboratory, to be issued by the Johns Hopkins Hospital.

The most common and characteristic lesions, as given in the *Johns Hopkins Bulletin* for December, consisted in superficial and deep necroses, either circumscribed or diffuse, of the inflamed mucous and other coats of the large intestine, associated often with superficial branny diphtheritic exudation. Similar necroses were occasionally found in the stomach and small intestine, in the mouth, palate, and epiglottis, and less frequently in the gall-bladder, bile-ducts, and preputial sac. Some form of pneumonia was usually, although not constantly, present. In a few cases pneumonia was present without intestinal lesions; more frequently intestinal lesions were observed with little or no pneumonia. Strongyles in the bronchi were rarely missed. Bronchitis was the rule. Pleurisy was common; pericarditis and peritonitis were present in the minority of cases. Redness of the skin was common, but inconstant. The subcutaneous, mediastinal, and abdominal lymph-glands were usually swollen and reddened, chiefly in the periphery. The spleen was often normal, but in many cases was moderately and sometimes extremely swollen. The kidneys were either normal or the seat of hemorrhages and of parenchymatous degeneration or nephritis. The liver was often normal, but sometimes it presented necrotic areas. Ecchymoses were often observed in the gastric and intestinal mucosa and beneath the epi- and endocardium. In some cases all of the organs of the body were studded with small hemorrhages.

The bacteriological examination consisted in the study of cover-glass preparations from the different parts of the body; in the inoculation of animals, either white mice or rabbits, with parts of the lung, spleen, liver, intestine, and sometimes other organs; and in the preparation of Esmarch roll cultures, usually of agar, from the blood, intestinal contents, and all of the principal organs of the body.

Of the bacteria isolated in pure culture and observed in microscopical preparations of the tissues, only two species were sufficiently common or had such distribution as to suggest an etiological

relation to the disease. These are the so-called hog-cholera bacillus and the swine-plague bacillus; the former first described in the "Report of the Bureau of Animal Industry for 1885" as the bacterium of swine-plague, and in the report for 1886 as the bacterium of hog-cholera, — a change of nomenclature due to the detection in certain diseased swine in this country of the latter organism, which now received the name of the "bacterium of swine-plague," as it was believed to be identical with the micro-organism previously described by Löffler and by Schütz as the specific cause of Schweine-Seuche in Germany.

The bacilli of hog-cholera are short rods with rounded ends, averaging $1\mu - 2\mu$ in length and about 0.6μ in breadth, but forms both longer and shorter than these measurements may occur. They are very actively motile. They grow readily on all of the ordinary culture media, and best at temperatures between 30° and 38°C . They do not liquefy gelatine. The growth on gelatine and on agar has a grayish or whitish color, often with a bluish translucence. Bouillon cultures present a diffuse cloudiness with whitish sediment and without surface membrane. The growth on potato assumes generally a brownish or yellowish tint, but it may be white, and sometimes is indistinct, although microscopically the growth is abundant. The bacilli are killed by exposure for ten minutes to a temperature of 58°C . In cover-glass preparations from the fresh juices and tissues of animals dead of hog-cholera, the bacilli stain readily, and for the most part uniformly, with aniline-oil gentian-violet. If the stained specimen be treated with acetic acid, many of the bacilli appear with clear centre and stained margin, which may be either uniform or slightly thicker at the poles, as described in the reports of the Bureau of Animal Industry. Some may present a typical polar staining, but they are not regarded as good polar staining bacilli, like those of swine-plague. Various irregularities in staining appear in old cultures.

The hog-cholera bacilli are pathogenic for rabbits, mice, guinea-pigs, and pigeons. Only the experiments with rabbits will be described here. These animals, when inoculated subcutaneously with a platinum loop from a pure culture of hog-cholera bacilli, die usually in from six to eight days, but the duration of life may be shorter or longer. There is generally considerable dry purulent infiltration at the seat of inoculation; the subcutaneous lymphatic glands on the same side are enlarged, and often present necrotic foci; the spleen is swollen, as a rule extremely, and of a dark red color and firm consistence; the liver generally presents yellowish-white streaks and dots; the heart-muscle is fatty; and in some cases ecchymoses, necrotic patches, and diphtheritic exudation may be found in the intestinal mucosa. The bacilli, which often occur in clumps, are found most abundantly at the seat of inoculation, in the affected lymph-glands, the spleen, and the liver, and are often so scanty in the blood as to escape detection by microscopical examination. The statements in the reports of the Bureau of Animal Industry of the effects of these bacilli when inoculated in pigeons have been confirmed by Professor Welch.

The swine-plague bacilli are shorter than the hog-cholera bacilli. Measuring on the average 0.8 to 1.4μ in length, they may be very small, and present the appearance of slightly oval bodies, more like cocci than bacilli; or, on the other hand, they may present themselves as rods of considerable length. In appearance and other properties, they belong to the same group of organisms as the well-known bacteria of chicken-cholera and of rabbit septicæmia. They are devoid of independent motion. They grow on the ordinary culture media, with the exception of potato, but at ordinary temperatures the growth is less rapid and abundant than that of the hog-cholera bacilli. They do not liquefy gelatine. On gelatine and agar the growth is grayish, translucent, not extending far from the point of inoculation. Bouillon cultures are sometimes diffusely cloudy; but more frequently the growth is in the form of a whitish, rather viscid sediment, or in little specks, with clear fluid. When planted on potato, there may be a feeble invisible growth for one or two generations, probably due to the transference of a little nutritive medium to the potato with the organisms. We have not been able to cultivate them for several generations upon potato. They are killed at a temperature slightly lower than that destructive to hog-cholera bacilli, and their vitality in cultures is much shorter than that of hog-cholera bacilli. In cover-glass prepara-

tions from the fresh juices and tissues of animals dead of swine-plague inoculations, the bacilli present an exquisite and typical polar staining, unless the forms are very short, when the staining is uniform. They are pathogenic for rabbits, mice, guinea-pigs, pigeons, and bats. Two degrees of virulence in this organism have been met. The one kind kills rabbits in from sixteen to thirty hours, with enormous multiplication of the bacilli in the blood and organs: the other kind destroys life in from two to six days, occasionally longer, with extensive purulent and serous infiltration at the seat of inoculation, often with peritonitis, and with frequently few bacteria in the blood and organs, but an immense number in the inflammatory exudates.

Regarding the distribution in the diseased hog of these two species of bacteria, great variety exists, which cannot be fully described in this short communication. In some cases the hog-cholera bacilli have been found abundantly in the blood, intestine, and all of the organs; in other cases they have been present only in certain parts, most frequently the spleen and liver, and absent in other parts. They may be absent from the spleen when abundant elsewhere, as in the kidney.

The swine-plague bacilli, when present, likewise vary in different cases in their distribution. They are most frequently found in hepatized areas in the lungs, but they may also exist in the intestine, the blood, and various organs.

As regards the frequency with which each of these organisms has been found in the diseased hogs, the following groups of cases have been met: first, herds of diseased swine, in which only the hog-cholera bacillus has been found; second, herds in which only the swine-plague bacillus was present; third, herds in which both the hog-cholera bacillus and the swine-plague bacillus were present in the same animal, or the hog-cholera bacillus in some animals and the swine-plague bacillus in others of the same herd. A few, chiefly scattered cases, in which neither the hog-cholera nor the swine-plague bacillus was found, were met.

Professor Welch and his co-workers have not been able to establish any constant anatomical differences between the cases in which the swine-plague bacilli alone were present and those in which only hog-cholera bacilli or both organisms were found. While they have frequently found only the swine-plague bacilli in extensive hepatized areas in the lungs, they have also sometimes found the hog-cholera bacilli alone in apparently similar pneumonias. They have not met any epizootic corresponding to the German Schweine-Seuche in which pneumonia existed in any large number of cases without intestinal lesions.

With these results, they naturally looked with especial interest to the effects of inoculation of healthy hogs with pure cultures of each of these organisms. The most stringent precautions were taken in the selection and care of the experimental hogs.

Two hogs, weighing about 75 pounds, not subjected to any preliminary treatment, were fed each 225 cubic centimetres of bouillon culture of hog-cholera bacilli. The one died in four and the other in eight and a half days with extensive diphtheritic inflammation and superficial circumscribed necroses of the large intestine, with moderate swelling of the spleen and of the lymphatic glands, and with ecchymoses in the lungs and elsewhere. Strangely were present in the bronchi, but there was no pneumonia. Hog-cholera bacilli were found in abundance in the blood, intestine, and organs. In a third hog 6.5 cubic centimetres of the same bouillon culture were injected with antiseptic precautions into the duodenum. Death occurred in seven days with the same lesions as in the preceding hogs. Two hogs exposed in the same pen with the first hog were sick for a number of days, and gradually recovered. These, when killed, presented undoubted evidence of the previous existence of acute diphtheritic inflammation of the large intestine.

The injection into the thigh and into the lung of 5 cubic centimetres of the same bouillon culture in two other hogs produced only localized sloughs with slight constitutional disturbance. The hogs were killed at the end of five weeks, and hog-cholera bacilli were found alive in the sloughs, but none elsewhere in the body.

The injection into the right lung of a pig of 8 cubic centimetres of a pure bouillon culture of swine-plague bacilli was followed in from forty-eight to sixty hours by death with extensive pneumonia,

double fibrinous pleurisy, pericarditis, and peritonitis, and with very abundant swine-plague bacilli in the exudates, the blood, and the organs. Intestinal lesions were absent. The injection of 0.5 of a cubic centimetre of bouillon culture of swine-plague bacilli into each lung of another pig was followed by great rapidity and difficulty of respiration, and coughing. The animal was killed at the end of a week. Double sero-fibrinous pleurisy and pericarditis and foci of pneumonia were found. The swine-plague bacilli were present in abundance. The injection of pure cultures of swine-plague bacilli with a fine hypodermic needle into the peritoneal cavity was not followed by any manifest effects; but in two cases in which laparotomy was performed with antiseptic precautions, and pure cultures of swine-plague bacilli (6.5 cubic centimetres) were injected into the duodenum, the animals died in from sixteen to thirty hours with acute diffuse peritonitis, pleurisy, and pericarditis, and an enormous number of swine-plague bacteria in the exudates, blood, and organs, but without intestinal lesions. Doubtless some of the culture escaped into the peritoneal cavity. Subcutaneous inoculations in two cases, and feeding in four cases, of swine-plague cultures, produced no lesions, save localized abscesses and sloughs after the injections.

It is evident from these experiments that both the hog-cholera bacilli and the swine-plague bacilli are pathogenic for swine; that the former, when fed or injected into the duodenum, even in comparatively small quantity, are capable of producing intense diphtheritic inflammation and necrosis of the large intestine with general infection, and the latter, when injected into the thoracic cavity or into the injured peritoneal cavity, of causing pneumonia and inflammation of serous membranes.

If, as seems probable from these observations and experiments, the hog-cholera bacilli are to be regarded as the cause of hog-cholera, at least of the intestinal lesions, how is the failure to find these bacilli in a number of cases of the disease to be explained? A number of possibilities suggest themselves. First, the bacilli may be confined to the intestine, and mixed with so many other bacteria that it is difficult or impossible to isolate them. Their morphology and the appearance of their colonies are so little characteristic, that this might readily happen. That this, however, cannot always be the explanation, is evident from the fact that in several instances rabbits inoculated with typical necrotic buttons have survived, and cultures and inoculations from other organs have failed to reveal the bacilli of hog-cholera. Second, the bacilli may be confined to the intestine, and so modified that they fail to kill rabbits when inoculated subcutaneously. These bacilli appear to vary somewhat in their virulence, and the possibility suggested cannot at present be disproven. Third, as in cases of typhoid-fever and croupous pneumonia in human beings, the specific bacilli may disappear in the later stages of the disease. This explanation, which is suggested in the reports of the Bureau of Animal Industry, seems probable, but, as already mentioned, the investigators have not been able to distinguish anatomically cases in which hog-cholera bacilli could not be detected from some of those in which they were present.

It is not clear to them what rôle is to be assigned to the swine-plague bacilli in the natural infections which they have studied. The facts that experimentally the swine-plague bacillus is capable of causing extensive pneumonia and inflammations of serous membranes, and that epizootics occur in swine in Germany with these as the predominant lesions without intestinal disease, suggest that this organism, which is apparently identical with that of the German Schweine-Seuche, is also the cause of a similar affection in this country. They are not, however, aware that any swine epizootic of pneumonia without any intestinal lesions, and with the sole presence of the swine-plague bacillus, has been observed in this country, although cases of this description occur scattered in epizootics of hog-cholera with intestinal lesions. Until such an epizootic is observed in this country, it is not likely that the question will be thoroughly elucidated as to the rôle of the swine-plague bacilli. It is possible that the swine-plague bacilli are frequently present in the mouth, the air-passages, or the intestine of healthy hogs, analogous to the frequent presence of the micrococcus of sputum-septicæmia and of pneumonia in the mouth of human beings, and that in the mixed infections which have been observed

the widespread diffusion of the swine-plague bacilli is due to secondary invasion following infection with the hog-cholera bacilli. This, however, does not remove the grave significance of the swine-plague bacilli, which certainly cannot be ignored in the studies in this country of the diseases known as hog-cholera or swine-plague.

While differing in some points from the conclusions reached by the workers on this subject in the Bureau of Animal Industry, great pleasure is taken in recording the essential harmony of the observations here made with the facts which they have observed in their painstaking and creditable investigations of this difficult subject as reported since the year 1885.

Through the kindness of Dr. F. S. Billings, Professor Welch has had the opportunity of examining a number of cultures from diseased swine in Nebraska, chiefly direct cultures from the spleen. These in nearly all instances were pure cultures of the hog-cholera bacillus. Much confusion has resulted from Dr. Billings's attempt to identify this organism with that of Schweine-Seuche.

The former has had the opportunity of examining cultures of Schweine-Seuche and also of the Scandinavian swine-pest, obtained from the Hygienic Institute in Berlin. The organism in Schweine-Seuche cultures is apparently identical with the swine-plague bacillus which he has isolated. The organism in the swine-pest cultures is a different species of bacillus, and appears to resemble closely, if it is not identical with, the hog-cholera bacillus.

It is regarded of importance that the future study of swine affected with hog-cholera or swine-plague should be accompanied with a more thorough bacteriological examination of each case than has hitherto been customary. The mere production of a direct stab-culture from one organ, such as the spleen, or the mere inoculation of an animal with material from one organ, affords very incomplete and unsatisfactory information. So long as the relations of the two organisms—the hog-cholera bacillus and the swine-plague bacillus—to the diseases of swine are not thoroughly clear, it seems necessary to make Esmarch or plate cultures from the blood, the intestine, and the principal organs of the body, and also to inoculate animals with material from the lungs, spleen, intestine, etc. A single case thoroughly investigated according to modern bacteriological methods is of more value than many cases in which only stab-cultures have been made from one or two organs, or in which reliance is placed solely on the results of inoculating animals. Little reliance can be placed upon the results of experimental inoculations of swine with the suspected organisms of hog-cholera and of swine-plague in regions where the disease prevails, unless very strict precautions are taken in the selection and care of the experimental animals.

RUMINATION IN THE HUMAN SUBJECT.

In the *London Medical Recorder* for Nov. 20, 1889, Dr. Ireland summarizes the contents of a paper on this curious phenomenon by Dr. Sievers in the *Finska Läkaresällskapets Handlingar*, No. 5, 1889.

This author first gives a *résumé* of the different opinions upon rumination since 1618 (when Fabricius ab Aquapendente published the first case of this affection) until the present time. He recalls that since the appearance of the classical work by Adrien Dumur on the "Paralysis of the Cardiac Orifice or Merycism," the most recent authors see in this affection a nervous moving of the stomach accompanied by more or less diminution of the tone of the cardiac orifice. He thinks, however, that the true nature of rumination has not yet been thoroughly studied. Like Johannessen, to whom we owe the most detailed examination of this subject, Dr. Sievers says, that, before drawing any conclusion, the details should be more minutely studied. But while the researches already made do not explain satisfactorily the nature of rumination, they furnish us with very important facts for the therapeutic treatment.

Dr. Sievers publishes three cases of rumination which he observed in private practice at Helsingfors. Besides these, so far as he knows, there are only three other cases of rumination mentioned in Scandinavia, and reported by Johannessen in *Zeitsch. für klin. Medicin*, Bänder X. and XII. In the first case described, the patient, aged twenty-seven, who had been a governess and sick-nurse, belonged to a very nervous family, though none of them suffered

from insanity or any other grave disorder. She had previously enjoyed good health. She always ate very quickly, and did not properly masticate her food. It is now ten years since she commenced to ruminate her food, after a sea-voyage lasting from three to four days, during which time she had not defecated, owing to want of convenience. Five, ten, or thirty minutes after eating, the food is collected in little balls in the mouth in order to be subjected to a second mastication. The patient seems quite at ease during rumination. After an ordinary dinner the rumination lasts from an hour and a half to two hours. If she moves about, or even if she is disturbed, rumination begins sooner, and is more active. Trying to restrain the process brings on such distress that the patient is compelled immediately to give in. During rumination she prefers to be seated. She leans forward, and at every mouthful which returns she lowers her head.

On scrutinizing the abdomen during the act of ruminating, one notices a dimple-like depression under the ribs. This is accompanied by an uneasy sensation passing from right to left. This does not extend farther than about the cardiac orifice. The patient feels a slight shock, and the food returns to the mouth. The stomach was found to be moderately distended with air. There was no retardation of digestion, and no excessive secretion of gastric juice; but there was found to be unusual acidity of the contents of the stomach, owing to the increased production of hydrochloric acid. No lactic acid could be detected. For this patient Dr. Sievers prescribed a teaspoonful of Carlsbad salts before dinner and supper, and a teaspoonful of bicarbonate of soda after each meal. The diet was to consist of milk, eggs, meat, and a very little bread. Under this treatment there was a gradual improvement; and at the end of five weeks the rumination had entirely ceased, nor did it return after she had discontinued using the alkalis.

The second case was a priest sixty years old. He had always ruminated. His father, now eighty-eight, did the same. The process commenced after a meal, and lasted from two to three hours. He never tried to stop it, and does not think he could, as it goes on independently of his will. He did not desire medical treatment with a view to remove it.

The third case was a Jewess, thirty-five years old, of a highly neurotic family. Her father also ruminated; and one brother out of the family of nine occasionally did the same. She herself has ruminated from childhood. The food returns of itself. The act causes her no uneasiness, which would not be the case if she tried to resist it. She did not desire medical treatment. The contents of the stomach were found to be very acid.

In *La Psychiatrie* (Fasc. III.-IV.) there is a paper on "Rumination," by Dr. Cantarano. He had opportunities of studying this affection in four idiots, two imbeciles, and three patients deeply demented. No uneasiness seems in these cases to have followed the process. Dr. Sievers, among other contributions to this curious subject, refers to the papers of Alt (*Berl. klin. Wochenschr.*, 1888, Nos. 26 and 27) and of Boas (No. 31 same journal); and in the *Archives de Neurologie* (VII. 1884) the reader will find an interesting paper on "Merycism," by Drs. Bourneville and Séglas.

HIGHWAY IMPROVEMENT.

In an address on highway improvement delivered before the Carriage Builders' National Association at Syracuse, N.Y., recently, Col. Albert A. Pope of Boston said that the best roads in the world to-day are those of England, France, and Germany, their excellence being due to the fact that those countries were the first to awaken from the long sleep of the dark ages, and that the growing rivalry between them necessitated attention to their roads, for the proper prosecution of both their military and their mercantile interests. In each country the roads early came under the national supervision, the results of which are seen in the most splendid highways in existence, costing the least to maintain, and in every way the most satisfactory and economical for those who use them.

No country has a greater road mileage in proportion to the population than the United States, according to Col. Pope; but while, with characteristic American push and hurry, the more extensive means of communication and intercourse have been provided, we

have suffered the consequence of a lack of any general system of public policy covering the location, construction, and maintenance of roads. American roads are far below the average: they certainly are among the worst in the civilized world, and always have been, — largely as a result of permitting local circumstances to determine the location, with little or no regard for any general system, and haste and waste and ignorance in building.

Among the benefits attendant upon the proper construction and maintenance of roadways, the speaker mentioned the following. Good roads attract population, as well as good schools and churches, and they improve the value of property; so that it is said a farm lying five miles from market, connected by a bad road, is of less value than an equally good farm lying ten miles away from market, connected by a good road. A larger load can be drawn by one horse over a good road than by two over a bad one. Good roads, consequently, encourage the greater exchange of products and commodities between one section and another, besides being of great value to railroads as feeders.

As one solution of the road problem, Col. Pope outlined the following plan. A commissioner of highways might be provided for, in the Agricultural Department, with a corps of consulting engineers, and suitable appropriations made for the prosecution of a general supervising work. Under the charge of this commission, full systems of maps should be prepared; based largely, perhaps, upon the working of the state and county boards, showing more or less completely, as circumstances would permit, the highways of the country.

For co-operation with this central bureau, and the prosecution of the work in the most thorough and practical way, each State should have its highway commissioner, charged with the highest interests of the State in the way of maintaining its system of roads under the most approved methods and for the general public welfare. Then the best practical results could probably be attained by the division of the State into highway districts, consisting of counties, or perhaps townships, each of which should have its overseer, in full charge of the opening and construction of new roads in his district and the proper maintenance of all, responsible for the expenditure of the regular appropriations for these purposes. These districts could then be divided into smaller ones under sub-overseers.

The importance and the value to any country, any section, and every citizen from the highest to the lowest, whether tax-payers or tramps, of well-constructed and properly maintained roads, are not easily estimated, but clearly are greater than of many affairs which are continually receiving the time and attention of the people in their homes, counting-rooms, public meetings, and legislative halls. It is a matter to be considered side by side with our splendid and always improving system of public education, the assessment of our tariff duties, or the appropriations regularly made for river and harbor improvements.

R. A. PROCTOR MEMORIAL FUND.

THE English magazine *Knowledge* calls attention to the announcement in many of the London papers stating that the monetary affairs of the late Mr. Proctor have now been wound up by his administrator, and that the total sum available as provision for his widow and the seven children (four of whom are daughters, and one a little boy, a permanent invalid from hip-disease) is under £2,000. To the small income which this will produce there is to be added £100 per annum from the Civil List; which is, however, granted only during Mrs. Proctor's life.

The £2,000 above referred to as the value of the residue after the settlement of all debts, some of which were waived, has been produced by the sale of Mr. Proctor's copyrights. Mrs. Proctor and the eldest daughter have, under a satisfactory arrangement with Messrs. Longmans, retained a small interest in the works now in Messrs. Longmans' hands, including the "Old and New Astronomy," which will shortly be completed. But the value of the interest retained (calculated on the basis of the sum given for the remainder of these copyrights by Messrs. Longmans) is included in the £2,000, as is also the money received for all the other copyrights, which were purchased on liberal terms either by Messrs. Chatto & Windus or by Messrs. W. H. Allen & Co.

The money given immediately after the death of the late Mr. Proctor by the Royal Literary Fund, and the proceeds of five lectures given by Mr. W. Lant Carpenter, as well as gifts from other friends, have enabled the family, who, owing to the suddenness of Mr. Proctor's death, were absolutely without resources, to weather through the first year. But these funds have now been exhausted, and a committee is in course of formation which the many friends of Mr. Proctor are invited to join. Subscriptions to the R. A. Proctor Memorial Fund, and communications, will be received by Mr. E. G. Mullins, manager of the City Bank, Bond Street Branch, London, England.

Since the date of the announcement in the daily papers, the following subscriptions have been received: William James Adams, Esq., 10s. 6d.; "E. A.," £2; Mrs. Barrett, £2; "J. A. B.," £1; Andrew Chatto, Esq., £5; H. P. Curtiss, Esq., £5; W. Henry Domville, Esq., £10; "W. D.," £2 2s.; "A Friend," £1; Professor Grant, £2 2s.; Lord Grimthorpe, £20; D. Hodgson, Esq., £1; Edmund Johnson, Esq., £1 1s.; Messrs. Longmans, Green, & Co., £20; J. Mott Maidlow, Esq., £3 3s.; Miss Martin, £2; G. H. Mellor, Esq., 10s.; R. Hay Murray, Esq., £5; "Planetoids," 10s. 6d.; T. Shaw Petty, Esq., £10 10s.; Oscar Rohde, Esq., £3 3s.; T. C. Sanders, Esq., £5; William Schooling, Esq., £2 2s.; F. Stevens, Esq., £1 1s.; Col. N. G. Sturt, £5; Mrs. Stowe, 5s.; Walter Webyln, Esq., £1 1s.; Philip Williams, Esq., £1; total, £113 1s. Others have promised.

A NEW METHOD OF PREPARING FLUORINE.

A NEW method of preparing fluorine has been discovered by M. Moissan. This discovery is the outcome of the success which has attended M. Moissan's efforts to prepare anhydrous fluoride of platinum. During the process of his memorable work upon the isolation of fluorine by the electrolysis of hydrofluoric acid containing hydrogen potassium fluoride, one of the most remarkable phenomena noticed was the rapidity with which the platinum rod forming the positive electrode was corroded by the action of the liberated gaseous fluorine. It was surmised that a fluoride of platinum was the product of this action, but hitherto all efforts to isolate such a body have proved unsuccessful. In fact, for a reason which will be discussed subsequently, it is impossible to prepare platinum fluoride in the wet way. M. Moissan has, however, as stated in *Nature*, been enabled to prepare anhydrous platinum fluoride by the action of pure dry fluorine itself upon the metal. It was found at the outset, that, when fluorine is free from admixed vapor of hydrofluoric acid, it exerts no action whatever upon platinum, even when the latter is in a finely divided state, and heated to 100° C. But when the temperature of the metal is raised to between 500° and 600° C., combination readily occurs, with formation of tetrafluoride of platinum and a small quantity of protofluoride. The moment the gas is mixed with a little vapor of hydrofluoric acid, the action is immensely accelerated, and then occurs readily at ordinary temperatures. The same rapid action occurs when platinum is placed in hydrofluoric acid saturated with free fluorine, which accounts for the disappearance of the positive terminal during the electrolysis.

In order to prepare the fluoride of platinum, a bundle of wires of the metal is introduced into a thick platinum or fluor-spar tube, through which a current of fluorine gas from the electrolysis apparatus is passed. On heating the tube to low redness, the wires become rapidly converted to fluoride, when they are quickly transferred to a dry stoppered bottle. If the operation is performed in a platinum tube, a large quantity of fused fluoride remains in the tube. The tetrafluoride of platinum (PtF₄) formed upon the wires consists either of fused masses of a deep red color, or of small buff-colored crystals resembling anhydrous platinum chloride. It is exceedingly hygroscopic. With water it behaves in a most curious manner. With a small quantity of water it produces a fawn-colored solution, which almost immediately becomes warm, and decomposes with precipitation of hydrated platinum oxide and free hydrofluoric acid. If the quantity of water is greater and the temperature low, the fawn-colored solution may be preserved for a few minutes, at the expiration of which, or immediately on boiling the solution, the fluoride decomposes in the manner above indi-

cated. This peculiar behavior with water explains the impossibility of preparing the fluoride in the wet way.

When the anhydrous fluoride is heated to bright redness in a platinum tube closed at one end, fluorine at once begins to be evolved as gas; and, if a crystal of silicon be held at the mouth of the tube, it takes fire, and burns brilliantly in the gas. The residual platinum is found, on examining the contents of the tube, to consist of distinct crystals of the metal. Hence by far the most convenient method of preparing fluorine for lecture purposes is to form a considerable quantity of the fluoride, first, by passing the product of the electrolysis over bundles of platinum wire heated to low redness, and afterwards to heat the fluoride thus obtained to full redness in a platinum tube closed at one end. It only remains now to discover another method of preparing fluoride of platinum in the dry way, to be able to dispense with the expensive electrolysis apparatus altogether. M. Moissan has also prepared a fluoride of gold in the same manner. It is likewise very hygroscopic, decomposable by water, and yields gaseous fluorine on heating to redness.

MENTAL SCIENCE.

Diseases of the Memory.

CASES of amnesia, or the loss of a small or large portion of the contents of the mental storehouse, have been observed from very ancient times, and have always attracted attention. The decline of mental powers brought on by old age is frequently introduced by a failure of memory. When, however, this sets in at an earlier period, and develops rapidly and to an extreme degree, we recognize an abnormal and striking phenomenon. The possibility of such loss, particularly when following a purely physical cause, such as a blow, a fall, or other accident, could not but suggest the physiological counterpart of the memory process as something very material. To-day we attempt to analyze such cases more minutely, recognizing in the diseases of memory a natural experiment that throws light upon the laws of mental growth and decay, the interrelation of the various avenues of knowledge, as well as the *nexus* of mental function with anatomical characteristics. In all these aspects a recent study of diseases of memory by Dr. Korsakoff of Moscow (*Revue Philosophique*, November, 1889) is interesting.

The first case described is that of a Russian writer afflicted with multiple neuritis, — a nervous disease affecting many groups of fibres, as a consequence of alcoholic excess. When the patient was first seen, the trouble was very marked. He had completely forgotten all recent events: he did not even remember whether he had dined or not. The conversation just held was at once forgotten; and, when outsiders insisted that such and such things happened that the patient had forgotten, he lightly remarked that he always had a poor memory. Very striking is the fact that every thing previous to the onset of the disease he remembers clearly. Of a novel that he was writing at the time, and had half finished, he remembers the first half, but does not remember how he intended to finish it. Though the domain of his thoughts is limited, his reasonings are logical, and his judgment sound. But a slight interruption in the conversation will make him forget what it was about; and he will say the same things over and over again, using the same stereotyped forms of expression, and forgetting that he has said it. Moreover, under the influence of certain external stimuli, certain positions and suggestions, he will always make the same remarks, in which he draws upon the old storehouse without adding to it. There are indications, too, that to a slight degree the unconscious registration of impressions is going on. Thus, though he forgets Dr. Korsakoff between each visit, he always makes the remark (regarding it as original each time) that the latter is a physician. Emotions and feelings make more of an impression than facts and associations. A *post-mortem* examination in this case showed degeneration of both fibres and cells, which had also been inferred from paralysis and other symptoms observed in the patient.

Impairment of memory is characteristic of this disease; the memory for recent events being lost, while that for events antedating the attack remains, and the patient retains judgment and reasoning power. The same patient who forgets that he has dined five

minutes after leaving the table can play cards or checkers with fair skill, anticipating the consequences of his or his adversary's plays, and following out a plan of attack or defence. If the game is slightly disturbed, he cannot go on. The moment he is through playing, he knows nothing of it, and will declare he has not played for a long time. The contrast between the past and the present is sharply brought out in one patient who tells of his travels at great length, but repeats the tale a dozen times an hour, and always with the same phrases. Sometimes the patient does not even recall that he is ill, explaining a paralysis as a momentary cramp in the legs, and expressing his intention of rising as soon as that has passed. The same patient will cry out under his pain, but a moment later will have forgotten the sound and the pain. To show how slight an interval is needed for the impression to disappear, it may be mentioned that this patient, in reading, will read the same line twice, having forgotten the one line before setting out upon the next. Those who are constantly with such patients soon get to know what they will say upon the usual occasions. Their life is monotonous, — a response to the suggestions from the outside, and not originating from internal impulses. They are frequently conscious of their infirmity, and anxious lest they commit some indiscretion.

Dr. Korsakoff thinks, that while the patient does not consciously remember what is going on, yet the surrounding events leave some trace by which future conduct is influenced. Thus a patient who was undergoing an electric treatment, and forgot all about it each time, not being able to tell what the doctor was about to do, if asked to look about him, recognized the apparatus and its purpose, which he did not know before his illness. Another patient, who said "Good-morning!" when the doctor made his first visit of the day, did not remember the visit three minutes later, but did not then say "Good-morning!" The most convincing proof of this, however, appears when recovery sets in, and the patient begins to tell some little of what happened during his illness. In one case a sphygmograph was described, — an instrument the patient had seen only during his amnesic period. Emotional states seem the ones most susceptible of this unconscious perception. While the patient forgets his visitors from one time to another, yet he meets them with sympathy or antipathy, according to previous experiences; or, again, a patient who was treated with electricity remembered nothing of it, but was always put into a bad humor when he saw the machine.

In the process of recovery, usually quite gradual, several interesting phenomena appear. Frequently the patient begins to remember events, but in isolation. He cannot tell what happened just before or just after. He cannot tell *when* things happened; as a rule, regarding all things as more recent than they really are. When he begins to remember new faces and places, he still continues to repeat the same sayings again and again. He will be able to say that he has read a certain thing, but does not remember what it contained. Though not able to recall the events of his illness at will, an incident or a suggestion may bring it up. Little by little his past is filled out, though in a somewhat chaotic manner; dreams and the products of his imagination intermingling with real events without definite relation in time. He frequently continues to believe what has no basis in fact. His recovery is often a matter of two or three years. In another case, after five years the memory of the patient continued weak. He was able to resume his occupation of correcting sheets for the press, but had to keep his finger on the lines so as not to go over the same line twice. He even began to practise law, though he was compelled to avail himself of all sorts of memoranda, and was frequently perplexed by forgetting what he had said; yet he was able to conduct himself consistently. The memory for places, streets, and houses, localities in general, is restored long before that for time.

Dr. Korsakoff next attempts to analyze just what factor in memory is affected, concluding that it is simply the power to recall impressions; the facts above cited showing that the impression is made, though very faintly. Moreover, as recollection is based upon association, those ideas being most at command that have the widest and deepest associative connections, the defect is referred to that portion of the nervous system instrumental in connecting nerve-centres with one another. Into a more detailed and neces-

sarily hypothetical explanation of the relation between memory and nerve-cell, we need not enter. The main result connects the easiness of forgetting recent impressions with instability of nerve-cell, and isolation from the cell groups; while the older, more deeply impressed and integrated experiences remain.

A corroboration of this result is found in the fact that in the recovery there is a stage in which the patient remembers that a thing happened, but not where or how; not even, perhaps, whether it was dreamed, or really experienced. The associations that localize the event are not made, although the impression made by the event is there. Only in the final stages of recovery are the associations and the facts remembered.

NOTES AND NEWS.

A STALACTITE cave has been discovered in Ascheloh, near Halle, in Westphalia. It is reported to be more than 100 metres long.

— A series of questions on the effect of London fogs on cultivated plants has been issued by the scientific committee of the Royal Horticultural Society. The experience of the current season only is to be utilized.

— A hippopotamus was born in the Central Park menagerie, this city, on the night of Dec. 1; and this is said to be the first instance of an event of this kind in this country. Unfortunately it died on the 6th of pneumonia, as we learn from the *Boston Medical and Surgical Journal*.

— The Gilbert Club, to which we referred last week, was formally founded on Thursday, Nov. 28. The following officers were appointed at the first general meeting: president, Sir William Thomson; vice-presidents: Lord Rayleigh, Professor D. E. Hughes, Professor Reinold, Mr. Jonathan Hutchinson (president of the Royal College of Surgeons), Dr. B. W. Richardson, and Mr. H. Laver of Colchester. Mr. Latimer Clark was elected treasurer; and Mr. Conrad Cooke, Professor R. Meldola, and Professor S. P. Thompson, honorary secretaries. The resolution finally adopted by the meeting was, according to *Nature*, "That the objects of the Gilbert Club be as follows: (1) to produce and issue an English translation of 'De Magnete' in the manner of the folio edition of 1600; (2) to arrange hereafter for the tercentenary celebration of the publication of 'De Magnete' in the year 1900; (3) to promote inquiries into the personal history, life, works, and writings of Dr. Gilbert; (4) to have power, after the completion of the English edition of 'De Magnete,' to undertake the reproduction of other early works on electricity and magnetism, provided at such date a majority of the members of the club so desire." At the time of the inaugural meeting eighty-seven members had joined the club.

— The chief signal officer has adopted a signal known as the "information signal," and forming one of the system of "storm, cautionary, and wind-direction signals." The "information signal" consists of a yellow pennant, of the same dimensions as the red and the white pennants (wind-direction signals), and, when displayed, indicates that the local observer has received information from the central office of a storm covering a limited area, dangerous only for vessels about to sail to certain ports. The signal will serve as a notification to ship-masters that the necessary information will be given them upon application to the local observer. The use of this signal began Dec. 1. It is believed that the display of the "information signal" will in many instances obviate the necessity for the display of the "cautionary signal" (yellow flag with white centre). The signal at night for indicating westerly winds is now a white light above a red light.

— Lieut.-Commander Charles H. Stockton, U.S.N., commanding the United States steamship "Thetis," reports to the United States Hydrographic Office that during the past summer, while on the north and north-west coasts of Alaska, the "Thetis" set adrift numerous drift floats. These floats are made of wood, about 2 feet long and 9½ inches thick, with the name of the ship, date, and the words "for drift," cut upon the face. In a cavity at one end of the float, plugged with soft wood, there is a copper cylinder containing a letter requesting the finder to inform the Hydrographic

Office, Washington, D.C., the nearest United States consul, or the commanding officer of the "Thetis," the time and place where the float was found. These floats are intended to show the direction and strength of the currents off the coast of Alaska, and any information obtained from them will be of value to navigation. Masters of vessels in Alaskan waters, or residents on the coast of Alaska, finding any of these floats, are especially requested to comply with the request contained in each copper cylinder.

— A course of public lectures was begun before the New York Academy of Sciences, Madison Avenue and 49th Street, on Monday evening, Dec. 2, at eight o'clock, to continue until May 19, 1890. The following is a list of the lecturers, together with the subjects and dates of the lectures: Dec. 2, "The Raiyan-Mœris; the Irrigation of Ancient and Modern Egypt" (illustrated by the lantern), by Mr. F. Cope Whitehouse of New York; Dec. 16, "Strategic Features of the Gulf of Mexico and the Caribbean Sea" (illustrated by maps), by Capt. A. T. Mahan, U.S.A.; Jan. 20, 1890, "The Ice Age in North America, and the Antiquity of Man" (illustrated by the lantern), by Professor G. Frederick Wright, Oberlin College, Ohio; Feb. 17, "Four Weeks in the Desert of Mount Sinai" (illustrated by the lantern), by Dr. H. Carrington Bolton of New York; March 17, "Nebulae and the Nebular Hypothesis" (illustrated by the lantern), by Professor Charles A. Young, Princeton, N.J.; March 31, "Volts and Ampères, and What they mean" (to be held in the chemical lecture-room, School of Mines; illustrated by electrical apparatus and experiments), by Professor Charles F. Chandler, Columbia College; April 14, "Methods of Research in Bacteriology" (illustrated by photo-micrographs of bacteria), by Major George M. Sternberg, M.D.; April 28, "Glimpses of the Arctic Regions" (illustrated by the lantern), by Mr. William Bradford of New York; May 19, "Grand Cañon of the Colorado" (illustrated by the lantern), by Professor Rossiter W. Raymond of Brooklyn.

— The question of a system of improved public roads, to which we refer elsewhere, is one so closely related to every material interest of the State as to place it properly among the most important questions of public economy. The science of road making and maintaining, though neither difficult nor abstruse, is nevertheless based on principles so well established, and so unvarying in their operation, as to render their thorough comprehension essential to success in securing and maintaining public roads at once efficient and economical, whatever the administrative system by which they are constructed and controlled. In other countries the superintendence of public highways is recognized as an important and responsible duty, and is usually assigned to specially trained, expert government engineers; while in the United States, where the greater mileage makes the economy, if not the efficiency, of roads even more important than abroad, the States depend for this responsible service on private citizens, locally and temporarily appointed to the duty, without providing for them the technical instruction and training so essential to success under any system. To offer such as desire it an opportunity to make good, in part, this defect, the Engineering Department of Vanderbilt University, Nashville, Tenn., continues its offer of former years to admit free of charge, to a class in road engineering, one principal or deputy highway official from each county in Tennessee. The appointment shall be made by the chairman of the county court, on or before Jan. 1, 1890, and must set forth that the candidate is in a position to be of benefit to the public road-system of the county wherein he resides. If in a county no applicant apply for appointment before Jan. 1, the chairman of the county court shall, until Feb. 1, 1890, have the privilege of appointing one similarly qualified applicant from any other county of any State. The course of instruction will extend from Feb. 1 till April 1, and will consist of lectures and work on the economical location of highways to conform to conditions of topography and traffic; principles of construction of new and reconstruction of old roads, and of maintenance *vs.* repairs; methods of drainage; simple highway structures, retaining walls, drains, culverts, simple bridges; practice in field-sketching, simple platting and draughting, instrumental location, and computing estimates of cost; and study of systems of highway administration.

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Communications will be welcomed from any quarter. Abstracts of scientific papers are solicited, and twenty copies of the issue containing such will be mailed the author on request in advance. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents.

Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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ONE OF THE DISADVANTAGES of a popular form of government and of thorough democracy, recognizing absolute equality of all citizens, whether rich or poor, wise or stupid, familiar with business or ignorant of all its forms, is illustrated by the fact that the current technical journals are describing an ironclad "designed" by a distinguished lawyer, who happens to be a member of Congress and of the Naval Committee of the House of Representatives. It would seem that this distinguished lawyer has thought himself, and has been thought by his colleagues, competent to plan what, in its highest form, is the very culmination of scientific knowledge, of engineering talent, and of the mechanic's inventive power. In other countries it is supposed, both popularly and by the officials of governments, that such a construction could only be safely attempted when the designs have been prepared by engineers and naval architects of the most exceptional experience, and who have shown by their works that they possess those combinations of talents (vastly more rare than those of the successful general) which are essential, as has been supposed, to highest perfection of construction. It would sooner be proposed, in any other country than the United States, to intrust the life of a sick man to the care of an uneducated laborer of the docks rather than to that of an educated physician, as to place in the hands of a non-professional the planning of structures which are expected to cost millions of dol-

lars, to illustrate the grandest results of modern engineering, and protect the interests and the honor of a great nation.

The story, if told abroad, will undoubtedly be received with absolute incredulity, as one of those incomprehensible American "jokes" which the average European mind can never hope fully to appreciate; but, were it believed, the average American can probably as little conceive the astonishment that it is likely to awaken. The conceit of the lawyer, turned engineer and naval architect, who could imagine himself fitted for performing the work of a member of another profession; the social, and especially the official, customs that could make such a thing possible; the quietness with which the proper departments and officials could thus permit themselves to be set aside while an amateur undertakes their work; the even more extraordinary attitude of the committees of Congress, of Congress itself, in looking on with indifference while this curious and remarkable phenomenon is being exhibited, and actually, as is reported, voting the million dollars and a half required for the still more remarkable experiment in the inversion of the commonly accepted principles of business,— would appear, then, about equally extraordinary and incredible. In fact, it would seem quite as incredible to some of our own citizens, were it not for the fact that the name of the distinguished amateur is given, and the details of his proposed construction are presented in full.

Our only explanation of this singular incident seems to be suggested by the extent to which details are given in the specifications published, which indicate, that behind the great lawyer, and hidden by his grander proportions, is somewhere a naval architect who is too modest, or who, for some more inscrutable reason, either does not care or does not dare come into view as the responsible designer of this expensive toy. Could it be possible that the whole performance represents the catering of a bureau of the Navy Department to the political friend relied upon to promote its interests or those of its officials in Congress? If this be the case (and we would not like to believe it, suggestive as the circumstances are of such an explanation), the danger to the interests of the government and of the people; the injury to the reputation of the constructive bureaus of the Navy Department and to that of the secretary of the navy; the compromising of the unquestionably able and distinguished lawyer who is the victim of this scheme, and who must appear before the world, at home and abroad, as enormously conceited and equally unwise,— should promptly lead to the revelation, by the officials concerned, of the real state of the case. The people of the United States cannot afford to hand over a million dollars and a half to an amateur, or to risk its success in battle, and its honor on the sea, in any such wild experiment; much less can it afford to place in official position men who have so little knowledge of the first principles of ordinary business.

THE CONTOURED MAP OF MASSACHUSETTS.

FIVE years ago the United States Geological Survey and the Commonwealth of Massachusetts entered into an agreement concerning a topographic survey of the State, the results of which are now gradually coming before the public. The field-work was completed two years ago. A number of the inch-to-a-mile, contoured, quarter-degree sheets have been engraved, and proofs have been struck off for use in the survey. It is to be hoped that they may all be soon published by the State, and placed on sale at the cost of printing. New Jersey has reached this desirable stage, and its invaluable atlas of twenty sheets can now be bought for twenty-five cents apiece, or five dollars for the entire set.

The maps of Massachusetts here referred to more particularly is in four sheets on a reduced scale of about four miles to an inch (1:250,000), with contours every hundred feet. The irregular shape of the State gives the map an unsatisfactory form, that will be

remedied when Connecticut and Rhode Island are added to it, as they may be in a few years; the field-work being completed for Rhode Island, and well under way for Connecticut. The water is printed in blue; the contours, in brown; the names, boundaries, railroads, and meridians and parallels, in black. The map is a handsome piece of work, but it is questionable if a finer effect could not have been produced by using a dark gray to indicate the cultural work; for the black is in too great a contrast with the rest to give satisfaction to the eye.

The larger physical features of the State are brought out with much clearness. The gradual ascent inland from the coastal lowland to the uplands can be traced quantitatively now for the first time on a map. The upland surface is, to be sure, greatly broken by valleys, but the general accordance of summit altitudes and their progressive increase westward are so well marked that they are best interpreted as remnants of an old lowland, nearly plain, — a "peneplain," as it might have been called, — now moderately elevated and inclined eastward, and much worn by subsequent valley-cutting. Very few hills rise distinctly above the surface of the old peneplain; Blue Hills near Boston, Wachusett between Worcester and Fitchburg, and Greylock in the north-western corner of the State, being the most conspicuous examples of such forms. The mountains of Berkshire are generally but little higher than the expanded surface of the plateau next eastward, and have gained their present bold relief by the wasting-away of the limestone valley floor. In the same way the trap ridge of Mount Tom and the conglomerate mass of Mount Toby stand above the floor of the deep and broad Connecticut valley that has been excavated by this ancient river in the soft triassic shales.

The contrast of form between upland and valley gives corresponding contrast in the villages built at high and low levels. Hubbardston, Petersham, and Royalston on the central plateau, east of the Connecticut valley, stand just above the contour line of 1,000 feet. Blandford, Worthington Corners, and Heath, on the western plateau, are over 1,500 feet. The hills rise little above the open country far and wide around these airy settlements, but the valleys are sunk deep below them. All the larger villages, and most of the factories of the plateau region are in the valleys; but the shoe-shops climb to high levels in Spencer and North Brookfield. The railroads follow the valleys as far as possible, and have no high bridges; this being characteristic of railroad construction on an upland so far consumed by river-work. In western Pennsylvania and New York, where the upland is more continuous and the valleys correspondingly narrower, many railroads run on the high ground, and then have to cross the river-trenches in lofty viaducts.

The wide valleys of Berkshire and the Connecticut River, opened on weak rocks, are cultivated in broad, smooth fields. The narrow transverse valleys of the adjacent plateaus, cut across the hard rocks, have steep rocky slopes and mere strips of gravelly bottomland. The Deerfield, Westfield, Miller's and Quaboag Rivers show these features most distinctly, as any traveller on the Fitchburg or Albany Railroad may observe. The western plateau is drained in a curious fashion by streams that rise close to its western margin at heights above 2,000 feet, and traverse its entire breadth in direct or oblique courses to the Connecticut valley. Its western slope into the Berkshire valley is very abrupt. This suggests that the Berkshire limestones were not so widely exposed on the surface of the old peneplain as they are now; and that then there was no master-stream upon them, such as the Housatonic now is. If this be correct, we must picture the drainage of the old peneplain lowland as flowing eastward from the western border of the State to the Connecticut valley, and must regard the Housatonic as a capturing stream that grew northward by head-water gnawing, after the old lowland was raised to something like its present height. The short steep ravine streams that now drain the western slope of the plateau follow inverted courses to the Housatonic; and the divides that separate them from the Connecticut tributaries must be unstable, and slowly migrating to the eastward. A walk along the margin of the plateau, past the heads of these ravine-streams, ought to detect the characteristic consequences of such migration in the form of the lateral secondary valley, that have been recently diverted from eastward to westward outlet; but the presence of

drift in this region may complicate matters so far as to render such analysis impossible.

The presence of ponds and lakes is the most perceptible consequence of glaciation. The eastern part of the State is perceptibly blued over by them, but on the higher uplands they are relatively rare.

The separate quarter-degree sheets of larger scale, about fifty of which will be required to cover the State, will receive special notice when they are completed and published. W. M. D.

BOOK-REVIEWS.

Aspects of the Earth: A Popular Account of Some Familiar Geological Phenomena. By N. S. SHALER. New York, Scribner. 8°. \$4.

THIS is a superb reproduction in book form of the excellent papers by Professor Shaler, that recently appeared in *Scribner's Magazine*. There are sixteen full-page illustrations, besides nearly a hundred in the text, the most of them copies of photographs in the finest and most faithful style of wood-engraving. These transcripts from nature the author believes to be more helpful to the general reader than diagrams that require a schooled eye to apprehend.

The topics of the chapters are "The Stability of the Earth," "Volcanoes," "Caverns and Cavern Life," "Rivers and Valleys," "The Instability of the Atmosphere," "Forests of North America," and "The Origin and Nature of Soils." It is a good selection of themes that at once possess a scientific interest and a popular and practical bearing; all, in fact, relating to the surface of the earth or to phenomena more or less familiar to the public. The author has made it his special purpose, in his own words, to choose subjects that "commend themselves to the attention of intelligent people," and "show the relation of natural forces to the fortunes of man."

The first chapter offers a satisfactory explanation in general of earthquakes, though not emphasizing and illustrating the effect of cumulative tension in the earth's crust, which might be compared to that which is indicated by the cracking sounds of a stove-pipe under the expansion of heat, or of a house under the contraction of extreme cold. There is a full treatment of the facts in regard to earthquake regions in the United States, especially as connected with undisturbed pinnacles of rock and poised boulders as indices of long periods of rest. These may be admitted as proofs of the absence of great earthquakes, but are hardly to be regarded otherwise, inasmuch as a pinnacle, a wedged boulder, or a "rocking stone" might endure a good deal of oscillation.

Volcanoes are referred to the superheating of water everywhere permeating the crust to the amount of twenty per cent or more, — a simple solution that is a relief to one's mind after all the theories about descending sea-water, lakes of fire, and what not. Caverns and cavern life, rivers and valleys, are treated with the freshness of statement and illustration that characterize the entire volume; and while a theoretic item still under discussion is sometimes assumed as fact, there is, for example, a candid remark that cave-life exhibits modifications that cannot be caused by the competitive struggle of existence, — an impartial remark in the noble spirit of Darwin himself. The natural bridges, as that of Virginia, are explained as remains of caverns. The cañons of the West are well accounted for, and the cutting of rivers across mountains, also, but in a way that would have been helped by the very apt illustration (in a United States geological report) of a saw-log slowly rising against a horizontal saw.

The advocates of forest conservation have an ally in Professor Shaler, who clearly sets forth the evils of denudation. It would appear, however, that the destructive process goes on mostly in wild districts, and that long settlement of a district tends to restore, and even to create groves where they were not. This last tendency is strikingly manifest on the prairies in a few years after occupation, and a manifestly changed climate follows. The loss of a rich top-soil by washing, after the plough has broken up the original protecting turf, is an evil that needs more attention. Is it not possible to check this in a measure by so running the furrows that these shall not be channels of waste, and to further avoid this

result by back-ploughing every alternate furrow, making it a dam. Surely the practice, recommended by some, of subdividing the rainfall by furrows running up and down a slope, must be more wasteful in the final result than an occasional rushing break of the water retained by the process above described.

Cyclones and tornadoes are amply discussed in the light of the latest investigations. A diagram of equatorial and polar currents would aid such readers as are not familiar with the general theory of winds; and there seems to be in this book an over-valuation of winds in the production of the great ocean-currents. In regard to tornadoes, observation would teach that the author's advice to construct houses of brick or stone in tornado regions is not wise. A massive stone building is torn to pieces as easily as one of wood, and with far more danger to the occupant. In fact, the stone foundations of a house are sometimes swept clean off, level with the ground. In the path of the tornado there is but one security,—an outside underground refuge with most direct access from the living-rooms of the house, such as by a trap-door and stairs, if the ordinary cellar stairway is not near the south-west corner. The roar of the storm may readily be mistaken for that of cars. The funnel of the cloud may follow at some interval the accompanying general storm, when one least expects devastation. There may not be a moment to lose in going to an out-of-doors tornado-refuge, which some have recommended. And there should be not only ingress from the cellar, but some mode of egress from the cave in case the cellar entrance is blocked by *débris*, and especially in case the wrecked house takes fire. Certainly, in exposed regions, fifteen dollars spent in rightly providing a refuge is worth the peace of mind it brings, though the terrible disaster never comes.

The concluding chapter on soils is of interest to every intelligent reader as well as to cultivators of the ground. Happily, it must have come into many rural homes in its first form as a magazine article. Of course, the great expense of this volume is its engravings, such a full-page picture as that of the Yellowstone Falls probably costing two hundred dollars. But, many of the woodcuts having already paid something like their cost in the magazine, it is to be regretted that a cheaper edition on less costly paper is not issued along with this luxurious one; lighter, too, for the very heavy paper in a book of this size is a considerable weight to hold, in this instance three and a half pounds. Large type and very thick paper are suitable in books of a pictorial sort for brief entertainment rather than continuous reading.

"*Evolution of Sound*" Evolved. By M. J. THOMPSON. Cincinnati, Standard Publishing Co. 8^o.

THERE once lived in this town (by "this town" we mean New York) a certain Dr. Hall, who was much given to violent attacks on all that had been considered as reasonable by ordinary mortals in the results of the investigations of scientific men. It may be that some of our readers will remember the doctor's attack on the wave-theory of sound, and his vehement appeals to scientific men to answer his arguments against the validity of the conception we now have of the way in which sound is propagated. It cannot be said that opportunity for discussion was lacking, for the warlike doctor even went so far as to establish a journal—*The Scientific Arena*—for the very purpose of furnishing a suitable medium for open discussion of the merits of his arguments. But all this was to little purpose till the author of "*Evolution of Sound*" evolved, at that time professor of science in Garfield University, Wichita, Kan., published a number of letters, pointing out how the doctor had wandered a little from the paths of wisdom. These have been collected in book form; and, even if they did not serve the purpose of opening the eyes or ears of Dr. Hall, it may happen that there will be others who will find in them answers to attractive sophistry or to their own doubts.

Appended to these letters is reprinted Professor Thompson's graduation thesis at Ann Arbor, on the measurement of chemical affinity.

Mountaineering in Colorado: the Peaks about Estes Peak. By FREDERICK H. CHAPIN. Boston, Appalachian Mountain Club. 12^o.

The Appalachian Mountain Club is made up of those men and women, boys and girls, who, for the most part living not far from

Boston, delight in taking walks. The most of their excursions are, per force of circumstances, taken through the most attractive regions to be found near their homes. But every year one or more parties start for a tramp through the White Mountains, a winter tramp in that region being a yearly feature of the club's doings. All this leads to an increase in the intelligent interest in the hills and mountains visited, and is very pleasant as a recreation for those able to take part.

The volume now before us shows that one member has had the temerity to venture thousands of miles from the usual haunts of his colleagues. We have in it a record of his wanderings through unfrequented valleys, and even those hitherto unvisited by white men, of his clamberings over peaks, and of the views he saw. Fortunately our author was an admirable photographer, and fortunately again his negatives fell into the hands of good engravers, as we are enabled, by the excellent and numerous pictures with which the volume is embellished, to gain some idea of what was spread before his eyes.

The book is well written, contains a good deal of information such as is told in the narratives of travellers, and is a real contribution to our knowledge of one of the few out-of-the-way and yet wild corners of our country.

The Graphic System of Object Drawing. By HOBART B. JACOBS AND AUGUSTA L. BROWER. New York, A. Lovell & Co. 75 cents.

THE aim of the authors of this admirable series of drawing-books is to give the pupil a clear idea of form, to help him to express that idea on paper, and to give him command of his pencil, so that he can draw the objects about him. The plan of the work is so simple that any teacher can use it; and a manual for the teacher's use, which accompanies the set of drawing-books, makes the system plain even to those entirely unskilled in the art. The course is intended to cover four years of practice, and is adapted for use in both public and private schools. The part of the series intended for the primary course deals only with single objects in outline; the part for the intermediate course is devoted to drawing from groups of objects; in the part prepared for the grammar department, studies in tones and values are given; and for the high school, thorough instruction in drawing from life is found. Manuals for the four departments, or four-years' courses, are provided.

While the methods for work given in this series are based on the systems current in many of the best schools of art, and on the practice of the most successful art teachers, no attempt is made to attain the critical accuracy to be expected in more advanced textbooks. The authors claim for it simply an original and highly efficient arrangement of lessons; and no one who carefully examines the system will deny that it is one which will naturally call forth the interest and develop the powers of the pupil.

AMONG THE PUBLISHERS.

A HISTORY of American literature, by Karl Knortz of this city, will be published shortly in Berlin by Hans Lüstenöder.

— John P. Morton & Co., Louisville, Ky., have in preparation a work on "Kentucky Jurisprudence," by Lewis N. Dembitz of the Louisville bar.

— The American Writing Machine Company, Hartford, Conn., has issued a pamphlet showing a selection of writing-papers suitable for use on the Caligraph.

— "Odds and Ends from a Literary Junk Shop" is the title of a priced catalogue of new and second-hand books just issued by A. S. Clark, 34 Park Row, this city. It contains many points of interest to book-buyers.

— Thoroughly earnest work is being done in behalf of tariff reform by the New York *Weekly Post*, which holds that the time to discuss this economic question is now rather than in the heat of a presidential campaign. Every issue of the paper contains articles bearing upon some phase of the subject, together with questions by doubting readers, with answers by the editor, all tending to facilitate and simplify the discussion. The *Post* is compiling a di-

rectory of active tariff-reform organizations in the United States, and has already published one instalment of the list.

— Travellers on the Nile will be glad to learn that the second volume of Baedeker's "Guide-Book to Egypt" is at last about to appear. It will be devoted, says *The Publishers' Weekly*, to a description of upper Egypt, and has been compiled by the well-known Egyptologist, Professor Eisenlohr.

— Charles L. Webster & Co. publish this week Mark Twain's new book, "A Connecticut Yankee at King Arthur's Court," which satirizes the shams, the laws, and customs of to-day under pretence of dealing with the England of the sixth century. It is fully illustrated by Daniel Beard.

— The Bancroft-Whitney Company, San Francisco, Cal., have just issued the first two volumes of Lawson's "Rights, Remedies, and Practice." The work, which is to be complete in seven volumes, issued at the rate of one a month, does not deal in theories, but is written for the every-day use of the profession.

— Houghton, Mifflin, & Co. announce "The Bible and Modern Discoveries," by Rev. Henry A. Harper, connected with the Palestine Exploration Fund. He has written other books of much interest on Palestine, but the peculiar feature of this book is that it connects the remarkable discoveries made in the Holy Land with the Bible narrative.

— B. F. Stevens, according to the London *Athenaeum*, has just produced the first volume of his magnificent collection of facsimiles of documents in European archives relating to the United States. The second volume will be ready this month, and two more will be in the hands of the subscribers early next year. The total number of copies printed is limited to two hundred.

— The J. G. Cupples Publishing Co. have in press a work by Nathaniel Pitt Langford, of St. Paul, entitled "Vigilante Days and Ways; or, The Pioneers of the Rockies, being Sidelights on the Makers and Making of Montana, Idaho, Oregon, Washington, and

Wyoming." It will be published in two volumes, and will be illustrated.

— The first number of *College and School*, a monthly magazine for teachers, students, and parents, has made its appearance; Utica, N. Y., being the place of publication. It is bright and attractive in appearance, presents a good table of contents, and we trust will be a success, although its field of work is pretty well covered already.

— A book entitled "Thought and Thrift," written by Joshua Hill, a farmer in Kentucky, is announced as in the press of Raisen & Co., No. 19 West 6th Street, Cincinnati. It will be a discussion of political and economic questions from the point of view of a practical agriculturist, which it is said will be of great value and interest to the agricultural classes as well as to those interested in the subject from the economic and political side.

— In *The Writer* (Boston) for December, following a personal sketch of Mrs. George Archibald, are articles entitled "Duplicating Manuscripts," "The Opening Sentence," "The Husbands of Literary Women," "Don'ts for Young Writers," "Needless Words," "A Reader's Appeal to Writers," and "Blocking Out Poetry." A new department is entitled "The Use and Misuse of Words." In its every-day questions of language are discussed briefly. The department "Helpful Hints and Suggestions" this month is devoted mainly to plans for preserving clippings, and many novel ideas are suggested.

— *The Chautauquan* for January contains the following articles: "The Railroads and the State," by Franklin H. Giddings; "A Miniature Glacier," by Professor N. S. Shaler; "Too Much Theorizing," by John Habberton; "A Striking Feature of the Age," by Professor A. S. Hardy; "Great Britain's Ministry," by J. Ranken Towse; "James Anthony Froude," by Professor W. M. Baskerville; "Sam Houston's Marriage," by Coleman E. Bishop; "The Negroes of Trinidad," by Victor Smith; "Some Ohio Gypsies," by James K. Reeve; and "What England has done for India," by Bishop John F. Hurst.

Correspondence solicited with parties seeking publishers for scientific books.

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HOUGHTON, MIFFLIN & CO., BOSTON,

— The fourth volume of Baron Haussman's memoirs, which is shortly to be published in Paris, will describe in detail the inner life of the Second Empire. Among many other matters, according to *The Publishers' Weekly*, the narrative promises to throw a new light on the discussions with Prince Bismarck, at Biarritz and elsewhere, as to the conclusion of an alliance between France and Prussia, and the formation of a German Empire at the expense of Austria. There will also be some unrevealed particulars in connection with the negotiations for peace after the war of 1870, affording much information about the part which Napoleon III. took in them.

— D. Appleton & Co. announce as ready this month "Exercises in Wood-Working: A Text-Book for Manual Training Classes in Schools and Colleges," by Ivin Sickles, M.S., M.D. This book consists of two parts. The first, a treatise on wood, includes the growth, structure, properties, and kinds, cause of decay, destructive insects, and means of preserving wood. The second part contains a description of tools, methods in drawing used to illustrate the exercises, and methods of sharpening tools. These are followed by thirty-nine progressive exercises, arranged as follows: 1. Practice with the ordinary wood-working tools; 2. Construction of simple joints; 3. Construction of complex objects; 4. Elements of house-carpentry; 5. Directions for finishing work. The exercises are illustrated by full-page plates, and are accompanied by numerous applications. Directions for each exercise are printed on the page opposite its diagrams, and particular attention has been paid to marking or laying out the work preparatory to cutting.

— Messrs. Funk & Wagnalls (New York) announce a new biographical series, "American Reformers," edited by Carlos Martyn, D.D., — a man of whom Wendell Phillips said, "If I were looking for a biographer, I would lay hands on Mr. Martyn. His arrangement is unique and effective. His grasp is both wide and strong. His historical scent is keen as that of an Indian on a trail." There are to be twelve volumes in the series, to be published one each two months, beginning in January, to be issued in uniform size and style (12mo, of about 300 pages each, in cloth) at \$1.25 per volume. Here are the subjects and the writers: "Wendell Phillips, the Agitator," by Carlos Martyn, D.D.; "Horace Greeley, the Editor," by Francis Nicoll Zabriskie, D.D.; "Horace Mann, the Educator," by Hon. Frank B. Sanborn; "William E. Dodge, the Christian Merchant," by Carlos Martyn, D.D.; "Abraham Lincoln, the Emancipator," by Professor C. W. French; "Frederick Douglass, the Colored Orator," by Frederic May Holland; "John G. Whitier, the Poet of Freedom," by Sloane Kennedy; "William Lloyd Garrison, the Abolitionist," by Hon. George W. Williams, LL.D.; "John B. Gough, the Apostle of Cold Water," by Carlos Martyn; "Charles Sumner, the Scholar in Politics," and "Henry Ward Beecher, the Pulpit Orator."

— We have received the first and second numbers of "Haverford College Studies," published by the college faculty. They are all either historical or mathematico-astronomical. No. 1 opens with an article on "The Library of the Convent of the Holy Sepulchre at Jerusalem," by J. Rendel Harris, giving an account of the formation of the library by the union of three smaller ones, with notes on some of its treasures. Then follow a series of "Micro-metrical Measurements of Double Stars," and other observations made at the college observatory. They are quite elaborate and extensive, filling nearly sixty pages of the pamphlet. There is another astronomical paper, "On the Period of Rotation of the Sun," by Henry Crew, who gives as the result of his observations the period of 26.23 days. Frank Morley has a paper, "On the Geometry of a Nodal Circular Cubic," which has been published before in the *American Journal of Mathematics*; and the number closes with an elaborate essay by Francis B. Gummere, "On the Symbolic Use of the Colors Black and White in Germanic Tradition." This last paper is perhaps the most interesting in the collection, and contains much curious lore. Pamphlet No. 2 consists mainly of an essay on "The Rest of the Words of Baruch," by J. R. Harris, with several pages of the Greek original; and this is followed by facsimiles of "Two Esarhaddon Texts," by R. W. Rogers, from the originals in the British Museum. On the whole,

these studies are more elaborate than most publications of American colleges, and represent a great deal of work.

— Henry C. Frink (234 Broadway, New York) announces a calendar for 1890 ("Perles de la Littérature Française"), with one quotation each from 365 different French authors; also a calendar for 1890 ("Perlen der Deutschen Literatur"), with one quotation for every day in the year, selected from eminent German authors. The above calendars are engraved and hand-painted. The quotations are selected by A. N. Van Daell, professor of modern languages in the Massachusetts Institute of Technology.

— Mr. Clarence M. Weed, M.Sc., has published, in a recent bulletin of the Illinois State Laboratory of Natural History, an article entitled "A Partial Bibliography of the Phalanginae of North America." In it he states that he has included most of the references to this group in our American literature, and mentions the genus of several species of *Phalangium* of which he has seen no specimens, but which probably do not belong to that genus as now restricted. He has also published in the same bulletin an article entitled "A Descriptive Catalogue of the Phalanginae of Illinois." The great majority of the American species of those familiar creatures commonly known as "harvest-men," or "daddy-long-legs," belong to the subfamily *Phalanginae* of the family *Phalangida* of the sub-order *Opilonea* and order *Arthrogastra*. Though abundant and widely distributed, these arachnids have as yet received comparatively little attention in this country. The laboratory collections on which this article is based have largely been made within the last two years.

— The following is the title of a book just published by the C. R. Barns Publishing Company, St. Louis, Mo.: "New Light from Old Eclipses; or, Chronology corrected and the Four Gospels harmonized by the Rectification of Errors in the Received Astronomical Tables," by William M. Page, with an introduction by Rev. James H. Brookes, D.D. The book is illustrated by several striking engravings of eclipses, and the author's arguments are supported by astronomical calculations; which calculations are verified by making with them all the eclipses known to the ancients, in time and quantity as described by those who witnessed them. It has also a new arrangement of the four New Testament narratives in one combined narrative, giving all the occurrences of our Lord's life in chronological order.

— Mr. Townsend Mac Coun of this city has published "An Historical Geography of the United States," written by himself. It is a small quarto volume, containing more than forty maps illustrating the history of the country from its discovery to the present time. It opens with facsimiles of some of the maps made by European geographers during the sixteenth century and earlier, which show very clearly how difficult it was for them to get a correct idea of the form and size of this continent. Then follow maps illustrating the colonization of the United States and the early wars and national rivalries, and, last of all, a series in which the growth of the national domain from the close of the Revolution to the present time is clearly and strikingly shown. The maps are well engraved, and unnumbered with detail. A descriptive and historical text follows the maps, and adds to the usefulness of the book for study and for reference.

— It is now just two years since the *Academy* announced that Lord Carnarvon had found — among the papers which passed into his possession on the death of his mother-in-law, the late dowager countess of Chesterfield, widow of the sixth earl — a second series of "Chesterfield Letters," and that he proposed to edit them for publication. These letters, which number 236, are in an excellent state of preservation. They were addressed by the famous Lord Chesterfield, the fourth earl, to Philip Stanhope, his godson and successor in title, and may be regarded as a revised version of the celebrated letters to his natural son, who died after he had disappointed his expectations. The subjects are to a great extent the same; the language is often all but identical. But much of the cynicism of the earlier series has evaporated; the morality is on a higher level; the writer appeals to loftier principles than we are wont to associate with his name. The correspondence extends over nine years, beginning in 1761, when Philip Stanhope was in the sixth year of his age.

—Brown, Thurston, & Co., Portland, Me., announce the completion of the six volumes of the "York (Me.) Deeds." This work, which has been in progress for the past six years, is one of the most important historical and antiquarian publications relating to the early history of New England that has ever been published, being of particular value and interest to the people of Maine, New Hampshire, and Massachusetts, as in it is found a large portion of the unknown and unwritten history of those States. The work was done under the direction and patronage of the Maine Historical Society and the State of Maine.

—Of *The Ladies' Home Journal* it is said that it has the largest actual paid circulation of any magazine in the world; it had on its books at last count 422,356 paid annual subscribers, with a subsequent daily increase; it prints and sells each month 500,000 copies; it has two editions a year of one million copies each; it goes monthly into 35,000 post-offices throughout the United States and Canadian provinces; it has regular paid subscribers in 46 of the 60 countries of the civilized world; it has a subscriber in almost every English-speaking nation of the globe; it requires 8 large cylinder presses, running an entire month, to print a single edition; it has over 5,000 employees, agents, and subscription canvassers in its employ; it has a working staff of 80 writers and 14 editors, besides artists and engravers.

—In *Lippincott's Monthly Magazine* for January a feature of especial interest is the publication of the first part of some unpublished manuscript of Nathaniel Hawthorne's,—a weird tale entitled "The Elixir of Life." This is a version of the theme of "The Bloody Footstep," also treated by Hawthorne, in "Dr. Grimshawe's Secret," "Septimius Felton," "The Dolliver Romance," etc. Mr. Julian Hawthorne, who edits the manuscript, by drawing attention to the similarities and discrepancies between this and other versions, presents a study of the great romancer's methods of work, and, by paraphrasing such portions of the manuscript as are repeated in the published stories above named, imparts to the whole the character of a complete tale. "Nathaniel Parker Willis" is the theme of R. H. Stoddard's study of American authors. This paper is one of a series of critical articles which Mr. Stoddard has contributed to *Lippincott's*. In an article entitled "Newspaper Fiction," William Westall, the popular English novelist, tells of the growth of the syndicate idea in England. "The Theatrical Renaissance of Shakspeare" is contributed by Edward Fuller, the dramatic editor of the *Boston Post*, who reviews the extraordinary revival of Shakspeare's plays at our theatres during the season of 1888 and 1889. The article is full of suggestions concerning the setting of the plays, and also of criticisms upon modern actors. In "Under the Mistletoe," Henry Collins tells about the origin of the custom of kissing under the mistletoe; and Miss Anne H. Wharton, in "Our Winter Festivities," gives the origin of many of our Christmas and New Year customs.

—A. E. Kennelly, Mr. Edison's chief electrician, who has so frequently been called as an expert in important litigations, will contribute to the January *Scribner's* the sixth article in the electric series, entitled "Electricity in the Household," which is a popular discussion of the numerous devices that can be conveniently applied to every modern home where comfort is aimed at. The article will be illustrated. In his very interesting and timely article on "Water Storage in the West," Walter Gillette Bates discusses in the same number some of the reasons which may make it advisable that in the near future the government should undertake the whole question of reclaiming the arid regions of the West by an immense system of artificial dams and lakes. Of the Eiffel Tower, W. C. Brownell says, "It was, however, not only not vulgar, but agreeable. Technically the Tour Eiffel was superb. It may have been intended merely to be astonishing, but in reality it was in the highest degree impressive." In his article on "The Beauty of Spanish Women," Henry T. Finck says, "If I were asked to state in one sentence wherein lies the chief advantage of Spanish women over those of other countries, and to what they chiefly owe their fame for beauty, I should say, that if a Spanish girl has round cheeks, and has medium-sized, delicately cut nose and mouth, she is almost certain to be a complete beauty; whereas, if an American or English girl has a good nose, mouth, and cheeks, the

chances are still against her having a beautiful complexion, and fine eyes, hair, and teeth, which Spanish girls are always endowed with as a matter of course. But over and above every thing else, it is the unique grace and the exquisite femininity, unalloyed by any trace of masculine assumption or caricature, that constitute the eternal charm of Spanish women."

LETTERS TO THE EDITOR.

*.*Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.
The editor will be glad to publish any queries consonant with the character of the Journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

A Peculiar Case of Adhesion.

A VERY singular case of adhesive power has come under my notice lately, and the results of an investigation made with the view of establishing its nature are recorded in the following lines.

Mr. Louis Hamburger of Baltimore, sixteen years old, and of rather delicate build, noticed for the first time, about the middle of November last, that a cane would, as he expressed it, "stick" to his fingers, and that wiping off the cane and washing his hands would not prevent this occurrence. Laying his fingers on other light articles, such as lead-pencils, penholders, etc., he found that he could lift them up by simply placing his fingers upon them, the objects adhering firmly to the skin. Not being able to explain these phenomena, Mr. H. came to see me on Nov. 19, and surprised me by performing a few of the experiments which he had learned to execute, and which consisted in the raising of various objects by their adherence to his fingers. The heaviest of these articles did not weigh twenty grams.

At a loss to understand the nature of these phenomena, I began a series of experiments, which, in the course of a few weeks, brought to light a number of facts more interesting, and even more startling, than those which had been observed by Mr. H. himself up to the time he first called upon me. The experiments performed were made with the view of determining (1) the quality and nature of the adhering substances, i.e., their chemical composition and texture; (2) the quality or weight of adhering masses, and their relation to the hand's surface brought into play in a given experiment; (3) the exact points or surfaces of the fingers or other parts of the body which exhibit this adhesive power; (4) the length of time during which substances will adhere.

Before stating the results of the various experiments made, I will mention that it was soon found that the hands had to be carefully cleaned by washing with soap and water, and then with alcohol and ether, in order to attain the highest degree of adhesive power; and that the surface of the articles experimented upon had likewise to be well cleaned, and rubbed absolutely dry. Particles of dust or moisture greatly interfere in all experiments where the highest power is demanded.

In regard to the first point of inquiry, the nature of the material which would adhere, it was easily proven that chemical composition had nothing whatever to do with the adherence. Metals, stone, glass, rubber, wood, etc.,—all probably adhere equally well, provided their surfaces possess the same degree of smoothness. As a general rule, it may be stated that the adhesive power increases with the degree of smoothness of surface. It is for this reason only that well-polished metals or glass show the highest degree of adhesion. The latter substance answers especially well, because it can be cleaned easily. In proportion as the surface becomes less even, the adhesive power diminishes; and porous substances, such as paper, cloth, etc., or articles covered with them, cannot be made to adhere at all.

The second question, regarding the determination of the extreme limit of the weight of matter adhering, was found more difficult to answer. A number of factors influence the results of experiments made in this direction. It was found that not only the shape of the adhering mass had to be considered, but also the position of the hand itself. Cylindrical forms seem to be preferable, while flat surfaces adhere but poorly; and a much larger weight may be attached to the fingers while the hand is held perpendicularly than

when in a horizontal position. In order to reach some definite results, glass rods of different diameters were used. They were so arranged as to allow an increase of their weights by attachments, and so that the hand might be applied in a perpendicular position. When first examined, on Sept. 22, it was found that the extreme limit of weight which could be made to adhere, by means of a glass rod of 10 millimetres diameter, to the surface of the front part of the four fingers of the right hand, when held perpendicularly, was 1,450 grams. A glass tube of 20 millimetres diameter was next substituted, and would yet adhere when its weight had been increased to 1,900 grams.

When the experiments were repeated on subsequent days, the same glass tube could each time be loaded heavier, and Mr. H. can now lift the comparatively enormous weight of 2,610 grams, after having pressed his fingers tightly to the glass rod, which stands in a perpendicular position upon a metallic disk to which it is fastened, and which also carries the weights.

I ought to state that the thumb is never used to cause the adhesion, and that, in commencing a series of experiments, Mr. H. can never at the beginning lift the greatest weight. It appears that the power of adhesion increases during a series of experiments made within a period of fifteen or twenty minutes. So far, the power has continued to increase almost from day to day, but appears to have now reached its maximum. Following are the results of a few of the experiments made as described above; the first figure representing the diameter of the glass tube (in millimetres), and the second the maximum weight suspended (in grams): 5, 1,530; 10, 2,120; 15, 2,400; 20, 2,610; 25, 2,260; 30, 1,860.

The weights recorded above are nearly one hundred times greater than those which can be lifted by adhesion when the corresponding tubes are used horizontally. Exact measurements of that portion of the hand's surface which comes in contact with the adhering mass are difficult to make. However, the determinations were made sufficiently accurately to show that very nearly 3 square centimetres surface enter into action during the adherence of a 20-millimetre rod, when supporting 2,500 grams.

When the investigation was first begun, Mr. H. not only firmly believed in his utter inability to use his left hand as he did his right, but also looked for the seat of the adhesive power only in the front part of his fingers. It has now been demonstrated that the left hand does all the work equally as well as the right one, and that the surface of adhesion extends, though different in intensity, over almost the whole of the inner part of the hands. The power is strongest in the front part of the fingers, and weakest in the centre of the palm and on that portion of the fingers which is nearest to it. All the protruding portions, including the ball below the thumb, possess adhesive power, however. Neither the back of the hands, nor other parts of the body, including the surface of the soles and toes, show any signs of adhesion. The power of the hand to sustain objects may be shown by suspending upon it, for instance, four 6-inch test-tubes alongside of one another, or by applying an iron rod, a wooden stick, and a glass tube simultaneously to different parts of the hand. A test-tube adhering to the hand may be made to roll to and fro by jerking the hand backward and forward while the tube is in a perpendicular position.

The intensity of adhesive power in the various fingers differs widely. It is strongest in the index and middle finger, and weakest in the little finger; the latter doing so little work, that the three others may lift almost as much as the four. What is most singular is that one finger possesses very little power. The greatest weight shown to adhere to one finger has been about 35 grams, while two fingers may lift 1,400 grams. In order to decide whether or not the aid given by a second or third finger, in balancing or steadying the weight of the suspended mass, was the cause of this inability of one finger to do much work, three fingers were covered with a thin film of collodion, which rendered them unfit to act by adhesion, but not by their muscular support.

The experiments thus performed showed conclusively that the three fingers covered with collodion were absolutely unable to assist the fourth one. It can therefore not be the steadying power which causes two fingers to do forty times the work of one finger. That this should be so, might have been inferred from the fact that Mr. H. can suspend a combustion tube about four feet long on two

fingers, and cause it to swing like a pendulum through a distance of at least three feet.

The length of time during which substances adhere depends chiefly upon their weight. Light objects, such as test-tubes, will remain suspended even horizontally for ten minutes or longer, and can then be removed only by the application of some force, when a slight click, caused by the concussion of air, can be heard. Very heavy articles will fall off sooner; but whether in consequence of a diminution in the adhesive power of the surface, or in consequence of the strain exerted upon the muscles, it is difficult to say. Another cause of the falling-off is to be found in the perspiration which at times oozes freely from the pores, and interferes greatly with the experiments.

It may be added, that neither the shape of Mr. H.'s hands nor the structure of the skin, even when examined under a magnifying-glass, shows any thing abnormal, though the skin is very soft and smooth. These are the principal results of the investigation made, and the next question is, how to account for the phenomenon. I need not mention the reasons which exclude the possibility of an electric or a magnetic action, because the facts presented show this conclusively. We therefore seem to be limited to a consideration of surface action, or atmospheric pressure, or both. The reasons for this assumption are, (1) that it has been found impossible to notice any attraction whatever exerted at a distance; (2) that the power increases with the cleanliness and smoothness of the surface, i.e., with the number of actual points of contact; (3) that the peculiar sound heard on breaking contact is characteristic of the concussion of air; (4) that the power increases with the increase of surfaces in contact, as shown in the experiments with glass tubes of different diameters.¹

Whether, or to what extent, the pressure of atmospheric air induces these phenomena, I am unable to say. I have not had an opportunity to examine Mr. H. under a diminished or increased pressure, but hope to do so ere long. Certain it is, that the ratio of one square inch of adhering surface to fifteen pounds in suspended weight has not been exceeded, though approached to within twenty per cent. But even if air-pressure participates, as it most likely does, we have to assume that the skin of Mr. H. is peculiarly fitted to show these phenomena of skin-adhesion, and in a degree, to my knowledge, unnoticed heretofore. That he is not the only person possessing this power, I have good reason to believe. Among a large number of people examined, there were many whose hands showed at least signs of this power, and certainly a few who promised to develop it sufficiently to exclude doubt in regard to the occasional existence of the force. It may be well to warn persons who may try experiments, not to mistake for actual adhesion the suspension of tubes by means of counter-pressure exerted by portions of the terminal phalanges or the fleshy portions surrounding them. The unmistakable sign of adhesion is the performance of the experiments with the fingers kept absolutely close to one another, in which case it becomes next to impossible to exert counter-pressure. That muscular action may come into play in some of Mr. H.'s experiments is not absolutely impossible, yet very doubtful. I leave it to physiologists to furnish a more satisfactory explanation of these phenomena than I myself have so far been able to give.

W. SIMON, PH.D.

Baltimore, Dec. 16.

Convictional Currents in Storms.

READERS of *Science* will remember, that, in the numbers for May 10 and June 21 of the current year, there were given some computations of the probable effect of convictional currents and of the condensation of moisture carried by them into the cooler air strata above. These computations showed that there could be no liberation of energy from any such action. An interesting article has appeared in the *American Meteorological Journal* for December from the pen of Professor Davis of Harvard University, in which I find, "It is difficult to understand why this question should be so confused by Hazen, as appears in his recent articles. . . .

¹ That there is a decrease in power when the tubes are wider than 20 millimetres may be explained by the fact that those surfaces of the fingers which show the highest degree of adhesion are prevented from coming in proper contact with the surface of tubes, when of too large a diameter. This would account also for the poor adhesion of objects with flat surfaces.

It is a mistake to say that latent heat thus liberated [from the condensed moisture] will warm the air enough to allow the condensed vapor to evaporate again; for the latent heat is completely expended in the work of pushing away the air that surrounds the ascending expanding mass, and therefore cannot be applied to any other task. Espy made this error for a time, but afterwards corrected himself. It is regrettable to see the error now revived by Hazen." As all these computations were based on commonly accepted theories, it is a little difficult to comprehend these expressions. I hope to show that the confusion is where it is least suspected. I am aware that the ordinary theories have such a fascination, there is little hope in bringing the philosophers who accept them to what the facts seem to indicate; but there are an increasingly larger number of persons who have grave doubts as to the sufficiency of present meteorological inferences to account for the facts observed, and it is for these I write, as well as to explain my position.

The fact that there is no exchange of air *en masse* from one level to another has been proved by the strongest arguments, and such as have not been controverted. It is a great pity that this assumption should be boldly made at this day without answering the objections. It seems high time to lay aside "glittering generalities," and carry out our analyses to the actual conditions we observe. To do this it is only necessary to set forth quantitative computations of the effects produced by certain inferences. I am not aware that this has been attempted save once (see *Science*, xiii. p. 369). In that case the assumptions and results were so absurd and so easily controverted, that it is not surprising that no philosopher has taken up that line since.

There are two points to be made plain. First, regarding "work." This is the great shibboleth of theoreticians. If there is a troublesome quantity of heat to get rid of, or the formation of vapor which is the source of energy to account for, "work," and the difficulty disappears. If we place *a* pounds of gunpowder in a cannon, and discharge a ball upward, a certain number (say, *b*) of foot-pounds of work is done, and this can be definitely computed. If a similar amount of gunpowder be strewed over a field, there is, what we may call, the same potential energy present as before; but no one believes that firing the powder will carry a shot, or that a single foot-pound of effective work will be done by it. This would appear one of the most serious defects in modern theories. The philosopher sits down, draws on his thinking-cap, and, seeing rain falling at the rate of two inches per day, in a twinkling finds that 11,796,000 cubic inches of water is condensing over a single acre. Next he finds a million times that in an ordinary storm, and this represents billions on billions of foot-pounds of energy. Is not this the veriest nonsense? What these theoreticians need most of all is to transport their steam-engine, if they can find one, into the cloud region, and then compute the amount of work actually made effective. No one, outside of these philosophers, would boil away tons of water in the open air on the Atlantic coast, and imagine by this means to obtain effective energy enough to transport a great steamer across the ocean in less than six days.

A word regarding the "using-up of the latent heat of condensation by doing work in pushing aside the air which surrounds the ascending expanding mass." Nothing can better illustrate the views just enunciated than this inference. It is universally accepted that air blows toward our storms almost normally to the isobars at the outside, but more and more at an angle as it approaches the centre, till it becomes tangential at ten to two hundred miles from the centre. This whirling column has, it is also inferred, an upward convectional movement at the centre. It is impossible for us to imagine that there is a central core, forming a convectional current, and that on all sides of this there is a vertical cylinder of air pressing in on the core, and which must be pushed aside; for just beyond this core the air is whirling in the same circle, and it is believed by some that the centrifugal effect would even throw this outward. This shows conclusively that there is absolutely no air to push aside, and, even if there were, the work needed to move it in a frictionless medium would be inappreciable. Is not this inference a most weak attempt to bolster up an exceedingly weak theory?

It is probable that the old inference that the sun heats up a limited portion of the earth's surface, and sets up a convectional current

which ultimately results in a violent tornado, will soon disappear. Professor Ferrel, one of the most ardent advocates of this inference, has recently declared, that, in order that this convectional current may not be broken up from the greater speed of the upper portion, it is necessary to suppose that the upper part separates from the lower, advances in front of the storm, and sends its gyrations through a frictionless medium to the earth. Verily, to use a homely but forcible and apt expression, "this is cutting off the tail of this theory close behind its ears."

It is now known that the sun's heat has no direct effect upon air-columns near the earth. We know,

1st, That the earth becomes very hot, but the air is almost a non-conductor of this heat; and this effect extends only a few inches.

2d, That convectional currents occur only between contiguous air strata, and there is no transport of air *en masse* by them.

3d, On some days the air is heated thirty or more degrees above the morning temperature; but this produces no effect on the moisture contents of the air, it does not produce any convectional current, and the heat extends over a circle about a thousand miles in diameter.

4th, As a storm approaches, clouds cover the sky, and the direct effect of the sun's heat is almost entirely removed.

5th, Notwithstanding the removal of the sun's direct influence, the moisture in the air is most remarkably affected. We find enormous additions to this moisture over a region extending for hundreds of square miles in front of the storm. Whence comes this moisture? We have indubitable evidence that heat has nothing to do with it. Its occurrence is entirely independent of the winds, it does not descend from above, for there is ordinarily less moisture there than below, and theory indicates an upward and not downward motion. It seems to me this is one of the most important points to be determined. It would seem that the moisture collects in the upper regions before the storm, for the first indication of the storm is the high cirrus four hundred or five hundred miles in advance. This shows plainly that the origin of the storm is not from convectional currents beginning at the earth's surface. Is there a condition in the atmosphere which is so changed upon the approach of a storm that the air begins to absorb moisture? Is there an influence from the sun that only requires a slight change on the advance of a storm to cause the moisture to mass itself? Is there a condition in front of the storm itself that attracts moisture directly without its transport by air or heat currents? Does the moisture come from the whole region near the storm, and mass itself at it? These are startling hypotheses, but they have much to support them. Our storms come over the arid plains of the West with little moisture in them. Almost suddenly, as they approach the more fertile valleys, there is a marked increase in the moisture. Light rain begins, which becomes heavier the farther east the storm moves. At times the storms move clear across the country without depositing much moisture. Is this because the attractive force has less power, or because it holds the moisture more tenaciously, or because the air is too dry to allow precipitation? We have here what seems a most important field of research, and one that promises much. H. A. HAZEN.

Washington, Dec. 13.

INDUSTRIAL NOTES.

Calendars.

At this season, when every one is looking for a convenient calendar for use during the coming year, there should not be overlooked the various very attractive calendars, issued as advertisements, it is true, but in which the advertising feature is not introduced in a way to make the calendar objectionable. Among these we have just seen that issued by the well-known firm of C. I. Hood & Co., of sarsaparilla fame. This calendar can be had for the asking at any druggist's, or is sent postpaid on receipt of 6 cents in stamps at the main office of the firm in Lowell, Mass. The head of a young girl lithographed in fourteen colors appears on the face of the card, and is an admirable example of what can be done in this line of art. It is a very pretty bit of color to brighten up some dark spot.

CALENDAR OF SOCIETIES.

Biological Society, Washington.

Dec. 14. — C. Hart Merriam, Results of a Biological Survey of the San Francisco Mountain Region in Arizona; C. D. Walcott, A New Genus and Species of Ostracod Crustacean from the Lower Cambrian; A. F. A. King; On the Flight of Young Birds.

Connecticut Academy of Arts and Sciences, New Haven.

Dec. 18. — Professor Hastings, A Visit with the Jena Opticians.

Boston Society of Natural History.

Dec. 18. — Frederick Tuckerman, Gustatory Organs of Mammals; S. H. Scudder, Fossil Plant-Lice.



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Publications received at Editor's Office, Dec. 9-14.

- APPLETON, J. H. Laboratory Yearbook, 1890. Providence, R.I., Gordon Roscoe & Co. 31 p. 16". 12 cents.
- COLLEGE and School. Vol. 1. No. 1. m. Utica, N.Y., F. G. Barry, 22 p. 6". \$1 per year.
- ELECTRICAL INDUSTRIES. Vol. 1. No. 1. m. Chicago and New York. Electrical Industries Publ. Co. 28 p. \$2.50 per year.
- LOST INCA, The: A Tale of Discovery in the Vale of the Inca-Mayu By the Inca-Pancho-Ozollo. New York, Cassell, 287 p. 12".
- LUNNITZ, C. Among Cannibals: An Account of Four Years' Travels in Australia and of Camp Life with the Aborigines of Queensland. Tr. by Rasmus B. Anderson. New York, Scribner. 395 p. 8". \$5.
- PRATT INSTITUTE Record, Vol. 1. No. 1. Founders' Day Number. Brooklyn, N.Y., Pratt Institute. 53 p. 12".

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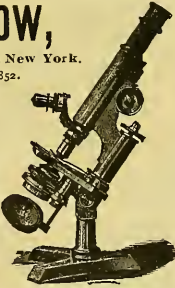
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SEVENTH YEAR.
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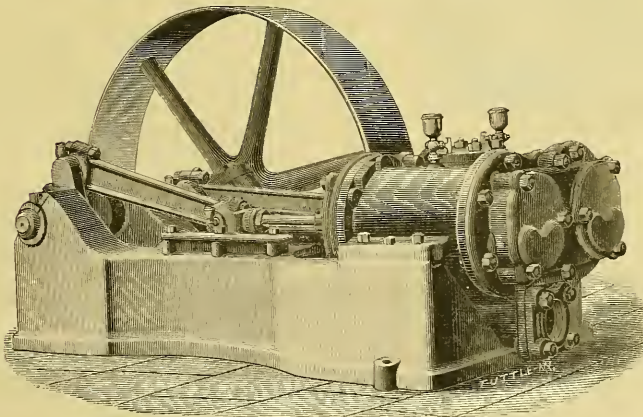
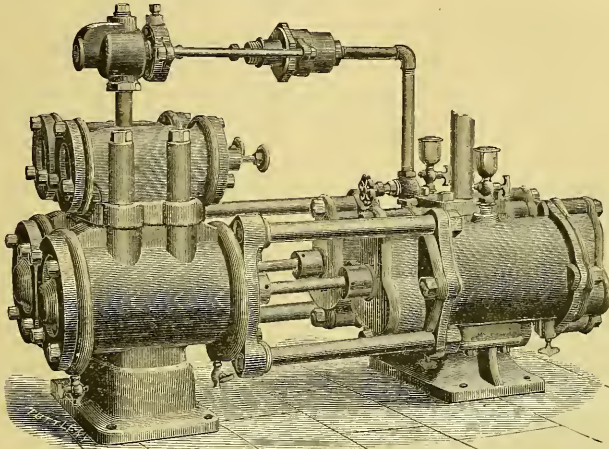
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THE HALL AIR-COMPRESSOR.

FOR any purpose in which a positive air-pressure is required, a compressor possesses many advantages over a fan or blower. Even for moving air for ventilating purposes, where under ordi-

exceed twenty-five pounds to the square inch, the compressors shown on this page are intended.

These compressors are built by the Hall Steam Pump Company of this city, and they are much used for elevating liquids, such as strong acids, etc., as well as for ventilating mines and shafts. They



THE HALL AIR-COMPRESSOR.

nary circumstances a blower answers very well, there are times and places in which a positive movement of the air, such as that produced by a compressor, is not only desirable, but actually necessary. For such purposes, where the required pressure does not

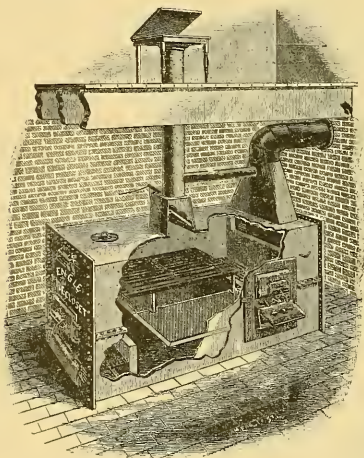
are also largely used for furnishing the air-blast where oil, atomized or converted into spray, is made use of on a large scale for fuel. Such a system of burning atomized or aerated petroleum was described and illustrated in *Science* of April 5, 1889.

Both the compressors shown here are duplex or double-acting, but they differ in other features. One is actuated by steam direct, and the other is intended to be driven by a belt. The valves and much of the other mechanism of the compressors are constructed on the same principles as those of the steam-pumps made by the same company, which are too well known to require any description here. As the length of stroke of the pistons, in both the pumps and the compressors, is about the same under all ordinary variations of steam-pressure or load, much less clearance is needed for the steam-valves than would otherwise be necessary, — an important point in the construction of compressors. Any desired air-pressure may be maintained by means of an automatic regulator, which opens or closes a valve in the steam-pipe. It may be added that these machines are as compact and simple in construction as is compatible with the uses for which they are intended; and they are not liable to get out of order, even when run at high speeds.

GARBAGE CREMATION.

WE had occasion a year ago to describe the Engle furnace for the cremation on a large scale of a city's garbage. To-day we are able to show an illustration of a small furnace for the same use in private houses.

It is doubtless true that nature has its own way of transforming offensive unsanitary matter into new forms in which it is no longer dangerous; but the application of fire can bring about in a few



THE ENGLE FIRE-CLOSET.

moments that which, if left to natural processes, would take weeks or months to accomplish.

The practice of cremation in place of burial is doubtless growing, and is each day gaining new adherents. A recent canvass of the opinions of the leading physicians of Philadelphia brought out the fact that the majority of them favored the fire method of disposal of human bodies, several of them taking occasion to point out that it all comes to the same thing in the end, the difference being only in the time consumed.

The Engle fire-closet is the application, on a somewhat smaller scale, of exactly the same principles contained in the garbage cremator described last year. By the use of two fires, one at either end of a small furnace, the smoke and gas evolved in consumption are destroyed. There is no escape of any offensive smell, and the furnace perfectly supplies the use intended, for the sanitary and economical destruction of all matters placed therein.

The advantages of such an apparatus as this are obvious. It is placed in a dwelling, where it is used for the reception and destruction of all garbage, as well as night-soil. It is especially useful in places of public resort, hotels, and restaurants, where a large num-

ber of people congregate, and supplies the place in such institutions of an expensive and elaborate system and sewerage. It is in daily use in large collegiate institutions and public-school buildings of cities where no adequate system of drainage is in force, and is serviceable for the destruction of the waste and worthless matters produced by all manufacturing establishments.

The Engle fire-closet is in use in hospitals, for the burning of infected clothing, bedding, furniture, and other matter requiring to be destroyed, from patients suffering with contagious or infectious diseases. As an adjunct to the disinfecting and quarantine stations of cities and the general government, it is an auxiliary of importance.

The illustration shows the construction of an Engle fire-closet adapted for the use of a single family. The matter to be destroyed, both solid and liquid, is received directly through soil-pipes from closets above into the evaporating pans and on the garbage bars of the furnace. The flues into the chimney are kept open, and there is no escape of any smell or odor into the surrounding room; and at the proper time fire is applied, and the contents are destroyed. These fire-closets are constructed of steel, lined with fire tiles, with receiving pans adapted for the purpose required, and occupying a comparatively limited space. They are placed in convenient locations, usually in the lower part of the building, or in the cellar, where access can be had to a flue or chimney of moderate size. Being portable and easy to handle, they may be removed at any time to any other desirable site as the exigencies of the weather may require.

A NEW PROCESS OF PROTECTING IRON EFFECTUALLY AGAINST CORROSION.

THE following report on this process was made by Professor H. Haupt to the Franklin Institute of Philadelphia some time since:—

"For a period of more than ten years experiments have been made under the auspices of the Hydrogen Company of the United States to discover a simple, economical, and practical method of protecting iron and steel from all ordinary corrosive influences. A large number of patents were secured, and about \$100,000 expended in the erection of plants at Washington, D.C., Newburg on the Hudson, and New York; and some of the results were of the most satisfactory character. Iron that had been treated by the processes referred to effectually resisted the action of nitromuriatic acid and other severe tests to which it was subjected, while untreated iron was immediately attacked by the acids and quickly destroyed.

"But, although many of the specimens thus treated gave very satisfactory results, others proved defective; and it became apparent to the contributors to the funds that the exact conditions as regards temperature, quality, and quantity of material employed, and duration of treatment, had not been so accurately determined that results could be duplicated with unerring certainty, — an essential condition, without which no process could ever be made a commercial success.

"This explanation has been considered necessary to account for the fact that an industry which promised results of such extraordinary value to the public and to the parties financially interested should have been allowed to linger until the greater portion of the life of the original patents had expired.

"But persistency has at last been rewarded with success. The company succeeded in securing the services of a thoroughly practical and scientific engineer, chemist, and metallurgist, Dr. George W. Gesner, who was enabled to discern the defects of former treatments, and to remedy them successfully by new apparatus and processes, which have recently been patented; so that, while the old patents are still held by the company, they have to a great extent been superseded by more recent issues, under which operations now are and will hereafter be conducted.

"The former treatment consisted in placing the articles to be operated upon in a close chamber, similar to a gas-retort; and when heated to a temperature of about 1200° F., steam superheated in a separate furnace was introduced, followed by naphtha or other hydrocarbon vapor.

"The results, as previously stated, were not always uniform, and,

when satisfactory, could not be duplicated under former management with certainty as to the result.

"All this is now changed; and the results are so uniform and certain, that, with a few hours of instruction in the manipulation of the apparatus, an ordinary laborer, with no technical education and with average intelligence, can secure results with entire uniformity.

"Dr. Gesner soon discerned that one of the chief defects in the former treatment arose from the fact that the steam superheated in a separate furnace, and conducted by pipes into the retort, was invariably cooled to the extent of several hundred degrees before admission, and came in contact with the heated iron at a much lower temperature.

"To remedy this defect and insure absolute uniformity of temperature between the iron and the superheated steam at the instant of contact, a peculiar but very simple form of superheater was devised, and inserted in the retort itself. The result was entirely satisfactory; and, after a number of experiments by him to determine the conditions necessary to insure the best treatment, the works were turned over to an employee, who has since operated them with uniform results.

"The plant now in operation is located at East Port Chester, near the extensive foundry of Abendroth Brothers, and consists of twelve vertical retorts with a capacity for the treatment of about twenty tons per day of the Gesner sanitary soil-pipe. The time required for each charge is about two hours.

"After the pipes have been lowered into the retorts by means of a traveller, the retorts are closed for about fifteen minutes, until the contents are heated to the proper temperature. Steam from a boiler at sixty pounds pressure is then introduced into the superheater, which it traverses, and from which it escapes at the temperature of the iron, upon which it acts for about one hour. A measured quantity of some hydrocarbon is then admitted with a jet of steam, followed again by a fixing-bath of superheated steam, which completes the process.

"The most extraordinary feature of the operation is that, as Professor Gesner positively asserts, there is no pressure in the retort, and no free explosive gases. The water-seals attached to the retorts show only slight oscillations, but not an inch of pressure; and when the covers are removed, and air admitted, there is no explosion, as there always is when free hydrogen or carbonic oxide are present, and as there always was before Professor Gesner took charge.

"The absence of pressure and of explosive gases is a proof that all the operations have been so nicely regulated as regards material used, quantity, and time of application, that a perfect absorption and union of the carbon, oxygen, and hydrogen with the iron has been effected.

"The protection thus afforded to the iron is not a mere coating, like paint, but an actual conversion, to a greater or less depth, into a new material, just as, in the process of case-hardening, iron is converted into steel. When properly treated, this material does not seem to be detachable by pounding, bending, hammering, rolling, or heating. The pipes treated at Port Chester have been immersed in baths of dilute sulphuric acid, and exposed to the salt air for weeks without change, while untreated pipes were quickly covered with red oxide or with sulphate of iron.

"The exact chemical composition of the material produced by this treatment has not been reported upon by Professor Gesner, but it is probably a carbide, hydride, and superoxide of iron. This would seem to be a necessary result, if, as is stated, the retorts when opened contained no free gases, neither hydrogen, oxygen, nor carbonic oxide. As these gases are necessarily formed, their disappearance can only be explained on the theory that they have combined with the iron, forming the three compounds of superoxide, plumbago, and the alloy of hydrogen and iron, for which Professor Gesner has proposed the name of 'hydron.'

"The plant now in operation at Port Chester has been designed simply for cast-iron soil-pipe, but Professor Gesner is preparing plans for a more extensive plant for the treatment of wrought iron and steel, to be erected at South Brooklyn.

"In the application of this process, each specialty will require a plant adapted to it, and a series of experiments to determine the

exact conditions as to temperature, quantity, kind, duration, etc., to secure the best results, after which they can be duplicated indefinitely with any ordinary intelligence.

"The question is often asked, 'What is the effect of this treatment upon the tensile strength of the material?' This can only be answered by direct tests; but if the new material should not possess the tensile strength of the untreated iron, as in wires or rods, compensation can be secured by a slight increase in diameter. It is certain that in some specimens the treatment has increased the toughness and strength by the annealing process to which the material is subjected. Sheet iron of poor quality, that would break by bending, has been rendered tough and pliable.

"The cost of the process is said to be about one-fourth of that of galvanizing, while the durability under similar conditions promises to be greatly extended."

SUPPOSED SHOWERS OF METEORITES IN THE DESERT OF ATACAMA.

It is now universally acknowledged, says a correspondent of *Nature*, that meteorites come from outer space, and that shooting-stars, whatever they are, have an extra-terrestrial origin. It is further asserted that a meteoritic fireball and a shooting-star are only varieties of one phenomenon. Indeed, after it is once granted that a meteoritic fireball is produced by the passage through the terrestrial atmosphere of a dense body entering it with planetary velocity from without, and that shooting-stars have an extra-terrestrial origin, it is a very fair assumption that a shooting-star is likewise a dense body rendered luminous during its atmospheric flight.

One great objection to this assertion is, that again and again showers of hundreds of thousands of shooting-stars have taken place, during which no heavy body has been observed to reach the earth's surface. The only known case of the arrival of a meteorite during a shooting-star shower was that of Mzapil, on Nov. 27, 1885, and that single coincidence may possibly be the result of accident. A sufficient explanation of this difficulty, however, is to be found in the small size of the individuals which produce the appearance of a shooting-star shower. That the individuals are really minute is proved by the fact, that, while the total mass of a large swarm, like that producing the November meteors, is so small that there is no perceptible influence on the motion of the planets, the number of separate individuals is almost infinite. It is established that the Leonid swarm must be hundreds of millions of miles in length, and some hundreds of thousands of miles in thickness; and in the densest part of the Bielid swarm, passed through in 1885, the average distance of the individuals from each other was about twenty miles.

Further, it is now acknowledged that comets are themselves meteoritic swarms, and Mr. Lockyer has lately brought forward spectroscopic evidence that the fixed stars and the nebulae are similar to comets in their constitution.

The question therefore immediately presents itself, is the size of a meteoritic shower, on reaching the earth's surface, ever comparable with that of a meteoritic swarm, as manifested by a shower of shooting-stars?

During the present century nearly three hundred meteoritic falls on the earth's surface have been observed, and on only a single date, namely, Aug. 25, 1865, has there been observed a fall on two distant parts of the earth on the same day. On that date stones fell at Aumale in Algeria, and at Shergotty in India; but as the times of fall differed by about eight hours, and the stones arrived from different directions, it is more than probable that the coincidence of date was accidental.

The most convincing proof of the actuality of such showers is furnished by the masses which have been found in the valley of Toluca, in Mexico. Their existence had been chronicled as early as the year 1784, yet in 1856 it was still possible to collect as many as sixty-nine. Belonging, as they do, to a single type, they lead to the conviction that they are the result of a single shower. But the region over which the fall took place is not large: the length of it is said to have been only about fourteen miles.

It is a question of a certain amount of interest as to whether there is any evidence of the actual fall of a shower of meteorites over a large extent of the earth's surface. Such evidence has long been supposed to be furnished by the plentiful occurrence of meteorites in the Desert of Atacama, a term applied to that part of western South America which lies between the towns of Copiapo and Cobjia, about 330 miles distant from each other, and which extends inland as far as the Indian hamlet of Antofagasta, about 180 miles from the coast.

The generally received impression as to the occurrence of meteorites in this desert is well illustrated by the following statement of M. Darlu of Valparaiso, read to the French Academy of Sciences in 1845:—

“For the last two years I have made observations of shooting-stars during the nights of Nov. 11–15, without remarking a greater number than at other times. I was led to make these observations by the fact that in the Desert of Atacama, which begins at Copiapo, meteorites are met with at every step. I have heard, also, from one who is worthy of trust, that in the Argentine Republic, near Santiago del Estero, there is, so to say, a forest of enormous meteorites, the iron of which is employed by the inhabitants.”

A study of the literature indicates that “the forest of enormous meteorites” near Santiago del Estero, understood by Darlu as significant of infinity of number, is really a free translation of a native statement “that there were several masses having the shape of huge trunks with deep roots,” and that not more than four, or perhaps five, masses had really been seen in the Santiago locality at the time of Darlu's statement. There is a similar misunderstanding relative to the Atacama masses: it is clearly proved, that, at a date long subsequent to 1845, the desert was virtually untrampled and unexplored. In Darlu's time it was only crossed along definite tracks by Indians travelling between San Pedro de Atacama and Copiapo, and between the inland Antofagasta and the coast. In fact, it is established that the only Atacama meteorites then in circulation were all got from a single small area, three or four leagues in length, in the neighborhood of Imilac, one of the few watering-places on the track between San Pedro and Copiapo.

Since that time the discovery of rich silver-mines in the centre of the desert, and the working of the nitrate deposits, have led to vast changes; the desert has been more or less closely examined, and other meteoritic masses have been found. Still, the number of meteorites yet discovered, distinct either in mineralogical characters or locality, is shown to be, at most, thirteen.

One of them, Lutschauing, is distinct from all the rest as being a chondritic stone; a second, Vaca Muerta, likewise differs from all the others in that it consists of nickel-iron and stony matter, both in large proportion; a third, Imilac, is a nickel-iron with cavities, like those of a sponge, filled with olivine; a fourth, Copiapo, is a nickel-iron with irregularly disposed angular enclosures of troilite and stony matter; the remaining nine consist of nickel-iron, virtually free from silicates, some of them showing no Widmanstätten figures when etched, others showing excellent figures more or less differing in character.

Now, in every meteoritic shower yet observed, the individuals which have fallen simultaneously have been found to belong to a common type. Hence it is reasonably certain that several distinct meteoric showers are represented in the desert, and that the above masses are the result of several falls; and, this being accepted, the assertion of simultaneity of fall of two or more masses on the purely geographical ground that they have been found in the same desert, can be allowed no great weight.

It is thus clear that the meteorites of the Desert of Atacama afford absolutely no proof that enormous meteoritic showers have ever reached the earth's surface.

The general dryness of the air of the desert, and the rarity of rain, have been sufficient to insure the preservation of masses which have fallen in the course of many centuries unto a time when an exploration of a large extent of the desert has taken place.

That the meteoritic masses are far from being so plentiful as has been imagined is conclusively proved by the experience of Mr. George Hicks, one of the earliest explorers of the 23d and 24th parallels. Although much interested in their occurrence, he never found a

mass himself, and he only obtained his first specimen after years of persevering inquiry from the Indians.

THE PULSION TELEPHONE.

A CURIOUS scene was enacted recently at a place called Child's Hill, on the Midland Railway, near London, England. What took place there, as vouched for by *Engineering*, was as follows. A party of gentlemen alighted from the train and ascended the embankment. Here one of them reached up to a wire stretched along the telegraph poles, and, placing the crown of his hat flat against it, he commenced a conversation with some unseen correspondent. The answers to his questions and remarks came back quite audibly to the group gathered around him, while those who felt sceptical as to the reality of what was being enacted before them, removed to a distance, and, pressing the wire against their ears and cheek-bones, heard the return messages for themselves. After some desultory conversation, the unknown speaker was asked to give a good shout, and in reply he jodelled with such vigor that a boy plodding his way along the cutting, at the opposite side of both up and down lines, looked up with amazement. He was at least eighty or one hundred feet distant, and yet he evidently heard the yell transmitted along the wire and received into the crown of an ordinary silk hat. It was quite impossible that he should have caught the original sound, for it was uttered in a cabin built on the side of the line at the Welsh Harp station, more than a mile away, and probably was not directly audible for one hundred yards. Those who were on the embankment knew that it was transmitted by means of a new mechanical telephone, for they had already listened to the same voice at Finchley-road station, which is $\frac{3}{4}$ miles from the Welsh Harp.

When every one had satisfied himself that spoken words, whistling, and musical sounds could be received without special apparatus, the party re-entered the train, and went on to the Welsh Harp station, where they found several lines erected in the grounds of the local hotel. One of the lines starts from a small cabin in the grounds; it then proceeds to a post on the margin of the lake, and goes right across to a hut on the opposite bank. The distance is between a fourth and a third of a mile; and as this wire is not particularly tight, and only starts at a height of about ten feet above the water, it will be readily understood that it must lie for nearly its entire length in the mud which forms the bed of the lake. Another line traverses the gardens; its supports are formed by branches of trees, around several of which it is wound three times, and is then led off at an angle to its original direction. In another instance a row of statues are made to carry a line, which is laid upon any part of them which furnishes a convenient guide. This line is so slack that it can be bent into S form by the thumb and forefinger. The very various circumstances appeared, however, to make but little difference to the instruments, and in all cases conversation could be carried on with the greatest ease, and often could be heard a foot or two away from the receiver.

The instrument by which these curiously constructed lines were made to give such remarkable results is the property of the British Pulsion Telephone Company. It is the invention of Mr. Lemuel Mellett of Newton, Mass., and already several hundred instruments are at work in Boston and elsewhere. The construction is so exceedingly simple, that one is filled with wonder that it can effect so much. The receiver, which also acts as a transmitter, consists of a wooden case, divided into two parts by a metallic diaphragm held by a clip-ring and screws. In the centre of the diaphragm is a hole through which there passes the line wire, having at its end a button to take the pull. So far there is no special novelty to distinguish the telephone from the old pill-box and string. The new feature consists in a set of resonators placed over the diaphragm to re-enforce its vibrations. These resonators may be made in many different forms; those used on this occasion are spiral springs of various lengths, and made from wire of different gauges. One set of springs is fastened between the screws which hold the diaphragm, while others are held at one end only, and project upwards and inwards within the case. These resonators are chosen experimentally of such dimensions that each will be set into vibration by some one or more of the tones which are usually

found in the human voice. Consequently the faintest vocal tremor imparted to the disk is immediately taken up by them, and immensely magnified. This is done both at the transmitting and receiving ends, the result being that the wire is put into intense molecular vibration of a hitherto unappreciated character. It is evidently not merely lateral vibration, like that of a guitar string, for such motion would certainly be damped in the wire laid in the lake; it would also greatly suffer in the case of a span strung so slackly that at the centre it rests for many feet on the ground, yet such a span was shown to work reasonably well. It is evident, however, that the vibration is not purely longitudinal, for if it were it should be transmitted through a coil of wire flung loosely on the ground; and this, we understand, is not the case. It would, however, be a waste of time to try and formulate a theory apart from experimental investigation. What principally concerns us now is the fact that a mechanical telephone has been constructed, which will speak with absolute distinctness for three and a half miles, and which is simple, cheap, and, most important of all, free from induction. It is easily conceivable that its performances may be much improved; new forms of resonators may be found that have a nearer affinity to the tones of the voice than those already tried. Two vocal chords form the source of all the sounds we can utter, even if we be as gifted as Patti, and it seems possible that some material may be found more nearly allied to their action than wire helices. Although these can vibrate in harmony with the tones of human language, they have not the same quality of sound, and the metallic resonance which they impart to the articulation they transmit is not altogether an improvement.

HEALTH MATTERS.

Preventive Inoculation for Yellow-Fever.

WE are indebted to the *Medical Record* for the following translation of a report which was presented to the Academy of Sciences, Paris, by Dr. Domingos Freire, professor of organic chemistry and biology in the faculty of medicine of Rio de Janeiro, Brazil.

The epidemic of yellow-fever that developed in Rio de Janeiro in 1888 and 1889, and which propagated itself in several other places in the interior of Brazil, has been the means of demonstrating for the fourth time the value of inoculations by means of the attenuated microbe of yellow-fever. The maximum of the epidemic was between the months of December and March, the first sporadic cases having appeared about the end of the month of May, 1888, and the last in June, 1889. During this period there were inoculated 3,570 people; to wit, 988 strangers and 2,582 Brazilians, divided thus: the city of Rio, 2,138; city of Campinas, 651; town of Vassouras, 199; city of Niteroy, 166; city of Santos, 133; Desengano, a village of 425 inhabitants, 102; Serraria, a small town, 80; city of Rezende, 54; Cataguazes, a village of 2,000 inhabitants, 50. The disease swept with great intensity in all of these spots, and the vaccinations were made, for the most part, during the height of the epidemic.

Of the 2,582 Brazilians, there were 1,740 that should be added to the 988 strangers, as this figure embraces not only individuals coming from the interior and resident in the city of Rio for less than six years,—that is to say, non-acclimated,—but also children, who, according to our experience, are just as susceptible as the strangers themselves.

The rate per hundred of mortality among the vaccinated was 0.078: at Santos, at Rezende, at Serraria, and at Cataguazes, the immunity from the disease was absolute. Here is the rate per cent from each locality: Rio, 0.98; Campinas, 0.46; Vassouras, 0.05; Niteroy, 0.75; Santos, 0.00; Desengano, 0.09; Serraria, 0.00; Rezende, 0.00; Cataguazes, 0.00. The mortality from yellow-fever among the non-vaccinated was 4,135, divided thus: city of Rio de Janeiro, 2,407 (this includes the dead from the Marine Hospital); Campinas, 812; Vassouras, 15; Niteroy, 177; Santos, 650; Desengano, 221; Serraria, 21; Rezende, 11; Cataguazes, 20. Among the 4,135 there were about 2,800 strangers, of whom, 1,176 died in Rio (and 750 of these in the Marine Hospital), 63 at Niteroy, 500 (about) at Santos, 300 (about) at Campinas, 7 at Desengano; 3 at Rezende, 3 at Vassouras.

Thus one-fourth of the deaths were among Brazilians who were

unaccustomed to the poison, inasmuch as they resided in localities where the epidemic appeared for the first time this year. In order to make the efficacy of the inoculations more marked, it suffices to remember the proportion established by M. Jemle in Senegal; namely, that among the strangers who had been there from one to three years, 75 per 100 were attacked by yellow-fever, and 68.06 per hundred died.

Applying these facts to the vaccinated strangers, or the provincials who had from a few days' to three years' residence in the infected locality, the following results were obtained. At Rio were vaccinated 1,183 people under the above conditions, of whom at least 591 should have succumbed to the disease, but only 18 died. Thus 573 lives were saved. At Campinas, a city that never before had an epidemic of yellow-fever, and where the 651 inoculated might be considered as new arrivals, of whom 325 should have died, the unsuccessful inoculations were but 3. At Vassouras, 5 should have died; one only died, who was not a recent arrival. At Niteroy the 11 strangers, under the conditions cited above, should have furnished five deaths; one only was a victim. At Santos, of 57 persons under the same conditions, 28 should have died, but the immunity from disease was absolute. At Desengano, the two unsuccessful inoculations were among strangers who had lived from six to eight years in the country. But in view of the fact that the disease obtained for the first time, all of the 102 persons inoculated were as susceptible as strangers who had just arrived. Among them 51 should have died. At Serraria, according to the main calculation, 39 should have died, whereas the immunity from the disease was absolute. The same reflections apply to Rezende, where the 54 vaccinated should have furnished 27 deaths, and at Cataguazes, where the 50 vaccinated should have furnished 25 deaths, in view of the fact that the epidemic made its first appearance in these two localities; still the immunity was perfect, without exception.

There were vaccinated, between 1883 and 1889, 10,524 people, with a mortality of 0.04 per hundred.

Vaccinations made in 1883-84.....	418
" " " 1884-85.....	3,057
" " " 1885-86.....	3,473
" " " 1888-89.....	3,582
	10,524

Dr. Freire ceased vaccinating in 1887, owing to his trip to Europe and in the United States. The mortality from yellow-fever among the non-vaccinated, during the four epidemics mentioned above, was close on to seven thousand. It may be added, in closing, that all the results given have been authenticated by a large number of medical men, and municipal and police authorities. The vaccinations were made without fee. This succinct statement proves, without question, the truth of all the doctrines founded by the eminent master, M. Pasteur.

ANTIPYRINE HABIT.—To the already long list of drugs the use of which, under proper restrictions, is both beneficial and proper in combating the various ills to which flesh is heir, but whose abuse becomes a curse to humanity, another has recently been added. Scarcely have we learned to properly use antipyrine, says the *International Dental Journal*, than the tocsin of alarm must be sounded against its abuse. The recent discovery of its value as a nerve-tonic places it on the list with morphine, chloral, cocaine, etc., so seductive is its gentle, soothing influence upon the overstrained nerves. Its victims are already found, especially among society women, whose nerves, strung up to a high pitch by the overwhelming demands of a winter season of gaiety, seize eagerly upon any thing that will afford relief from the headaches and other disorders arising from prolonged fatigue and overtired nerves. So pleasing is the effect, that it is soon used for every trifling ill feeling, until the patient finds herself unable to live without it, and the fascinating "antipyrine habit" is formed. Properly used as a nerve-tonic, its effects are admirable, but abused, the victim becomes even more hopelessly entangled than the morphine or cocaine victim. The effects vary with the dose. In large doses it produces complete relaxation with loss of reflex action. In moderate doses, continued, it induces convulsions. As a stimulant its effect is much like that of quinine.

Hygiene and Sunday.

Among the questions treated of at the recent congresses in Paris, says the London *Lancet*, that of the observance of the sabbath as a day of rest was not the least interesting. The congress on this subject was presided over by M. Léon Say, who remarked that this rest, which several religions rendered obligatory, is a law of nature, and consequently a law of hygiene, the excellence of which has long been demonstrated, although it is not to be found in all national codes. The resting on the seventh day is of biblical origin, and the custom of counting the days by seven was formerly the rule among the most diverse races, — in India, as among the Celts, in China as well as in Arabia. Now that hygiene has become a positive science, it confirms the moral and material necessity for a temporary rest on the seventh day.

Several reports were presented to the congress, and physicians, professors, philosophers, and hygienists are in accord on this point. All, without exception, support for workers of all classes and of all ages a weekly day of rest, which should even be made obligatory. It may here be noted that in 1881 this subject was opened to competition by the Swiss Government for a prize, which was awarded to Dr. Niemeier of Leipzig. The subject was brilliantly treated by Dr. Niemeier, who observed that the dominical rest is the first commandment of hygiene, which should be followed to obtain a peaceful and continued amelioration of society, and in this respect it is as much a rational institution as a religious one.

The following is the summary of the conclusions as voted by the great majority of the members of the congress: "Rest on Sunday is possible in varying degrees in all industries. Sunday is the day which best suits the employer and employed, both as regards the individual himself and his family, and it is well that the day of rest should be as much as possible the same for all. When the Sunday rest is impracticable for certain reasons, it should be replaced by some other day, so that the workman may have fifty-two days' rest in the year as equally divided as possible. This rest permits man to produce considerably more and better work, inasmuch as it contributes to maintain his zeal and to restore his physical forces."

ITALIAN SAUSAGES. — The excitement caused throughout Italy by the detection of extensive frauds in the Bologna-sausage manufacture is spreading. Other cities, notably Florence, are demanding an immediate inspection of the same articles of food as are vended in Italian warehouses. The public, says the *Nazione* of that city, are entitled to some such inquiry in their behalf as has just yielded such startling results in Bologna. Instead of the pig's flesh, popularly supposed to form the main ingredient in the Italian sausage, horse-flesh is that which is really used, — horse-flesh moreover, of more than dubious origin, taken from animals that have died of infectious disease, and even that in an advanced state of decomposition. According to the *Tribuna*, there has been collusion between certain sausage-manufacturing firms and the veterinary authority, the latter winking at frauds which it ought to have exposed. The new powers conferred by the Codice Sanitario, indeed, are finding material for their exercise in quarters hitherto above suspicion; in an industry, to wit, which has long been one of the special boasts of Italy.

NOTES AND NEWS.

THE municipality of Paris is considering the feasibility and expediency of increasing the water-supply for that city by impounding the head waters of the Vigne and Verneuil. This would admit of increasing the water-supply to fifty-five gallons per head per day, the present supply being only twenty-two gallons per head per day, besides giving a much purer water for domestic uses.

— It may prove of interest briefly to describe a series of models that have recently been loaned to the Johns Hopkins University by E. H. Butler & Co. of Philadelphia. The set includes North America, South America, Europe, Asia, Africa, the United States, and Pennsylvania. The models are the work of the Mindeff Brothers of the United States Geological Survey, who prepared them expressly for the publishers. They have been used in illus-

trating the geographies recently published by that firm. The models surpass in elaborateness any that have hitherto been constructed, and, by agreement with the publishers, they remain the only set, no copies will be made of the present series. They are made of plaster-of-Paris, and the approximate dimensions are four feet by three feet and six inches. The land is represented in buff on a blue ground, thus assuring a sharp outline to each continent and its accompanying islands. The mountainous portions stand out in bold relief, so that the chief elevations and depressions of the continents are clearly emphasized. The prominent river courses, with their characteristic channels of broad valley or narrow cañon, are plainly shown. One of the most striking features in the topography is the distinctness with which the chief drainage basins are outlined. The extent of the Mississippi basin, for example, and the character of its topography are at once apparent. On the enlarged relief of the United States more details are added than were possible on the model of North America, while on that of Pennsylvania the characteristic features of Appalachian topography are plainly exhibited. The great importance of such models for purposes of illustration in physical geography cannot be over-estimated. The value of the entire set is not far from \$2,000. Mr. J. A. Shriver placed the sum of \$175 at the disposal of the Geological Department for the purchase of models and maps relating to physical geography. A set of thirty relief maps, designed by Professor W. M. Davis of Harvard University, to illustrate the development of the more prominent features in topography, has already been acquired, and a second set, showing the associations of topography with geological structure, prepared by Professor N. S. Shaler, has been ordered. In addition to these, several maps relating to special points in physical geography are in course of preparation. A large model of a unique region in Pennsylvania, showing the effect of valley carving on anticlinal and synclinal structure, is at present under construction by a member of the Pennsylvania Geological survey.

— Emin Pacha, who received serious injuries from a fall soon after reaching the coast, is now in fair way to recovery.

— The slight improvements made from time to time in incandescent electric lamps tend mainly in the direction of giving them a longer life. A lamp of the Woodhouse & Rawson make, as reported from Taunton, England, is credited with a service of 10,608 hours before giving out.

— The fifth annual meeting of the Indiana Academy of Science, to be held at Indianapolis, Dec. 30 and 31, has been announced. The officers and *ex-officio* executive committee of the academy are John C. Branner, president; T. C. Mendenhall, Oliver P. Hay, John L. Campbell, vice-presidents; Amos W. Butler, secretary; Oliver P. Jenkins, treasurer; David S. Jordan, John M. Coulter, J. P. D. John, ex-presidents. The list of papers is as follows: "Explorations of the United States Fish Commission in Colorado and Utah," by David S. Jordan; "Explorations of the United States Fish Commission Steamer 'Albatross' in the Pacific Ocean," by Charles H. Gilbert; "Explorations of the United States Fish Commission in Missouri," by Frank M. Drew and Louis Rettger; "Preliminary Note on the Fishes of the Sandwich Islands," by O. P. Jenkins; "Description of a New Species of Rhinoptera from the Gulf of California" (by title), by B. W. Evermann and O. P. Jenkins; "Some Notes on Indiana Reptiles and Batrachians," by A. W. Butler; "Some Rare Batrachians," by W. S. Blatchley; "Fishes of Putnam County," by O. P. Jenkins; "Some Habits of the Crayfish," by C. W. Hargitt; "The Occurrence of the Badger in Indiana," by Amos W. Butler; "Fishes in the Yellowstone Park," by David S. Jordan; "Notes on Some Fishes from the West Coast of Africa, collected by Carl Steckleman," by O. P. Jenkins; "Morphology of Siphonophores," by Louis Rettger; "Notes upon the Economic Phases of Entomology and Ornithology," by C. W. Hargitt; "Observations on the Destruction of Birds by Storms," by A. W. Butler; "Notes on Indiana Butterflies," by Albert J. Woolman; "Investigations on Relation between the Intensity of Stimulus and Re-action Time," by W. J. Bryan; "Incandescent Gas-Lighting," by W. DeM. Hooper; "Dangers of the Electric Circuit," by John L. Campbell; "Apparatus for the Determination of Power Consumption in Friction and

the Cutting of Metals," "Thomson's Portable Magnetostatic Electrical Measuring Instruments, of Long Range," and "On the Determination of the Elasticity Constants of Materials by the Deflection Method," by Thomas Gray; "Preliminary Report on the Changes in Density of Wires on Stretching," by Thomas Gray and C. Leo Mees; "The Use of Two Mirrors for the Determination of Co-efficient of Expansion in Solids," and "Cause of Periodicity in Thermometers as discussed by Professor W. A. Rogers," by C. Leo Mees; "On Sulphophenylpropionic Acid," by Chase Palmer; "Vapor Densities of the Volatile Metallic Halids," by P. S. Baker; "Soap Analysis," by John F. Schnaible; "The Carbohydrates of the Sweet-Potato," by W. E. Stone; "Oxidation by Means of the Fixed Alkaline Hydrates," and "Action of Chloroform on Aluminium Chloride," by P. S. Baker; "Specific Reactions for the Penta-Glucoses," by W. E. Stone; "The 'Perkin's Synthesis,'" by P. S. Baker; "Atomic Weight of Oxygen," by W. A. Noyes; presidential address, by John C. Branner; "The State of the Crater of Kilauea in August, 1889," by O. P. Jenkins; "The Moraines of the Maunee Glacier," by C. R. Dryer; "Probable Future of Petroleum in South-western Indiana," by C. A. Waldo; "Observations on the Lakes of Indiana," by C. R. Dryer; "Some Unusual Forms of Lime Carbonate Deposition," by U. F. Glick; "The Top of the Matterhorn," by David S. Jordan; "The Uses of Infinity and Zero in Algebra," by Rufus L. Green; "Variation in Plants from Unripe Seeds," by J. C. Arthur; "Stone Characters of Nyssa," and "Snake Cactus," by Walter H. Evans; "Distribution of Cornus," by John M. Coulter; "The Plants of Putnam County," by D. T. McDougal; "The Composite of Vigo County," by W. S. Blatchley; "Germination of the Macrospores of Isoetes," by Douglas H. Campbell; "Some Structures in Epiphegus," by E. M. Fisher; "Mycorhiza and Epiphegus," by John M. Coulter; "Some Remarkable Floral Variations," by C. W. Hargitt; "Some Stem Characters in Compositæ," by Harry D. Seaton; "Some Indiana Mildews," by M. A. Brannon; "On Some Plants New to the State List," by W. S. Blatchley; "Method of Embedding and Staining Delicate Vegetable Tissues," by Douglas H. Campbell; "The National Herbarium," by John M. Coulter; "Plant Reproduction," by W. J. Spillmann; "The Potable Water-Supply of the City of New York," by A. E. Phillips; "The Effects of Trusts," by Jeremiah W. Jenks; "The Proposed Meeting of the American Association for the Advancement of Science at Indianapolis," by Amos W. Butler. The treasurer will be found at the secretary's desk before the beginning and at the close of each session. Applications for membership will be found at the secretary's desk. These should be filled up with the name of the applicant, signed by two members, and given to the chairman of the membership committee, to be appointed at the meeting.

—The Academy of Sciences of Vienna, as we learn from *Nature*, has appointed Professor G. Niemann of Vienna, and Major Steffan of Cassel, to be present as impartial witnesses at the excavations at Hissarlik, begun on Nov. 25, under the direction of Dr. H. Schliemann and Dr. W. Dörpfeld. Capt. Ernst Bötticher, who has often called in question the utility of Dr. Schliemann's archaeological investigations, has been requested to take part in the excavations.

—Among recent appointments of graduates of the Johns Hopkins University may be noted the following: G. H. Harold Ballard (A.B., 1888), instructor in the Washington (D.C.) High School; Gustav Bissing (Ph.D., 1885), principal examiner of Division A, United States Patent Office; Benjamin C. Burt (fellow, 1880-81), docent in historical psychology, Clark University; Florian Cajöri (graduate student, 1883-85), instructor in mathematics, Colorado College; William H. Carpenter (fellow by courtesy, 1881-83), assistant professor of German and the Scandinavian languages, Columbia College; Albert S. Cook (associate, 1879-81), professor of English, Yale University; John D. Epes (graduate student, 1888-89), associate professor of English, Centre College, Ky., George Hempf (instructor, 1884-86), assistant professor of English, University of Michigan; William H. Hobbs (Ph.D., 1888), curator of the Geological and Mineralogical Museum, and lecturer on mineralogy and metallurgy in the University of Wisconsin; Cary T. Hutchinson (Ph.D., 1889), electrician, Sprague Electric Company,

New York City; James G. Hume (graduate student, 1887-88), professor of mental and moral philosophy, University of Toronto; J. Edward Keeler (A.B., 1881), astronomer, Lick Observatory; George T. Kemp (Ph.D., 1886), associate director of the Department of Physiology and Experimental Therapeutics, Hoagland Laboratory, Brooklyn, N.Y.; William S. Lemen (graduate student, 1886-87, 1888-89), instructor in biology, Indianapolis High School; Gonzalez Lodge (Ph.D., 1886), associate in Latin, Bryn Mawr College; Otto Luggler (curator of the Biological Museum, 1883-85), professor of entomology and agriculture, University of Wisconsin; Robert W. Mahon (Ph.D., 1882), chemist in the Maryland extension of the Pennsylvania Steel Company, in charge of the laboratory of the company at Sparrow's Point, Md.; C. Carroll Marden (A.B., 1889), instructor in French and German, Norfolk (Va.) Academy; Dice McLaren (graduate student, 1888-89), professor of natural history, Maryland Agricultural College; J. Playfair McMurrich (Ph.D., 1885), docent in biology, Clark University; W. Howard Miller (A.B., 1888), teacher, Centerville, Md.; Charles W. Moulton (Ph.D., 1889), professor of chemistry, Shattuck School, Minnesota; Louis Rettger (A.B., 1888), associate in biology, University of Indiana; Thomas H. Spence (matriculate, 1886-88), principal, Snow Hill (Md.) High School; William K. Williams (Ph.D., 1889), assistant in the Boston Athenæum.

—In a paper read at a meeting of the American Oriental Society in this city in October last, Dr. Cyrus Adler stated that the modern Jewish synagogue has preserved in its ceremonial the use of the shofar or cornet. This instrument is usually made of a ram's horn straightened and flattened by heat. It is not only the solitary ancient musical instrument preserved in the Mosaic ritual, but is the oldest form of wind instrument known to be retained in use in the world. The mode of sounding it has been handed down by tradition. A portion of the liturgy for New Year's Day (on which it is especially employed) refers particularly to the shofar. The Mishna of *Kosh-hash-shana* (New Year) gives minute directions with regard to this portion of the liturgy. It also furnishes instructions as to the kind of horn to be used. A study of the biblical passages shows that it was employed for religious ceremonies, on the day of the year of release, the new moon, the solemn feasts, and that it would assemble all the children of Israel on the day of judgment. It was principally used, however, as a war signal, to call an army together, give warning of an invasion, sound a charge or a release, announce a victory and the coronation of a king. It is rarely mentioned as a musical instrument. Horns of similar construction, with a simple opening at the end, were used by the Etruscans and Greeks (made in bronze), by the aborigines of Brazil (wood), and by the ancient and modern inhabitants of India and the Africans of the Lower Congo. Seven specimens of Indian and African horns, of cow's horns, and elephant's tusks, are preserved in the United States National Museum. The conclusions were: (1) The oldest wind instrument was the horn of an animal with a natural cavity and a mouth-piece formed by cutting off the end. Horns which required hollowing came into use later. (2) These horns were originally used as signals in time of danger, and for making announcements in general. (3) Many of these important announcements had a religious character. The antiquity of the instrument caused its permanent adoption for sacred purposes. (4) The shofar, speaking especially of the instrument of that name, was originally a trumpet made of the horn of a wild goat. Its especial sacred character may be connected with the sacrificial use made of the goat. (5) The etymology of the word is to be sought in the Assyrian *sappar*, a kind of wild goat: Assyrian *sappartu* meant originally the horn of a *sappar*, and it may afterwards have been used for horn in general.

—According to the annual report of the Department of Mines of New South Wales, the aggregate value of the mineral products of that colony up to the end of 1888 amounted to £76,818,235. The value of such products for 1888 was £3,879,833. The increase in the output of coal, iron, and antimony for the year was considerable, while there was a decrease in the output of gold and copper. The number of miners engaged in gold-mining was 8,460, who took out an average for each man of only about \$180. This would seem a small sum for a year's work, were it not for the fact that

many of the miners are engaged during part of each year in other pursuits. Silver-mining is now carried on in every mining district in the colony, but the richest and most extensive deposits are at the Barrier Ranges, in the extreme north-west corner of the colony. These deposits extend over a tract more than a hundred miles long by several miles in width. Among other minerals, cobalt, plumbago, and bismuth have been discovered in paying quantities, and are being mined to some extent.

— One of the largest engineering firms in England has undertaken the manufacture of aluminum on an extensive scale by the new Maussier process. This process comprises three distinct periods and kinds of operations, — the desilicification, the reduction, and the liquation. The desilicification is effected by means of fluorine or fluoride of calcium at a high temperature in the presence of carbon. Lime, or the carbonates of potassium or sodium, may be added to facilitate the decomposition of the silicate. The reduction or expulsion of the oxygen is obtained by means of iron and manganese raised to incandescence in the presence of carbon. The liquation, the object of which is to separate the aluminum from the iron and manganese, is effected by dropping the molten mass into carbon ingot moulds. These moulds are made of wood charcoal. The aluminum so obtained is said to be nearly pure.

— In a paper read before the Johns Hopkins University Philosophical Association, Nov. 15, 1889, by Leon ibn Abi Suleimán, it was said that American and European scholars who have come in contact with educated Arabs are much surprised to see how well they are informed in regard to European languages, history, and literature, and how little they know of their own native language and its literature. Nor is this wonderful, if we consider the manner in which Arabic is studied by the modern Arabs. The weak points are the incapacity of most of the teachers, and the very imperfect methods they employ, and also the great desire of every Arab to imitate the Europeans, especially the French, as closely as possible, not only in language, but also in dress and mode of life. It is in Syria, especially in Beirut, that the study of Arabic receives more attention than in any other part of the East. Beirut is situated 57 miles west-north-west of Damascus, the capital of Syria, and has about 90,000 inhabitants. Of those, 50,000 are Christians, mostly from the Lebanon Mountains, 4,000 Jews, and the rest Mohammedans. Science and literature are in the hands of the Christian population, whose number daily increases by immigration from the Lebanon Mountains and the adjacent districts. The city of Beirut is widely known as an educational centre, is resorted to by students from all parts of the East, and the pedagogical methods prevalent in its schools may be fairly assumed as representative. Every religious denomination maintains at least one school, where instruction is given either free or for a merely nominal fee. Such schools are frequented by the large middle class. When the Arab leaves his village and comes to the city of Beirut to go to school, he for the first time puts on his red shoes, or rather slippers, which he has hitherto carried carefully under his arm while walking barefooted to church on Sundays. This is his first step toward enlightenment. Having once entered the school, his only desire is to learn French, which is taught in every school; and, were it not that he is obliged to study Arabic, he would certainly not do so. His dislike for this study increases owing to the exceedingly dry and uninteresting manner in which he is taught. After spending nearly two years in learning the alphabet and spelling, he spends three years more in reading the Bible, and all the while no attempt is made to explain to him a single word that he does not understand. Thus far, at least, he in a measure follows what he is reading; but afterwards, when selections from old Arabic poetry are given him to read, his task becomes monotonous in the extreme; for now he does not know whether he is reading Arabic, Turkish, or Persian, and his teacher is absolutely unable to enlighten him, as he himself does not comprehend the meaning of a single passage. We must bear in mind, however, that modern Arabic is just as different from the classical language as modern Greek from classical Greek. After learning to read Arabic poetry fluently, the student enters a class in which the grammar is taught, learning by rote without understanding a word. Writing, like

reading, is taught mechanically, and much importance is attached to the acquisition of a good hand. When this has been acquired, the student is given, every two or three weeks, a letter to copy, and thus learns the art of letter-writing. After this he leaves the school, but continues his French and English studies. By this time he has exchanged his *saravveel* for a French suit, addresses his friend "*Ya mon cher,*" and tries to speak French whenever he can find or make opportunity. The upper classes, of course, study on a better basis. They usually attend the excellent private schools and colleges with which Beirut is well provided. The foremost of those, and the oldest, is the Madrasat-al-Bustani, the academy of the late Butrus Bustani, the editor of the famous dictionary "*Muht-al-Muht.*" This school, the American College, and the University of the Jesuits, are considered the best. But in these also, European languages hold the foremost place, and students desiring of devoting themselves to the study of classical Arabic do so privately after leaving college, studying the Koran, not taught in any school, the old grammarians, even now the best, and trying to imitate in their writings the language of the Koran, so pleasing to the ear of the cultivated Arabic scholar. Such men form the several literary societies, among which the *Zahrat-al-Adab* is the most prominent. But few Arabs can be said to possess a fair knowledge of their own literature. The example, however, of those who devote themselves to this study is beginning to be felt, and the system of the schools is daily becoming better. Nevertheless it will be long before the study of Arabic in the East will be established on a true scientific basis.

— At a recent meeting of the American Oriental Society, after a brief introduction describing the opinions held by various scholars that there was a connection between the aborigines of China and Mesopotamia, an account was given by Dr. Cyrus Adler of a paper by Mr. Yonekichi Miyake, in a Japanese literary journal, in which he compared an ancient golden banner preserved at the celebrated Buddhist temple Horiñi, in the province of Yamato, Japan, with designs on Assyrian and Hittite monuments. The conclusion of the author is, "that there once existed inter-continental communication in Asia, and that the Assyrian art was introduced into China probably through Persia and India. Although Japan is entirely separated from the continent, it came under this influence, by way of China, about 1000 years ago."

— A correspondent of *Garden and Forest* sends the following note upon *Magnolia glauca* in its isolated northern station in Essex County, Mass.: "*Magnolia* Swamp contains several hundred acres, and it is one and a half miles in length and from ten to over one hundred rods in width. I am of opinion that this swamp has furnished the shrub to all the others. In regard to three of the smaller swamps, I know that this is a fact, the magnolia shrubs having been transplanted by men. The inhabitants of Gloucester are firm in the belief that *Magnolia glauca* is a native shrub, but I cannot think so. I believe it was introduced by the old settlers, some of whom may have lived in and removed from a more southern State. 'The old Salem road,' deserted by the travelling public for over a hundred years, skirts the eastern side of *Magnolia* Swamp. Along the line of this road are the ruins of old cellars, and in the swamp opposite one of the cellars, near a spring, may be found magnolias which appear the oldest in the region. The root-crowns below the moss are often found to be two feet in diameter. In no other place can I find such a growth, and it is here, I think, that the shrub first started. It must be evident to any careful observer that *Magnolia glauca* is struggling here in an unnatural climate. The primary roots grow straight down into the muck, and in the fall are thickly covered with rootlets snowy white in color. In the spring these rootlets are mostly dead, and a greater part of young shoots die down to the moss, and a certain per cent of the old plants are winter-killed, which indicates that there is no harmony between shrub and climate."

— The fruit of the Japanese persimmon or kaki can still be found in the markets of this city in great abundance, and of extraordinary beauty and excellence. It is raised in Florida and Georgia, where the kaki has been planted in large quantities. According to *Garden and Forest*, it is by far the handsomest dessert fruit which the market affords at this season of the year; but it is a question

whether the kaki really possesses as good a flavor as one of our thoroughly ripened and frosted native persimmons from Georgia or Virginia, a fruit which some people consider about the best that grows. A cross between the American and Japanese species might be expected to produce a fruit of larger size and finer color than that of the former, and with a richer flavor than any of the cultivated forms of kaki. The Asiatic persimmon, according to Rein, is "undeniably the most widely distributed, most important, and most beautiful fruit-tree in Japan, Corea, and northern China. In Japan it endures night frosts at a temperature of from 12° to 16° C. It can be cultivated high up in the valleys, and far beyond the limit of the bamboo cane. It is a stately tree, after the fashion of a pear-tree, with beautiful deciduous leaves, almost as large as those of some magnolias, but of bright green color, and resembling those of the pear in shape only. The new leaves come in May. It blossoms in June. The season of ripe fruit is late in autumn, from the middle of September to the end of November. There are many kinds of kaki, ranging in size from a small hen's egg to a big apple. Some are nearly spherical, others oblong, others heart-shaped. In color of the outer skin, they run from light orange-yellow to deep orange-red. They are distinguished also by their taste, which is pleasant in its way, and reminds one of tomato, as does the color also. They are not only eaten in a soft, doughy condition, in which those of the *Migako-no-djô*, in the province of Hiuga, are prized most highly, but the fruit is gathered while still hard, to ripen afterward. The best in Japanese estimation are *Tarugaki*, that is, 'tub persimmons,' which have been converted from astringent into sweet fruit by being kept in an old saké tub. The bitter, astringent taste of all green kaki remains, even in the ripe fruit, in the case of most varieties; and it is from these that, during the summer, an astringent fluid, rich in tannin, is prepared (called *Shibu*),—an acid of considerable importance in several industries. When over-ripe and dried in the sun, pressed somewhat flat, and then put away in boxes, the sweet kaki get to look and taste in a few months, when skinned, like dried figs, and are used like them. The white powder which covers these dried persimmons in boxes is natural sugar that has exuded from the fruit. In September the kaki-tree, laden with a large, orange-colored fruit, is a great ornament to the landscape. This beauty it preserves till it loses its leaves in October."

—The great utility of the electric light on vessels passing through the Suez Canal is shown by the fact that during the year 1888 the average time occupied by vessels in passing through was 37 hours 57 minutes, when the boats in question were not fitted with the electric light, and 22 hours 32 minutes for those vessels so fitted, which are then able to proceed at night. The saving effected in the time of transit is therefore very considerable, and the use of the electric light is rapidly spreading. During the first three months of the year 295 vessels thus fitted passed through the canal, but during the last three months the number had increased to 519.

—On Wednesday evening, Dec. 11, a preliminary meeting was held at St. Paul, Minn., for the purpose of organizing a scientific society. A few years since, the St. Paul Academy of Natural Sciences was totally destroyed by fire, losing a valuable library and museum. From this loss it has never recovered, a subsequent effort to renew its operations not meeting with success. It is exceedingly gratifying now to note that the present movement develops unexpected strength, and from a larger number than ever before. A chairman and secretary, with a committee of twelve, were named to draught articles of organization and report early in January, when several hundred memberships are expected. It is also interesting to note, that, in connection with the work usually planned for an institution of this kind, the idea of forming a series of classes in different branches of science, with special reference to elementary and practical study, seems to receive unanimous support. This will be substantially the same scheme as the "University School Extension System," which is producing handsome results.

—The American Historical Association will hold its sixth annual meeting, Dec. 28–31, in the city of Washington, D.C. The evening sessions will be in the lecture-room of the Columbian University, 15th Street, where the association met during the Christmas

holidays last year. The morning sessions will be in the lecture-room of the National Museum, by permission of the Board of Regents of the Smithsonian Institution. The recent incorporation of the association by Congress, and the relation now established between the society and the Smithsonian Institution, make it especially desirable that the members should convene again in the Federal city. The headquarters of the association will be at The Arlington, where accommodations are promised to members of the association at reduced rates. Members are expected to make their own arrangements at this hotel or elsewhere. Round trip tickets from New York to Washington, *via* the Pennsylvania or the Baltimore and Ohio Railroad, are sold in New York for ten dollars. The advantages of Washington as a meeting-place for a national historical society are very obvious. The attractions of the capital in winter, the opportunity of easy access to public record offices and the Congressional Library, the general interest of the government buildings, the National Museum, etc.,—all combine to make a visit to Washington at once a pleasure and an advantage to students of American history. The holiday season was chosen by the committee on time and place, because it is generally convenient for members, and it is easier at that time to obtain good hotel accommodations, Congress not being in session. There will be time in the afternoon hours for members to engage in private conference, in visiting, or sight-seeing, for the literary exercises are restricted to morning and evening sessions. One of the great advantages of this annual meeting of the association is the opportunity for members to meet one another in a social way, and to discuss matters of common interest. Special courtesies will be extended to the association by the Cosmos Club and by the Hon. Horatio King of Washington, D.C. The programme is as follows: Saturday, Dec. 28, "The Literature of Witchcraft," by Professor George L. Burr, Cornell University; "The Journalism of the French Revolution," by Ex-President Andrew D. White, Ithaca, N.Y.; "The French Revolution in San Domingo," by Herbert Elmer Mills, instructor in history, Cornell University; "A Newly Discovered Manuscript, 'Reminiscences of the American War of Independence,' by Ludwig, Baron von Closen, Aide to Count de Rochambeau," by Clarence Winthrop Bowen; "Recent Historical Work of the Universities" (inaugural address), by Charles Kendall Adams, president of the American Historical Association; "Historical Survivals in Morocco," by Talcott, Williams of Philadelphia. Monday, Dec. 30, "The Origin and Early History of our National Scientific Institutions," by Dr. G. Brown Goode, assistant secretary of the Smithsonian Institution; "The Development of International Law as to Newly Discovered Territory," by W. B. Scaife; "The Impeachment and Trial of President Johnson," by Dr. William A. Dunning, Columbia College, New York; "The Trial and Execution of John Brown," by Gen. Marcus J. Wright, War Records Office, Washington; "A Defence of Congressional Government," by Dr. Freeman Snow of Harvard University; "The Economic and Social History of New England, 1620–1789," by William B. Weeden, president of the Brown University Historical and Economic Association; "Correspondence of the Pelham Family and the Loss of Oswego to the British," by William Henry Smith, Associated Press, New York; "Early History of the Ballot in Connecticut," by Professor Simeon E. Baldwin of the Law Department, Yale University; "Certain Phases of the Westward Movement during the Revolutionary War," by Theodore Roosevelt, civil service commissioner. Tuesday, Dec. 31, "Bacon's Rebellion," by Edward Eggleston; "The Constitutional Aspects of Kentucky's Struggle for Autonomy, 1784–92," by Ethelbert D. Warfield, president of Miami University, Oxford, O.; "Facts from the Records of William and Mary College," by President Lyon G. Tyler, Williamsburg, Va.; "Materials for the Study of the Government of the Confederate States," by John Osborne Sumner, A.B., Harvard University; "Notes on the Outlook for Historical Studies in the South," by Professor William E. Trent of the University of the South, Sewanee, Tenn.; "Report on the Bibliography of the American Historical Association," by Paul Leicester Ford of Brooklyn; "The Spirit of Research," by James Schouler of Boston; "The Perils of Historical Study," by Justin Winsor, librarian of Harvard University; "The Government as a Guardian of American History," by Worthington C. Ford of Washington.

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Communications will be welcomed from any quarter. Abstracts of scientific papers are solicited, and twenty copies of the issue containing such will be mailed the author on request in advance. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents.

Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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BOOK-REVIEWS.

A Text-Book of Animal Physiology. By WESLEY MILLS. New York, Appleton, 8°.

UP to the present time no work on physiology has been written which has been based on the comparative method. Hardly a book which treats of zoölogy has been published, within recent years, but has this method as a foundation. The book before us is an attempt on the part of the author to do for physiology what has already been done for morphology. In his preface he calls attention to an error which is found in too many works on human physiology,—the application to man of conclusions which have been deduced from experiments on lower animals. That this is thoroughly illogical goes without saying, and yet many writers of physiological text-books constantly err in this direction.

Professor Mills commences his treatment of the subject with the consideration of general biology, describing the cell, both animal and vegetable, and then passing on to unicellular, parasitic, and multicellular organisms. The origin of the forms of life finds a place in the author's plan for a concise and yet sufficiently extensive statement of the arguments of evolution. Reproduction, which is usually left until the last subject for consideration, is taken up early for discussion, and this portion of the work is one of the best. The general treatment of special physiology is excellent. The "summary" which is found at the conclusion of each subject treated is a most valuable addition. Especially worthy of com-

mendation is the table of contents, than which we do not remember ever to have seen one more full or more convenient for reference. The five hundred illustrations are well selected and admirably executed. As a whole, this text-book will be acceptable to all teachers and students of physiology, and, as it contains matter not found in any book on the subject which has as yet appeared, no other can take its place. It certainly deserves the name of being unique, especially in the plan upon which it is written.

The Lost Inca. A Tale of Discovery in the Vale of the Inti-Mayu. By the INCA-PANCHO-OZOLLO. New York, Cassell, 12°.

THIS is a pleasing novel by a writer evidently possessed of more genius than art, who hides his identity behind a pseudonyme, and makes himself the hero of his own story. The scene is laid in the Peru of the present, geographically modified to meet the demands of the occasion, and the action is a curious blending of the past with the present, and the possibilities of the future. Peru is a land rich in romantic traditions, which are lifted from the realm of fiction by the evidences of her antiquities; and it is strange that novelists, to whom these traditions should be suggestive and fruitful material, have so long neglected them.

The writer of this novel, who has evidently travelled in Peru, and given some attention to its antiquities and traditions, bases his work upon the mysterious disappearance of Manco-Capac, the last of the Incas, from the presence of his conquerors, as detailed by Prescott in his "Conquest of Peru." In working out his plot, the author sometimes outdoes Jules Verne in his inventions, though his evident lack of patient attention to details, so characteristic of that author, leads him into blunders that will furnish mirth to historians, engineers, and electricians. For instance, he travels on the Mollendo and Puño Railroad some three years before the contract for its construction was signed. Reaching Lake Titicaca, he embarks on a flat-bottomed, stern-wheel steamboat, constructed some time previously, under his own supervision, at Wilmington on the Delaware. One of the peculiar features of this boat is that the engines are located on the upper deck, amidships. Besides the engines, she was provided with electric motors, "served by six immense storing batteries disposed symmetrically on both sides the keelson." These batteries are charged by the "economical utilization of the nearly constant north-east winds of the lake, which generated electricity by means of machinery designed for the purpose." This was in 1865. But these are only slight flaws. When the author reaches the hidden fastnesses of the Lost Inca's ideal kingdom, all is beyond criticism. Here Verne, Bellamy, and Henry George seem to have combined forces in an attempt to improve on More's Utopia, and the result might furnish suggestions to Edison as an inventor and to Ingersoll as a reformer. The book is certainly interesting and edifying, if not instructive.

AMONG THE PUBLISHERS.

AMONG the contents of *Outing* for January, we note "Wabun Anung," a tale of sport in the Great Lake region, by F. Houghton; "The Merits and Defects of the National Guard," by Lieut. W. R. Hamilton (second paper); "Gymnastics for Ladies," by W. G. Anderson, M.D.; "Fly-catcher," a tale of the hunt cup, by Hawley Smart; "Brant Shooting on Smith's Island," by Alexander Hunter; "Haak Fishing off Ireland's Eye," by Robert F. Walsh; "Alligator Shooting in Florida," by J. M. Murphy; "California Winter Resorts," by C. H. Shinn; "Ice Yachting, the Prospects of the Sport," by W. W. Howard; "Catching Frost Fish with a Shot-Gun," a story of Australian sport, by Edward Wakefield; and "Instantaneous Photography," by W. I. Lincoln Adams.

— P. Blakiston, Son, & Co., medical and scientific publishers, booksellers and importers, 1012 Walnut Street, Philadelphia, will publish in January "Massage and the Original Swedish Movements: their Application to Various Diseases of the Body," a manual for students, nurses, and physicians, by Kurre W. Ostrom, from the Royal University of Upsala, Sweden; a text-book on mental diseases, having special reference to the pathological aspects of insanity, by Bevan Lewis, medical director, West Riding

Asylum, Wakefield, England; and "A Manual for Nurses," being a complete text-book, including general anatomy and physiology, management of the sick-room, etc., by Laurence Humphrey, assistant physician to, and lecturer at, Addenbrook's Hospital, Cambridge, England.

— A. D. F. Randolph & Co. have in press a work on "The Bible and Modern Discoveries," by Henry A. Harper.

— The J. G. Cupples Company will publish shortly a volume of European travel, entitled "A Bundle of Letters from Over the Sea," by Louise B. Robinson, well known in artistic and social circles of Boston.

— P. Blakiston, Son, & Co., Philadelphia, announce that they have arranged with the London publishers to reprint here a new text-book on anatomy, by Professor Alexander Macalister of the University of Cambridge.

— A catalogue of a collection of books, comprising Americana, including many rare genealogies and local histories, natural history, biography, numismatics, occult sciences, South America, the West Indies, etc., was issued under date of Dec. 15, 1889, by S. H. Chadbourne, Hotel Dartmouth, 57 Warren Street, Roxbury, Mass.

— As a memorial of a distinguished administrator, and to further the cause of imperial federation, Mr. Stanley Lane-Poole has edited the papers of Sir George Bowen, and they will be published immediately in London and New York by Longmans, Green, & Co. In one of Sir George's earlier letters there is a pleasant glimpse of Washington society during Grant's administration.

— The Open Court Publishing Company of Chicago announces the immediate appearance of the authorized translation of M. Th. Ribot's "Psychology of Attention." The monograph of M. Ribot, who is now professor of experimental and comparative psychology at the Collège de France, and editor of the *Revue Philosophique*, has been characterized by a prominent French critic as the most important production of the French philosophical press for the present year.

— Dr. Holmes's "Over the Teacups," and the first instalment of Mr. Frank Gaylord Cook's series of papers on "Forgotten Political Celebrities," are in the *Atlantic* for January. Dr. Holmes writes about old age. He says, "There is one gratification an old author can afford a certain class of critics, — that, namely, of comparing him as he is with what he was. If the ablest of them will only write long enough, and keep on writing, there is no pop-gun that cannot reach him." Another political article, "The United States Pension Office," by Gaillard Hunt, contains suggestions as to the reform of the present pension system. "A Precursor of Milton," a certain Avitus, Bishop of Vienne in the fifth century, forms also the subject of one paper.

— The *Critic* announces that with the new year Dr. W. J. Rolfe of Cambridgeport, Mass., the distinguished Shakspearian scholar, will take charge of a department in that paper to be entitled "Shakspeariana." In this department he will review new editions of Shakspeare's works, together with new publications relating to those works and their author, and will answer any questions concerning them that show an intelligent interest in the subject on the part of the inquirer. The study of Shakspeare has assumed such proportions nowadays as to demand special treatment in literary journals of a serious character. Dr. Rolfe will edit the Shakspearian department of no other periodical while he has charge of the one to be opened next month in the *Critic*.

— Mr. Edward Atkinson will open the January *Popular Science Monthly* with a paper on "The Future Situs of the Cotton-Manufacture of the United States," in which he answers the questions whether the number of spindles in this country is being increased faster than the demand for their products, and whether the South is likely to become a formidable competitor of New England in the cotton-manufacture. A series of six Chinese pictures, illustrating the processes of cotton-manufacture in China, embellish the article. Herbert Spencer was recently quoted in the London *Times* as favoring the nationalization of land, which drew out a letter from him repudiating the doctrine as ascribed to him. This led to a lively discussion, in which Professor Huxley, Sir Louis Mallet, and others took part, and a variety of views on the general question

were expressed. The correspondence will be printed in the same number under the title "Letters on the Land Question." "Public Schools as affecting Crime and Vice" is the title of another article, by Benjamin Reece, to appear in this number. Mr. Reece cites figures which show that crime does not decrease as illiteracy is diminished, and says that our school system should be made more effective by the addition of moral teaching. An interesting account of the "Irrigation of Arid Lands" in the Far West will be given by Henry J. Philpott. The effect which this practice has on the methods of agriculture, the interest of farmers in the science of meteorology, and on state and national legislation, are also brought out in the article.

— Houghton, Mifflin, & Co. have nearly ready the concluding volume of Justin Winsor's valuable "Narrative and Critical History of America." It covers the later history of British, Spanish, and Portuguese America. A general index accompanies it. They will also publish at an early day a new brochure by Professor E. N. Horsford, on "The Discovery of the Ancient City of Norumbega." The substance of the book was communicated to the president and council of the American Geographical Society, at a special session in Watertown, on the 21st of November last. In addition to the historical address, there will be photographs of the site of the ancient city, sixteen maps from Icelandic sources down to the United States Coast Survey, and an original map of the valley of the Charles River from Stony Brook to Cambridge. The book will also include the "Poem of Vinland," delivered at Watertown by Mr. E. H. Clements of the Boston *Transcript*.

— The fourth number of the second volume of the *American Journal of Psychology*, just at hand, contains an interesting collection of folk-tales of the Bahama Islands, by Charles L. Edwards; a critical exposition of the characteristics of symbolic logic, by Christine Ladd Franklin; and the concluding chapter of Dr. W. H. Burnham's historical study of memory, this chapter dealing with recent theories and the results of experiment, and closing with an extended bibliography of the whole topic; the usual fifty odd pages of reviews, abstracts and notes on the nervous system (by Dr. H. H. Donaldson), experimental psychology (including an original paper on colored shadows by E. B. Delabarre), hypnotism, etc., covering from seventy-five to eighty books and articles. The notes are followed in this number by a brief survey, by the editor, of progress in the psychological field during the two years of the journal's existence. With the first number of Vol. III., to appear in January, 1890, material changes in the form of the journal are promised, and a new department will be added. Special efforts will be made not only to enlarge the scope and improve the quality of the journal, but more attention will be given to foreign work in psychological lines. During Dr. Hall's recent year in Europe, he was at pains to make such foreign connections as will forward this end. In Vol. III. the following larger contributions will appear: a very detailed examination of the brain of Laura Bridgman, several studies in paranoia and other rare and borderland forms of mental alienation, a continued history of reflex action, and a series of articles embracing reviews of recent and important literature on heredity and the psychology of sex. It is probable, also, that the educational material will be increased on both its psychological and university sides. During the past year the journal has been under the efficient editorial care of Dr. E. C. Sanford; with the next number Dr. Hall will re-assume personal direction, and will probably associate with himself in the editorial work other well-known psychologists.

— *The Ladies' Home Journal* (Philadelphia) has secured its large circulation by believing in woman and home as the two greatest factors of human life. It has aimed to cover every department of life in which women are interested. Its purpose has been to make woman's daily life easier and brighter. The actual circulation is said to be 542,500 copies per month in 1889. For 1890 the journal has a most promising prospectus, including among many others such features and authors as "Two Sides of Washington Life," by two of the "most famous women" at the nation's capital, telling of the trials and pleasures of official and social life in Washington; "New York Fashionable Life and Women" as seen by Mrs. John Sherwood; "Woman's Life in Foreign Lands," by sev-

eral writers now travelling in Europe; "Mrs. Harrison in the White House,"—a paper telling of the daily life of the President's wife,—authorized by Mrs. Harrison, and written by one of the attachés of the White House; "Mary J. Holmes's Travels Abroad," in European capitals and countries. Articles by such writers as Mrs. Lew Wallace, Elizabeth B. Custer, Blanche Willis Howard, Julia Ward Howe, Harriet Prescott Spofford, Susan Coolidge, Dr. William A. Hammond, Anna Katharine Green, Mrs. Henry Ward Beecher, Grace Greenwood, Ella Wheeler Wilcox, Margaret J. Preston, Rev. Robert Collyer, D.D., and Kate Upson Clarke, will be features of each number. The new regular department by Rev. T. De Witt Talmage, D.D., we have already referred to. In this the famous preacher will talk on all subjects of interest to woman. The department will be called "Under my Study Lamp." Fifteen departments for woman's daily life will be sustained by the journal, including "Side-Talks with Girls," "Practical Housekeeping," "Artistic Needlework," "The Latest Fashions," "All about Flowers," "Facts for Mothers."

LETTERS TO THE EDITOR.

*. *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith. The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Is Man Left-Legged?

IN view of the subjoined facts and remarks, we would seem justified in awaiting the presentation of more statistics and investigations, before giving an affirmative answer to the above query.

1. Of over fifty men questioned by the writer, every one answered that he would kick a foot-ball with his right foot, except two, one of whom was left-handed, the other ambidextrous; and out of forty boys interrogated by the school superintendent here, thirty-eight kicked with the right foot, and the two others equally well with either foot, both being ambidextrous.

2. About half of those asked took the spring, in leaping, from the right foot, and alighted on the left; the other half, the reverse. The strain and force required in either case seem about equal.

3. Every shoe-merchant of this place testified that nearly all their customers preferred trying a new boot or shoe on the right foot, considering that one the larger, especially in breadth.

4. Standing on either leg, and using it more, would rather tend to consolidate the bone, and develop the muscle, of that leg; hence the somewhat increased length of the left leg, indicated by Dr. Sibley, might denote comparative weakness. Besides, if the greater length of the leg is admitted as evidence of left-leggedness, by parity of reasoning, we should find the right arm, on right-handed people, longer than the left; which, from such evidence as the writer has been able to obtain, is not the case.

5. The recruit is taught, at the word "forward," to throw his weight on the right foot; and, at the word "march," to step off with the left. This position, in olden warfare, would be favorable for the use of the shield, the spear, and the cross-bow, and in modern times is equally appropriate for a bayonet charge or for firing, by right-handed men. In dancing, the instructions are invariably to begin the "chassez," and similar movements, with the right foot. Piano and harp pedals, besides various treadles for harvesters and other agricultural implements, etc., are usually made to accommodate the right foot.

6. That man is naturally right-handed, is stated to arise from a physiological cause (see Bell's "Bridgewater Treatise on the Hand," or McClintock's "Biblical Cyclopedia," when commenting on the ambidextrous Benjamites); and the same cause would be likely to strengthen the whole side, including leg and foot.

7. In the West, our race-courses, quite as often as otherwise, are so arranged as to make the horse and rider, or sulky driver, curve to the left. Circus-riders invariably follow the left-hand curve, in order to mount and dismount on the near side. The reason for generally mounting on the left is obvious. Every right-handed man, in going to battle, has his sword in scabbard on his left side, and seizes his bridle-rein with his left hand: hence the necessity of mounting from the near side, and placing the left foot

in the stirrup, but all the weight comes on the right stirrup, when wielding the sabre, battle-axe, or lance; and the lunge with the foil or small-sword is made with the right foot, by right-handed men.

8. As in dancing the lady is on the right of her partner, naturally in "hands round" or "balance all," or in the first movement of the waltz, the turn is to the right; but in each case the circle pursued is a left-hand curve: so that the argument on that point seems to have little force.

9. Backwoodsmen state, that, when lost in the forest, they usually find they have wandered in a left-hand curve, and come back nearly to the place of starting; and experiments in wheeling a wheel-barrow when blindfolded usually result in the stronger right leg gaining on the left, thus producing an inclination to the left hand.

If the officers of athletic college-clubs at Harvard, Yale, Princeton, etc., would be kind enough to report to *Science* the percentage of those students who kick the foot-ball with the right foot, and the comparative measure between the right and left leg in circumference around the muscular portion, it would aid much in arriving at the truth, especially if the small percentage kicking with the left proved to be either left-handed or ambidextrous.

RICHARD OWEN, M.D.

New Harmony, Ind., Dec. 20.

On Physical Fields.

WHEN the physical state of a body reacts upon the medium that surrounds it so as to produce in the medium a state of stress or motion, or both, the space within which such effects are produced is called the "field" of the body. When a body is made to assume two or more physical states simultaneously, each state produces its own field independent of the existence of the others: hence two or more fields may co-exist in the same space. For instance: if a magnet be electrified, both the magnetic and the electric fields occupy the same space, and each as if the other did not exist.

PROPERTY OF VARIOUS FIELDS.

I. The Electric Field.—Suppose a glass rod be electrified with silk or cat skin. It is experimentally known that other bodies in its neighborhood are physically affected by its mere presence without contact, and various motions result which are commonly attributed to electric attraction or repulsion. The phenomena are explained as due to the stress into which the neighboring ether is thrown by the electrified body, the stress re-acting upon other bodies, and moving them this way or that as the stress is greater here or there. Suppose an electrified mass of matter remote from any other matter, in free space. The field, or the stress that constitutes it, is found to vary in strength inversely as the square of the distance from the body in every direction about it, which shows that the effect upon the ether is uniform in all directions, and that for such a stress under such conditions the ether is isotropic. Experiment shows that this kind of a stress travels outwards with the velocity of 186,000 miles a second, or the same as that of light, which shows that the velocity of motion in the ether depends solely upon the properties of the ether, and not at all upon the source of the disturbance. If this assumed electrified mass of matter were the only matter in the universe, then its electric field would be as extensive as the universe, and any electric change in the mass would ultimately re-act upon the whole of space, and be uniform in every direction. If, however, there be another mass of matter in proximity to the first, the disposition of the stress is altogether different; for instead of being disposed radially, as in the first case, the field is distorted by the re-action of the stressed ether upon the second body. The so-called "lines of force" bend more or less towards the second body, and the field stress becomes denser between the bodies at the expense of the field more remote. If this advancing stress in the ether from an electrified body be called radiation, and it seems to be an action of that kind, then it appears that the direction of such radiation depends upon the existence of other bodies in the ether. It is truly rectilinear no further than the shortest distance between the two bodies.

The electric field thus produced, and thus re-acting upon an-

other body, develops in the latter an electrical condition, that is to say, it electrifies it; and the process we call "electric induction," to distinguish it from the transference of the electrification by contact, which is called "conduction." In the process called induction there are two transformations: in conduction there is simply a transference, and no transformation. The experimental fact is this: an electrified body sets up in the ether a stress of such a nature, that, by its re-action upon another body, the latter is brought into a condition similar to that of the first; that is, it electrifies it.

II. The Magnetic Field.—A magnet in like manner sets up in the ether a stress that is propagated outwards with the velocity of light. The physical character of this stress is such that iron and some other substances upon which it can react are thereby rendered magnetic. Their molecules are re-arranged. On the supposition that a piece of iron were suddenly magnetized in any way remote from any magnetizable substance, the magnetic field would spread radially, having a spherical surface. As soon, however, as a piece of magnetizable substance was reached, the re-action of the ether upon it would begin; and the so-called magnetic lines of force will now be curves, and the equipotential surfaces will no longer be spherical. The distortion will depend upon the size, shape, and quality of the second body, as well as upon the strength of the field.

This process is called "magnetic induction." The magnetic field differs from the electric field in this important particular: the latter has no selective property, but re-acts upon all substances, while the magnetic field re-acts upon iron and a few other substances, and but slightly, if at all, upon most bodies. They are alike, however, in this: their equipotential surfaces are determined by the presence or absence of other bodies.

A magnet then sets up such a physical condition in the ether, that its re-action upon another body brings the latter into a condition similar to that of the first; that is, it magnetizes it.

III. — The Thermal Field.—An isolated hot body becomes cool by a process called radiation. It is explained by saying that

the atomic and molecular vibratory motions that constitute the heat of the body, set up undulatory motions in the ether. These undulations are propagated with the velocity of light, certain wave-lengths being light. The path of a ray is straight, and is continued indefinitely outwards, to the boundary of the universe if there be a boundary; if not, then to an infinite distance. A hot body has a field, as well as an electrified or a magnetized body.

Experimentally we know that when these undulatory motions called rays fall upon other matter, it becomes heated in consequence; and we also know that the energy acquired by the second body from the radiations depends rigorously upon the area exposed to them. It is customary to say that the intensity of light varies inversely as the square of the distance from the source, when intensity means energy. This is true, however, only for equal intervals of time; for if a body at unit distance was exposed to radiations from a constant source for one second, and another similar body at double the distance was exposed for four seconds, each unit of surface would have received the same amount of light or radiant energy.

The presence or absence of another body in the thermal field makes no difference in the strength of the field in other directions; in other words, the absorption of radiant energy of this sort makes no manner of difference in the direction of other rays that have not been stopped. I am not aware of the existence of any evidence that a ray of radiant energy of any wave-length is ever deflected from its rectilinear course except by a change in the density of the medium through which it passes, and not then if the incidence be normal. In this respect the thermal field is entirely unlike the other two fields. In addition to this, let it be remembered that a hot body continues to impart its energy to the ether until its income equals its expenditure, according to Prevost's law of exchanges: so, if there were but a single hot body in the universe, it would impart its energy to the ether, and approach infinitely near absolute zero; while an electrified body or a magnet would be perfectly insulated, and, so far as is known, would lose none of

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its properties, however long it was thus kept. There is no static condition in heat phenomena: exchange is constant. These facts indicate that light or radiant energy is no more an electromagnetic phenomenon than magnetism is a thermal phenomenon, but that it is one of a distinct order.

That point is immaterial here, for what I wish to call attention to is the fact that a heated body sets up in the ether such a physical condition that its re-action upon another body brings the latter to a condition similar to the first; that is, it heats it.

IV. The Acoustic Field.—There is another physical field with which all are acquainted, though it has not hitherto been called by that name. I refer to the phenomena of sound. Suppose a bell be struck: sound-waves in air are formed, that travel outwards, and have the same geometrical space-relations that other fields have. So long as the medium is uniform, the field is uniform, and the energy of the sound-waves per unit surface and unit time varies inversely as the square of the distance from the source. When such sound-waves fall upon other masses of matter, they are absorbed and reflected. Those that are absorbed set the body in vibratory motion similar to the original vibrating body; that is to say, they produce sound. If such second body upon which the waves fall happens to have its own vibratory rate in accordance with the time-rate of the incident waves, the effect is cumulative, and the body may be made to vibrate as well as audibly vibrate. If not, the vibrations are said to be forced vibrations; but in every case every body in an acoustic field is made to vibrate. Now, there is the same distinction between the vibratory motions of the bell and the air-waves that result from them as there is between heated molecules and the undulations in the ether; but acoustical terminology has not hitherto been so seriously incommoded by the failure to make the distinction as has been the case with heat phenomena. As sound phenomena are treated as special cases in kinetics, the space within which sound-waves are produced by the vibratory motions of a body may be spoken of as the acoustic field; and here, as in the other three cases, we have the fact that a sounding body sets up in the medium about it such a physical condition as, by its re-action upon another body, brings the latter into a vibratory state like the first.

These various physical relations may be thus generalized: when a mass of matter acts upon the medium that is about it, the latter is thrown into such a physical condition or state that its re-action upon another body always induces in the second body a state similar to that of the first body. This has a much wider application than most physical laws; for it embraces phenomena in mechanics, heat, light, electricity, and magnetism.

A. E. DOLBEAR.

Tufts College, Dec. 21.

The Waters of the Great Salt Lake.

LONG before white men first trod the shores of the Great Salt Lake, strange stories of this inland sea had found their way into the civilized regions of our own land, and even beyond the ocean. The earliest record of the lake was made in 1689 by the traveller, Le Hontan, who relied for his information upon the wild tales told by the Indian tribes of the Mississippi valley. In 1843, however, the lake was visited, its shores explored, and its waters navigated, by Gen. Frémont, of extensive fame. Six years later (1849-50) a fuller survey was made under the personal direction of Capt. Howard Stansbury, U.S.A., whose report, "Expedition to the Valley of the Great Salt Lake," issued at Washington in 1853.

The Great Salt Lake is by far the largest body of water existing in the "Great Basin." Its average length is seventy-five miles; and its width, forty miles. The altitude of the lake is near forty-two hundred feet above sea-level, and the region is declared by geologists to be still rising.

Even a hasty examination of the Salt Lake valley will convince the observer that the present lake is but the shrunken remnant of a vastly larger body of water, which at one time stretched far beyond the limits of the valley. This former sea was a feature of quaternary times, and has been named Lake Bonneville. It extended beyond the Idaho line on the north, invaded Nevada on the west, and closely approached the Arizona boundary on the south. Of this great body, Utah Lake and Sevier Lake, now existing as distinct occurrences in the regions south, were but comparatively

small bays. Numerous water-lines are visible along the mountains adjacent to the Salt Lake, the highest of which is about one thousand feet above the present water surface; and the evidence of wave-action along this ancient shore is abundant.

The history of Lake Bonneville, as recorded on the stony pages of its precipitous shores, and in the hardened sediments of its floor, is more complicated than a mere recital of the shrinking and falling of waters through evaporation and other wasting causes. For most of our knowledge upon this subject, we are indebted to the detailed observation and study conducted by the United States Government Survey corps, and especially to the investigations carried on under the direction of Major J. W. Powell. Referring to the labors of Mr. C. K. Gilbert and his associates in the lake region, Director Powell thus briefly summarizes the history of Lake Bonneville:—

"First, the waters were low, occupying, as Great Salt Lake now does, only a limited portion of the bottom of the basin. Then they gradually rose and spread, forming an inland sea, nearly equal to Lake Huron in extent, with a maximum depth of one thousand feet. Then the waters fell, and the lake not merely dwindled in size, but absolutely disappeared, leaving a plain even more desolate than the Great Salt Lake Desert of to-day. Then they again rose surpassing even their former height, and eventually overflowing the basin at its northern edge, sending a tributary stream to the Columbia River; and, last, there was a second recession, and the waters shrank away, until now only Great Salt Lake and two smaller lakes remain."

As is clearly understood, the oscillations of the water in a lake possessing no outlet will be far more marked than in an opposite case. In a body of water with an outlet, a tolerably uniform level will be maintained, the irregularities in the supply being compensated for the most part by the varying volume of water flowing away; but the level of a lake completely enclosed will be due to the relation existing between the supply of water and the rate of evaporation. The topography of the ancient shore-line of the Great Salt Lake shows, that since the time of the "second recession" of the waters, referred to by Major Powell in the quotation made above, the lake has been unable to find an outlet for its contents, and has consequently reached its present diminutive proportions through loss by evaporation alone. The composition of the water would necessarily vary with the concentration. The analysis most commonly accepted, and which forms, indeed, the basis for current quotations and references, is that made by Dr. Gale, and published in Stansbury's report. Gale found the water to possess a specific gravity of 1.170, and to contain 22.282 per cent by weight of solid matter, as follows: sodium chloride (NaCl), 20.196 per cent; sodium sulphate (Na_2SO_4), 1.834; magnesium chloride (MgCl_2), 0.252; calcium chloride (CaCl_2), a trace.

These figures are used as indicative of the present composition in several of the most recent cyclopædias, such as are used for general reference; and even the revised school text-books in geography quote as above. It should be remembered in accepting such results, however, that the investigation upon which they are based was made on water collected forty years ago; and it is scarcely to be expected that such would represent the composition of the water at the present time. For a number of years preceding 1883 the lake had been steadily rising. This rise was entirely independent of the annual oscillations to which the waters of the lake seem subject under all circumstances. In referring to this fact, Mr. Gilbert writes as follows (see "Lands of the Arid Regions," p. 66):—

"Thus it appears that in recent times the lake has overstepped a bound to which it had long been subject. Previous to the year 1865, and for a period of indefinite duration, it rose and fell with the limited oscillation and with the annual tide, but was never carried beyond a certain limiting line. In that year, or the one following, it passed the line, and it has not yet returned. The annual tide and the limited oscillations are continued as before, but the lowest stage of the new régime is higher than the highest stage of the old. The mean stage of the new régime is seven or eight feet higher than the mean stage of the old. The mean area of the water surface is a sixth part greater under the new régime than under the old. The last statement is based on the United States surveys of Capt. Stansbury and Mr. King. The former gathered

the material for his map in 1850, when the water was at its lowest stage, and the latter in the spring of 1869, when the water was near its highest stage. The one map shows an area of 1,750, and the other of 2,166, square miles. From these I estimate the old mean area at 1,820 miles, and the new at 2,125 miles, and the increase at 305 miles, or 17 per cent."

The probable cause of this increased water-supply in the Great Basin would form a most interesting and instructive subject of inquiry, but such would be foreign to the purposes of the present paper; and here it must suffice to say, that two theories have been advanced as offering most probable explanations of the phenomenon; viz., the climatic theory, and the theory of human agencies. In the report already referred to ("Lands of the Arid Regions") the author says, "On the whole, it may be wise to hold the question an open one, whether the water-supply has been increased by a climatic change, or by human agency. So far as we now know, neither theory is inconsistent with the facts, and it is possible that the truth includes both."

During this recent epoch of increasing volume, the lake-water would be naturally expected to show a far lower percentage of solid contents. In "Contributions to the History of Lake Bonneville," published in the "Report of the United States Geological Survey, 1880-81," Gilbert places the total salinity of the water at fifteen per cent, — a striking variation from the figures of Dr. Gale, yet a variation not at all too great to be fully explained by the increased volume of the lake, and the consequent decrease in concentration. An investigation of the water by Allen in 1869 (see King's report) showed the total solid matter to be 14.9934 per cent. The present writer made an analysis on water taken from the lake in December, 1885, with the following results:—

	Grams per Litre.	Per Cent by Weight.
Sodium chloride (Na Cl).....	132.4983	13.5856
Sodium sulphate (Na ₂ SO ₄).....	75.9540	7.4913
Magnesium chloride (Mg Cl ₂).....	12.6776	1.2295
Calcium sulphate (Ca SO ₄).....	1.6679	0.1477
Potassium sulphate (K ₂ SO ₄).....	4.8503	0.4321
Total solid matter.....	187.6481	16.7162

This water had a specific gravity of 1.1225. Another sample of lake-water taken in February, 1888, showed a density of 1.1261. A further test was made in June, 1889, the water being 1.148 in density; and in August, 1889, the water was 1.1569. The figures resulting from the latest determinations show a considerable increase in the proportion of solids; and this is fully explained by the succession of excessively dry seasons to which the Great Basin has been subjected since 1883, causing a remarkable shrinking of the lake volume. In August, 1889, the lake was lower than at any time since the inauguration of Gilbert's "new régime." A sample of water was taken from the lake during that month, and analyzed, with these results. The water possessed a specific gravity of 1.1569, and contained, —

	Grams per Litre.	Per Cent by Weight.
Sodium chloride (Na Cl).....	182.131	15.7430
Sodium sulphate (Na ₂ SO ₄).....	12.150	1.0502
Magnesium chloride (Mg Cl ₂).....	23.270	2.0114
Calcium sulphate (Ca SO ₄).....	3.225	.2788
Potassium sulphate (K ₂ SO ₄).....	5.487	.4742
Total solids.....	226.263	19.5576

It would be a difficult task indeed to determine the mean composition of the lake. Its waters rise and fall, and become more concentrated or dilute, according to the conditions controlling the rates of supply and evaporation. The latest analysis reported

above, indicating 19.5576 per cent solid matter, though it is a closer approach than usual to the earliest figures, and the ones most widely published, is hardly to be considered typical, since the season of 1889 was one of unusual drought. Two or three consecutive winters with heavy snows would dilute the water to its condition of a few years ago. In the opinion of the writer, it would be more correct to quote the average contents of the Salt Lake water at sixteen per cent solid matters than at twenty-two per cent, as is most frequently done.

Our subject presents an economical aspect which is well worthy of attentive consideration. The composition of the water is such as to suggest the easy manufacture of a number of chemical substances therefrom. Branches of such an enterprise have already been instituted, and the results achieved have kindled the brightest hopes of increasing success.

The preparation of common salt from the water would be naturally the first undertaking of the kind to suggest itself; and this process has been in successful operation on an industrial scale for a number of years. There are now half a dozen establishments for salt-manufacture on the lake shore. At several of these places, however, the preparations for salt-making consist simply in constructing a number of evaporating-ponds below the level of the lake, and separated from the latter by dikes of such a height that during periods of rough water the waves beat over the embankments, and fill the ponds with brine. The evaporation of the water thus enclosed goes on without any artificial aid, and a bountiful harvest of salt in the season thereof is the result. In such cases the evaporation is carried to completion. All the solid constituents of the brine remain in the salt, there being no attempt made to get rid of the mother-liquors after the deposit of crystals.

At other of the works, however, notably at the Inland Salt Company's Gardens, a different plan is pursued. This establishment is the largest salt-works in the West, and is situated near Garfield Beach, the most popular pleasure-resort on the lake. The method employed by this company differs from those already described in that the water is pumped from the lake into ponds prepared for its reception, and situated above the level of the lake surface. The mother-liquors flow off — are returned to the lake, in fact — when the evaporation has reached the proper stage. From the establishment of the works until 1883 the lake was close to the ponds; but, owing to the unusually high rate of evaporation attending the dry seasons of the immediate past, the water has receded, so that at present it has to be conveyed over 2,500 feet to the evaporating receptacles. This is effected by the aid of two centrifugal pumps, raising together 14,000 gallons of water per minute. The pumps throw the water to a height of fourteen feet, into a flume, through which it flows to the ponds. These are nine in number, and are arranged in series. In the first pond the mechanically suspended matters are left as sediment or scum, and the water passes into the second in a clear condition. The ponds cover upwards of a thousand acres, and the drain channels leading from them aggregate nine miles in length. The pumping continues through May, June, and July. A fair idea of the rate of evaporation in the thirsty atmosphere of the Great Basin may be gained from contemplating the fact that to supply the volume of water disappearing from the ponds by evaporation requires the action of the pumps ten hours daily in June and July. This is equal to the carrying away of 8,400,000 gallons per day from the surface of the ponds.

The "salt harvest" begins in August, soon after the cessation of pumping, and continues till all is gathered, frequently extending into the spring months of the succeeding year. An average season yields a layer of salt seven inches deep, which amount would be deposited from forty-nine inches of lake-water. The density at which salt begins to deposit, as observed at the ponds, and confirmed by laboratory experiments, is 1.2121, and that of the escaping mother-liquors is 1.2345. The yield of salt is at the rate of 150 tons per inch depth per acre. The crop is gathered on horse-cars which run on movable tracks into the ponds. At the works the operations are simple and effective. A link-belt conveyor carries the coarse salt to the crusher, thence to the dryer, after which a sifting process is employed by which the salt is separated into table salt and dairy salt.

It will be seen from the foregoing that the preparation of salt

from the lake-water consists of little more than evaporation and crushing, and the former part of the operation is effected wholly through natural agencies. The simplicity of the process, and the lavish yield, enable the manufacturers to put their commodity on the market at an incredibly low price. The Inland Salt Company sells dry, coarse salt for the Eastern trade, packed on cars at the works, at one dollar per ton.

The quality of the lake-salt is of the highest grade. Several specimens of the commercial article, as manufactured and sold by the various companies, have been analyzed by the writer; and of these, the following are typical:—

	Salt made and sold by the Inland Salt Co.	Salt made and sold by the Jeremy Salt Co.
Sodium chloride (Na Cl).....	98.407 per cent	98.300 per cent
Calcium chloride (Ca Cl ₂).....	.371 " "	.345 " "
Calcium sulphate (Ca SO ₄).....	.650 " "	.680 " "
Magnesium sulphate (Mg SO ₄).....	.030 " "	.042 " "
Insoluble matters.....	.102 " "	.472 " "
Moisture.....	.442 " "	.158 " "
	100.002 " "	99.997 " "

According to published figures, commercial bay salt from other sources seldom exceeds 96 per cent sodium chloride.

Next to common salt, in the order of abundance and ease of preparation, sodium sulphate should be named. This is deposited in the crystallized form as mirabilite (Na₂ SO₄ + 10 H₂ O) during the winter season. When the temperature falls to a certain point, the lake-water assumes an opalescent appearance from the separation of the sulphate. This sinks as a crystalline precipitate, and much is carried by the waves upon the beach and there deposited. Under favorable circumstances, the shores become covered to a depth of several feet with crystallized mirabilite. The writer has on several occasions waded through such deposits, sinking at every step to the knees. Speaking only of the amounts thrown upon the shores, and of most ready access, the source is practically inexhaustible. The substance must be gathered, if at all, soon after the deposit first appears; as, if the water once rises above the critical temperature, the whole deposit is taken again into solution. This change is very rapid, a single day being oftentimes sufficient to effect the entire disappearance of all the deposit within reach of the waves. Warned by these circumstances, the collectors heap the substance on the shores above the lap of the waters, in which situation it is comparatively secure until needed. To a slight depth the mirabilite effloresces, but within the piles the hydrous crystalline condition is maintained. At the present time there are thousands of tons of this material, heaped in the manner described, remaining from the collections of preceding winters. The sodium sulphate thus lavishly supplied is of a fair degree of purity, as will be seen from the following analyses of two samples of the crystallized substance, taken from opposite shores of the lake:—

	1.	2.
Water (H ₂ O).....	55.070 per cent.	55.760 per cent.
Sodium sulphate (Na ₂ SO ₄).....	43.060 " "	42.325 " "
Sodium chloride (Na Cl).....	.699 " "	.632 " "
Calcium sulphate (Ca SO ₄).....	.407 " "	.267 " "
Magnesium sulphate (Mg SO ₄).....	.025 " "	.018 " "
Insoluble.....	.700 " "	.756 " "
	99.991 " "	99.757 " "

For purposes of easy comparison, it should be added that chemically pure mirabilite (Na₂ SO₄ + 10 H₂ O) consists of 44.1 per cent of sodium sulphate (Na₂ SO₄) and 55.9 per cent of water.

Beside such substances as are presented in a comparatively pure

form by the lake, the price being simply the labor of collecting, there are many other compounds that may be had for the asking. The unlimited quantities of sodium sulphate spread upon the shore every winter, forcibly suggest the sodium-carbonate industry as a promising undertaking, the chemical labor for preparing the carbonate by the Le Blanc process being, in fact, already half done. A few years ago an establishment was founded for this purpose in Salt Lake City, and, though the labor thus far accomplished has been mostly experimental in its nature, the results conclusively prove that sodium carbonate and a number of other chemical compounds may be derived from the lake-water with ease and profit. When once such manufacture is undertaken on a proper scale, the output of soda need be limited only by the capacity of the works. Caustic soda and sodium hyposulphite have also been prepared from the lake.

The importance of the Great Salt Lake as a source of chemical supplies is still unrealized. Figures would have but little meaning if used in an attempt to express the chemical wealth diffused through its briny waters.

Even for the unscientific observer and the casual visitor, the characteristic phenomena of the lake possess a fascinating interest. Many persons who would be but slightly moved by the statement that the waters of the lake vary in density between 1.12 and 1.17 would be deeply impressed to learn that a bather can float at ease in the water with a large proportion of the body above the surface. When once accustomed to the lake, the swimmer can lie in the watery cradle, with his head resting on a pillow of wood, as securely as in a suspended hammock. The chief difficulty in swimming is the tendency of the lower limbs to rise above the water; and the principal danger lies in the occasional entrance of brine into mouth or nostrils, producing a painful irritation followed by suffocation.

The concentrated state of the brine insures the lake against the fetters of frost. Ice is not to be seen upon its bosom even during the severest winters. The temperature falls at times to -20° F., yet the lake remains as freely open as during the warmer seasons.

The antiseptic properties of the water have been known from the time of its earliest investigation. Capt. Stansbury reported a test, which has been repeatedly verified since his time. His description was as follows:—

"Before leaving Black Rock, we made an experiment upon the properties of the lake for preserving meat. A large piece of fresh beef was suspended by a cord, and immersed in the lake rather more than twelve hours, when it was found to be tolerably well corned. After this, all the beef we wished to preserve while operating upon the lake was packed into barrels, without any salt whatever, and the vessels were then filled up with the lake-water. No further care or preparation was necessary, and the meat kept sweet, although constantly exposed to the sun. I have no doubt that meat put up in this water would remain sound and good as long as if prepared by the most improved methods. Indeed, we were obliged to mix fresh water with this natural brine to prevent our meat from becoming too salt for present use, a very few days' immersion changing its character from corned beef to what the sailors call 'salt junk.'"

As would be expected of so concentrated a brine, and as has been proved by observation, life in the waters of the Great Salt Lake is confined to few species. Some writers have declared that no form of animal or plant life exists in the lake; but this is an error, with but little excuse for its perpetration. The tiny crustacean, *Artemia fertilis*, exists in very great numbers, often tinting the water over wide areas with its own delicate pink. There is also *Ephedra gracilis* in its early stages. The pupa cases of this insect are often carried ashore in large masses, where they undergo decomposition with characteristic odoriferous emanations. One form of *Corixa* has also been found. No fish or other large form of animal life, however, has been discovered in the waters. The vegetable organisms of the lake, the presence of which may be considered a fact from the abundance of animal existences, are almost entirely unstudied. The life of the Great Salt Lake is a subject awaiting further investigation than has thus far been bestowed thereon.

JAMES E. TALMAGE.

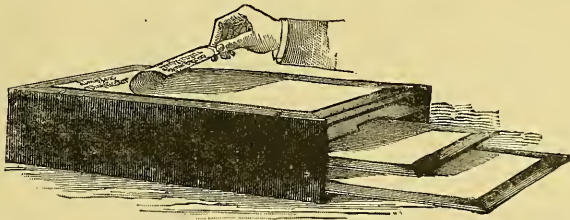
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CALENDAR OF SOCIETIES.

Anthropological Society, Washington.

Dec. 17. — William A. Croffut, Attempts to Promote Prosperity by Limiting Production; Henry L. Reynolds, Human Foot-Prints in Dakota.

New York Academy of Sciences.

Dec. 23. — H. Carrington Bolton, The Contributions of Alchemy to Numismatics (illustrated with rare books and facsimiles of medals, etc.)

Engineers' Club, St. Louis.

Dec. 18. — The executive committee announced the result of the ballot for officers for 1890 as follows: president, F. E. Nipher; vice-president, George Burnet; secretary, William H. Bryan; treasurer, Charles W. Melcher; directors, E. D. Meier and S. Bent Russell; librarian and manager, J. B. Johnson; manager, J. A. Seddon. Professor Nipher, on taking his seat, thanked the club for the honor conferred upon him, and expressed his intention of doing the utmost for the benefit of the club and the advancement of the profession. He then called upon retiring President Meier for an address. Col. Meier responded at some length, with a paper treating of the advances made during the year, particularly in the directions of civil, mechanical, mining, and electrical engineering. Instances of remarkable work done in these branches are noted. He also considered questions of local interest, the numerous engineering projects on hand in the vicinity, the world's fair in St. Louis viewed from an engineering standpoint, the prosperity of the club and plans for its future, and the desirability of a closer union among engineers of the country. The secretary read a communication from the chairman of the executive committee of the Liederkrantz, which body has undertaken the work of erecting a monument to Capt. James B. Eads. The communication suggested the desirability of co-operation between the Liederkrantz and the Engineers' Club of St. Louis, in the direction indicated. President Nipher announced the receipt of a telegram from Professor Potter, stating that he had been detained, and expressing regret that it would be impossible for him to present the paper on "Fuel Gas" announced for the evening. Professor J. B. Johnson, chairman, presented a report for the committee on national public works. President Nipher announced that the proposed visit of Professor T. C. Mendenhall to the city had been deferred until about the middle of January, so that it would be necessary to defer further action about the banquet to be given him. Mr. Nils Johnson showed the club a pump-valve which had been operated under a pressure of 550 pounds for fifteen minutes with ordinary hydrant water.

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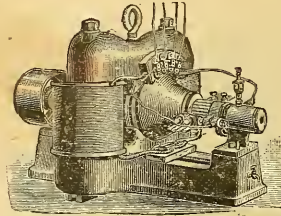
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