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# SEVEN AGES OF ENGLAND

OR,

ITS ADVANCEMENT

# ARTS, LITERATURE, AND SCIENCE,

EARLIEST PERIODS TO THE PRESENT TIME

CHARLES WILLIAMS.

"Recollections of the gradual upward course by which this happy island had for eighteen centuries been advancing to a pitch of elevation unmatched in the history of the world—all came crowding upon me."—RAUMER.

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# PREFACE.

It is remarkable that a volume like the present has not hitherto appeared. Even in the nineteenth century, and at a period abundant in literature, it may fairly establish a claim to *novelty*. England has already been viewed in various and important aspects; but her historians have ordinarily been too much absorbed in the accession and conduct of her monarchs, the factions and intrigues of her courts, and the depression and triumph of her arms, to trace her gradual advance in Arts, Literature, and Science. From various sources, therefore, information on this highly interesting portion of our history has been derived; and the present Work, containing the aggregate, is now most respectfully presented to the general reader.

To this brief introduction, a word may not be improperly added, as to the *size* of the volume. Had it been *less*, it would have furnished little more than a mere outline, deficient in interest; and had it been *larger*,—from the Author following his own inclinations, which it has often required no ordinary effort to repress,—its circuit would be more restricted than that he desires it should have.

LONDON,
*July 16th*, 1836.

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THE

# SEVEN AGES OF ENGLAND.

## THE AGE OF ESCAPE FROM BARBARISM.

B.C. 55—A.D. 1066.

If man, separate and alone, must always be considered an appropriate and important subject for study, then, associated with his kind, he may well awaken a warmer interest, and excite the hope of still richer instruction. Solitary, and wandering over his desert isle, Alexander Selkirk will doubtless reward the attention he receives; but what is the boon thus conferred compared with that which is offered by the intelligent observation of a mighty people? Already much has been gained from the pages of Britain's history, but as these are increased in number by the events of each successive period, our advantages are proportionately greater than those of our fathers, and inferior to those of posterity.

In surveying a nation at any particular conjuncture, however, it is necessary that two extremes should be carefully avoided. One is that of viewing it despondingly, and consequently sighing after "the good old times." And yet by even this error minds of no ordinary calibre have been sometimes enthralled. Thus a learned Apology was written by Hakewell, to show that the moderns were not left so utterly destitute of hope or providence as absolutely to despair of emulating the ancients; and still shorter is the interval since Milton had his misgivings as to the coldness of our climate, and the lateness of the age for an epic poem. The other extreme is that of dwelling on any period with undue complacency, as if a claim to an entire independency of the past could in any instance be established; and he therefore, who, alike disregarding the suggestions of melancholy and pride, resolves to be just, must tread the middle path;—the state of society contemplated should be regarded just as it is, and the fair demands of former times should be promptly and fully conceded.

In pursuing it, we shall find not only that society is progressive, but that the advance which is manifest on observing a certain era depended materially on the state of preceding ages. The lofty and widely-spreading tree which attracts the eye may indeed have recently added to its height or extent, but it arose from the seed or the sapling of a previous time; the edifice which fills us with surprise and admiration, as we gaze on its grandeur and magnificence, required perhaps the labours of many long removed from this world to hew its stones and prepare its site; and it is equally true that fabrics of other kinds lately reared and still arising to eclipse their precursors, are, notwithstanding, indebted to *them* for their beauty, stability, and value. Availing itself of various auxiliaries, England has *grown* to that distinguished state in which it now appears, and its present condition will most probably serve as the basis of an inconceivable progress.

Nor should the fact be overlooked, that if many of the means thus rendered available are of native birth, not a few are to be traced to other and sometimes distant lands. To these, then, as they successively rise to observation, it becomes us to offer an adequate tribute, and from them all to ascend to Him whose varied instruments they unquestionably are. A man, it has been well said, who, without knowing the nature of the course of a river, arrived on its banks, and seeing it here gliding through an extensive plain, there confined within narrow valleys, and in another place foaming beneath the precipice of a cataract, would take the nearest turning where it might be concealed by a projection for *the origin* of the river; ascending higher, however, the cataract would occasion the same illusion; until at length, on reaching its source, he would consider the mountain from which it issues as its spring. But he will soon think that the sides of the mountain would be exhausted by so continual a torrent; and he will see vapours formed, clouds collected, and the rains descending, without which the dried mountain could not supply a spring. Then the clouds will become the first cause; but even then it was the winds that brought them hither by passing over vast seas, and it was the orb of day that attracted the clouds from the ocean; and here therefore the question arises—"To what do we owe this power of the sun?" Guided, therefore, by these considerations, we enter on the progress of our beloved country, commencing our observations at the earliest point of its authentic history.

And here we are apprised that the earliest inhabitants of Britain were in a state of great mental and moral degradation. The larger number were clothed in the skins of beasts; they dwelt in huts reared in the forests and marshes which covered the country; and they wandered from spot to spot; while those who resided in the south-east parts of the island took the first step towards civilisation by the tillage of the land.

On this fact the mind may rest with peculiar pleasure, since mankind never adopt improvements without the pressure of an immediate want, and the ready means of its removal. The first character in which man appears in the drama of life is that of a hunter; only let the chase be abundant, and the supply of game sure, and he will scorn the foresight and labour required by rearing a domestic stock; and when advanced a little, a pastoral country yields food for an abundant increase of cattle, no herdsmen will give their energies to the culture of the fields. Urged by their wants, and allured by a prospect of supply, this portion of the aborigines of Britain passed therefore beyond their contemporary barbarians, and thus present us with what is analogous at least to the little luminous streak above the eastern hills, at once the glimmering token of a triumph over darkness, and the presage of advancing day.

For a time the Britons differed but little in manners from the Gauls, of whom, most probably, they learned some arts. Of the several kinds of cloth made by that people one was composed of fine wool, dyed of several different colours, which being spun into yarn, was woven either in stripes or chequers, and of this the Gauls and Britons made their lighter or summer garments. Here is the origin of the Scotch plaid or tartan, which is called to this day "the garb of old Gaul;" and indeed, excepting the plumed bonnet and the tasselled purse, a Highland chief, in his full dress, is much like an ancient Briton of distinction.

This assimilation was perfectly natural, as, according to the concurrent testimony of early writers, Britain was originally peopled from Gaul; and its first inhabitants belonged to the same Celtic race as occupied that country and Spain. For a time, too, these people only associated with the Britons. Lying on the margin of the known world, appearing as the extreme barrier of its ancient geography, an isle like a rude fragment torn by some convulsion of nature from the main land, and flung into the ocean-region of the north, Britain was one of the parts of the world last known to the Greeks and Romans. For a long time it appears to have been noticed only as a country supplying tin;—a rare and useful metal, not then found in any other part of Europe, or in Western Asia. The Cassiterides, or islands of tin, mentioned by Herodotus, included, Major Rennell conceived, a vague idea of the whole group of the British islands; though the appellation might be originally restricted to the Scilly Islands, and to the south-western promontory of England, from the Lizard Point to the Land's End, where alone tin was to be found. To obtain this valuable mineral, the coasts of Britain were sought, at an early period, by the ships of various mercantile states, especially the Carthaginians; and the tin of Tarshish, mentioned by Ezekiel, is thought by some to have been brought from the mines of Cornwall.

Intercourse thus originating with other people would be likely to increase the skill of the Britons, and to add valuable articles to their humble store. Thus the Tyrian traders seem to have taught them to make spear-blades and arrow-heads, from a composition of copper and tin, by first showing them their own rude weapons in this mixed metal, and then directing them to improve them in form, and to use them with dexterity. The lance, formed of a long bone, ground to a point, and placed in a split at the end of an oaken shaft, where it was secured by wooden pegs, was first followed by a metal blade, shaped and fastened in a similar way;

but shortly afterwards the shaft, instead of receiving the blade, was well fitted into a socket, and, finally, the blade assumed a proper form. The arrow and the hatchet, or battle-axe, were as gradually improved. The sword they probably owed to the Phœnicians or Gauls, who also made these weapons of brass, and of a similar form. The hilt was cased on each side with horn; and hence the saying— "He who has the horn has the blade."

The flat circular shields of the Britons, too, which, like their quivers, their boats, their idols, and various other articles, were of wicker, were soon either imitated in brass, or covered with a thin plate of that metal. Two, still preserved, have a hollow boss in the centre to admit the hand, as, in action, they were held at arm's length.

The temples in which the Britons worshipped their deities were composed of large rough stones, arranged in circles, for they had not sufficient skill to execute any finished edifice. Some of these circles are yet existing; such is the "Giant's dance," to use the British name, but which is known to us as Stonehenge, near Salisbury. There appear the huge masses, grey with age; and from the present state of the structure, we may clearly infer how the whole pile was formerly arranged. Imperfect as it is, it has still the air of a stern and savage magnificence. Its ancient name intimates that it was fabled to have been built by giants, or otherwise constructed by magic art.* All around in the plain

* Note A.

are the tumuli, or mounds of earth, beneath which the Britons buried their dead. Antiquarians have sometimes opened them, and discovered vases, containing the ashes and bones of the primeval Britons, together with their swords and hatchets, and arrowheads of flint or of bronze, and beads of glass and amber;—for it was probably believed by them, as it is by other uncivilized people, that the dead delight in what pleased them during life, and that the disembodied spirit retains the inclinations and affections it discovered in its mortal state.

But whatever traces may appear of civilisation, it is highly probable that it was long extremely partial. Knowledge was almost the exclusive possession of the Druids, and was carefully concealed in their groves and sanctuaries. Even the improvements introduced by commerce extended but little beyond the borders of the coast. The mass of the people were without clothing, without places of settled abode, without the means of certain subsistence, and without even the elements of instruction.

A fresh impetus, however, was received by the Britons when their country was added to the vast territory of the mistress of the world. Julius Agricola, who finally established her dominion in this island, did not neglect, amidst his military enterprises, the arts of peace. To him was owing no inconsiderable advance. He introduced the manners and language of his people; and before the close of the first century, the chiefs began to dislike the early British habit, and their sons to dress as the invaders did. Roman roads and castles were now built, and potteries established, the remains of which appear in many parts of England, particularly in Staffordshire,—the site of those which have added to the comfort, wealth, and fame of England. In the course of eleven years, it is said, Camelodunum, the most ancient Roman colony in Britain, became capable of containing many thousands of inhabitants, and was adorned with temples, baths, theatres, statues, and other public works.

The Romans also fortified many strong cities in different parts of the island, surrounding them with lofty ramparts. These "colonies" or "municipia" were peopled with Roman inhabitants, who came hither from Italy, accompanied by their wives and children; and within the circuit of the fortifications they built similar and splendid structures, living in luxury and delight. It still happens that when workmen are employed in digging the foundations of new erections in modern towns, occupying the site of Roman cities, such as Cirencester, Colchester, and Gloucester, they find, at a great depth below the surface, beautiful tesselated pavements, composed of coloured stones, arranged in elegant patterns, the decorations of the Roman palaces.

Silver has been obtained in considerable quantities in England, and that from an early period of our history. Cicero, indeed, tells his friend Atticus that there was not a scruple of silver in the whole island; from which we may perhaps safely infer, that the aborigines were not acquainted with the methods of obtaining it at the time to which he alludes, but which, it is probable, they soon learned from their Roman conquerors. At all events, within about half a century afterwards, Strabo mentions silver as one of the mineral products of Britain; and according to some authorities, it was obtained in sufficient quantities to have been coined into money in the time of Augustus. This precious metal, however, is rarely met with in this country in a pure state, but is commonly derived from the lead smelted in Cornwall, Devonshire, Northumberland, and Durham. Every description of our native lead ores is said to contain some portion of silver, and from these it has for ages been extracted. From about the period just mentioned we may date the beginning of our manufactures in metal.

The final retirement of the Romans exposed the Britons to the incursions of the Picts and Scots; and when refused relief by their former conquerors, they deserted their habitations, abandoned their tillage, and flying for protection to the forests and mountains, suffered equally from hunger and the enemy. On the withdrawal of the barbarians, they shook off their despair, returned to their usual occupations, and favourable seasons increasing the reward of their industry, soon forgot their past misery, and enjoyed in abundance the necessaries of life. Any approach to union amongst the Britons might have enabled them to repel their enemies when they returned to the assault. The walls of the cities fortified by the Romans were still firm and strong, the tactics of the legions were not forgotten, bright armour was piled in the storehouses, and the serried line of spears might have been presented to the half-naked Scots and Picts, who, thus determinately resisted, could not have prevailed against the invaded. But the Britons were deeply degraded; they were unfitted for such a struggle; and hence kings and people were alike involved in great and ruinous distress.

Within about forty years after the dissolution of the Roman government, the Saxons were therefore called in as allies. These hardy adventurers, issuing from the north of Germany, and occupying the line of coast from the mouth of the Rhine to Jutland, were equally formidable as warriors and mariners, and had long infested by their piracies the neighbouring parts of Britain and Gaul. Eagerly accepting an invitation, they sent a small force under two chiefs, who having obtained an easy victory over the Scots and Picts, determined to dispossess the Britons of a country which they could not defend against so contemptible a foe, and which was in all respects superior to their own. Especially was this the case, as agriculture had been so much encouraged, after its complete subjugation by Agricola, that it had become one of the western granaries of the empire. The Britons of the fifth century may therefore be considered to have pursued the best system of husbandry then in use, and their lands to have been extensively cultivated, and to have borne the features of improvement. Urged by the success of this enterprise, colonists arrived, chiefly composed of three valiant tribes, the Jutes, the Old Saxons, and the Angles. The Old Saxons claimed precedency as the leaders of the conquest; the Jutes demanded the credit of erecting in Kent the first independent kingdom; and the Angles, distinguished for their numbers and success, had the honour of bestowing a permanent name on the country.

Many buildings, it may here be observed, had been erected in this country by the Romans; but after their retirement the arts declined. In addition to this, the most wanton ravages were committed by the Anglo-Saxons, who seem to have destroyed all the towns and castles which they took, instead of keeping them for their own use.

Masonry, however, was restored, and some other arts connected with it were brought into England, towards the end of the seventh century, by two clergymen, who had often visited Rome. One of them, Wilfrid, Bishop of York, erected several buildings at York, Ripon, and Hexham, which are greatly admired. The cathedral of Hexham is described as a splendid structure.

A monastery was founded near the mouth of the river Were, A.D. 674, by Benedict, the other clergyman referred to; and about a year after, he brought a number of masons from France to build the church of his monastery of stone, after the Roman manner, of which he was a great admirer.

The first Saxon churches of our island had been all built of wood. The church of Durham was built of split oak, and covered with reeds, like those of the Scots; and in Greensted church, in Essex, the most ancient part—the nave or body—was entirely composed of the trunks of large oaks, split and rough-hewn on both sides. They were set upright, and close to each other, being let into a sill at the bottom, and a plate at the top, where they were fastened with wooden pins.

It has been thought by some that the Saxon churches, after they began to be built of stone, had only upright walls, without pillars or arches; but they are shown to be wrong, by the remains of some buildings, universally allowed to be of Saxon workmanship, one of which is the ancient conventual church at Ely. Many arches built by the Romans must have been often seen by the Saxons; two, particularly, are now remaining in Canterbury only—one in the castle-yard, and the other at Riding-gate. It appears, indeed, that what is commonly called Saxon, is in reality Roman architecture.

But while progress was thus made, the art of building seems to have been almost entirely lost among the descendants of those ancient Britons who had fled for refuge to the mountains of Wales. The chief palace of their kings, where the nobles and others assembled to make laws, was called the white palace, because the walls of it were woven with white wands, which had the bark peeled off. By the laws of Wales, whoever burnt or destroyed the king's hall or palace was obliged to pay one pound and eighty pence, besides one hundred and eighty pence for each of the neighbouring buildings—the dormitory, the kitchen, the chapel, the granary, the bakehouse, the storehouse, the stable, and the dog-house. Thus it appears that a royal residence in Wales, with all its offices, was valued, when these laws were made, at five pounds and eighty pence of the money of that age, which is equal in quantity of silver to sixteen pounds of our money, and in value to one hundred and sixty. This is a sufficient proof of the meanness of the dwellings, which were entirely of wood. Even the castles in Wales, that were erected at this time for the security of the country, appear to have been reared of the same materials; for the laws required the king's vassals to come to the building of them with no other tool than an axe.

The city of London acquired distinction at an early period; its fame was diffused far and wide; and it was resorted to by merchants from all parts of the world. Its extent was confined to what is now termed the city, then surrounded by a wall, built, as it is supposed, about the age of Constantine, and of which there are still a few fragments. All around was open country. Towards the north-east a deep marsh,—till lately known by the name of Moorfields,—extended to the foot of the Roman ramparts. On the western side of the city, and at the distance of nearly two miles, the branches of a small river which fell into the Thames formed an island so overgrown with thickets and brushwood, that the Saxons called it "Thorney," or the "Isle of Thorns." The river surrounding Thorney crept sullenly along the plashy soil; and the spot was so wild and desolate, that it is described as a fearful and terrible place, which no one could approach after night-fall without great danger. In this island there had been an ancient Roman temple consecrated to Apollo; and Sebert, perhaps on account of the seclusion which Thorney afforded, resolved to build a church on the site. This church is now Westminster Abbey; the busy city of Westminster is that seat of desolation, old Thorney Island. Sebert also built another great church in the city of London, which is now St. Paul's Cathedral.

Whitaker has said, in a lively and eloquent passage, which exhibits a country scene, "Could a curious observer of the present day carry himself nine or ten centuries back, and, ranging the summit of Pendle, survey the forked vale of Calder on one side, and the bolder margins of Ribble and Hodder on the other, instead of populous towns and villages, the castle, the old tower-built house, the elegant modern mansion, the artificial plantation, the inclosed park and pleasure-ground: instead of uninterrupted inclosures, which have driven sterility almost to the summit of the fells; how great must then have been the contrast, when, ranging either at a distance, or immediately beneath, his eye must have caught vast tracts of forest ground, stagnating with bog or darkened by native woods, where the wild ox, the roe, the stag, and the wolf, had scarcely learned the supremacy of man, when, directing his view to the intermediate spaces, to the windings of the valleys, or the expanse of plains beneath, he could only have distinguished a few insulated patches of culture, each encircling a village of wretched cabins, among which would still be remarked one rude mansion of wood, scarcely equal in comfort to a modern cottage, yet then rising proudly eminent above the rest, where the Saxon lord, surrounded by his faithful cotarii, enjoyed a rude and solitary independence, owning no superior but his sovereign." About a fourteenth part of this parish of Whalley, to which he refers, was cultivated at the time of Domesday. This proportion, however, would by no means hold in the counties south of the Trent.

The Saxons and Britons mingling by slow degrees, formed in time but one people. The frequent quarrels of the princes of the heptarchy rendered the manufacture of arms again a work of necessity. The tribe called the Deiri, aiding their prince, Edwin, by a liberal supply of weapons, and of soldiers hardy enough to use them, seated him on the throne of Northumbria, and supported him against the attacks of the infamous Penda; and he, in return, encouraged useful arts. For him the south Deirans are presumed to have tried a new fabric with their iron; for he had a number of iron dishes forged, and fastened with chains beside the various springs and fountains which lay on the route generally travelled from one town to another, so that passengers might refresh themselves on their journeys. According to local accounts, vestiges of these benevolent arrangements have not long since existed in that part of Deira which is comprehended within the wapentake of Strafforth and Tickhill.

Passing from these circumstances to others, it is worthy of remark that the Anglo-Saxons employed certain mysterious characters denominated Runes — a name implying secresy. The *heathen* nations who used them supposed that these letters possessed magical powers. Some Runes they believed could stop the vessel in her course, divert the arrow from its path, awaken love or hatred in the bosom, cast the living into a death-like slumber, and raise the corpse from the sleep of the grave. The origin of these characters ascends into the most remote antiquity.

The explanation given of them in particular instances has greatly varied. Thus an inscription on a fine and perfect font, still preserved in the church of Bridekirk, in Cumberland, has been interpreted by one individual — "Harold made this heap, and raised these stones, in honour of his mother, and of Mabrok;" while another says, "Let the inscription speak for itself;" and being thus allowed, it means, according to the attendant of the oracle,—"Here Eckard was converted; and to this man's example were the Danes brought." But

"Who shall decide when doctors disagree?"

Others, equally confident, have advanced and engaged in this strife;—a further arrival of antagonists may yet be announced, and perhaps in their rear some one will be found to demonstrate that all his predecessors were utterly in the wrong.

On the *conversion* of the Anglo-Saxons to Christianity, the Runes went almost wholly out of use, being superseded by the Latin characters, which enabled such as acquired the skill of letters to communicate with the civilized nations of Europe. The Roman missionaries taught their pupils to write the hand which they themselves used; and that character constitutes what is termed the Anglo-Saxon alphabet. It is believed, however, that the use of the Runes lurked among the Anglo-Saxons, and that they employed the ancient characters for magical charms. The Danish population of Northumbria certainly retained them till the Conquest, as is proved by various monuments.

Though reading and writing had now ceased to be mysteries, as under the thraldom of Druidism, they were still acquirements almost wholly confined to the clergy. Thus the word 'Clericus,' or 'Clerk,' became synonymous with Penman, the sense in which it is still most commonly employed. If a man could read, and especially if he could write, his attainments were considered as proof presumptive that he was in holy orders. When kings and other great men had occasion to authenticate any document, they subscribed the *sign* of the cross opposite to the place where the "Clerk" had written their names. Hence the phrase, to *sign* a deed or letter. Some persons now bending with years, and happily like the ichthyosauri, relics of times gone by, may still be found to pursue the same course; they draw a cross, by the side of which the attorney's clerk adds their christian and surnames. This was once the style *royal*, but it will soon altogether cease to be the style, *plebeian*. Heaven speed the day!

" For is it fitting that one soul should pine,
For want of culture in this favoured land,
That spirits of capacity divine
Perish like seeds upon the desert sand,
That Education in this age of light
Should not by birth be every Briton's right?"

Circumstances in early times were altogether very different to ours. The laity, or people who were not clerks, did not feel any urgent necessity for the use of letters. Commerce was carried on principally by truck or barter, or by payments in ready money; and sums were cast up as among the Romans, on an abacus, or accounting-table, the amount being denoted by *counters* or similar tokens.* From the difficulty of communicating between place and place, common people had seldom any opportunity of conveying intelligence to absent friends. Important transactions were then arranged in the most simple manner. If an estate is purchased at the present time, a conveyance—an instrument well known as a thing of parchment, and stamps, and seals, and hard words—must be prepared; but then, if Cathmore sold his land to Ulric, he cut a

* Note B.

turf from the green-sward and cast it into his lap, as a symbol that he was thenceforward the possessor of the soil; or tearing off the branch of a tree, he placed it in his hand, to show that he had become entitled to all its produce. When, too, the purchaser of a house received seizin, or possession, a bundle of thatch plucked from the roof, as well as the key of the door, signified that to him the dwelling was yielded.

With this practice the Normans were acquainted. Thus, when William first set foot on the British shore, he stumbled and fell forward on the palms of his hands, and his troops, affrighted by the omen, declared it to be unfavourable. But what was the reply of William, as he showed the clod of earth he had grasped? "No, I have taken seizin of the country." On which, one of his soldiers, with great quickness, followed up what must be deemed a happy thought, by running to a cottage and pulling out a bundle of reeds from the thatch, and begging him to receive that symbol also, as the seizin of the realm with which he was invested.

Sometimes the symbols of possession were varied by the fancy of the granter. One Anglo-Saxon delivered a knife, with (what a boon!) a hair of his beard; another gave a glove; and a third a curry-comb. Ulfus, a noble of Northumbria, disinherited his sons, and granted his lands to the Archbishop of York, by laying his mighty ivory drinking horn on the altar, while he declared his purpose, and the horn of Ulfus is still kept in the cathedral; for such testimonies of the right to property were then preserved as carefully as title-deeds or charters; and a part of the "Terra Ulfi" is even now possessed by the chapter of the Minster. The intent of these symbols also supplied the place of writing, by impressing the transaction on the minds of witnesses who were called together for the occasion.

As the extreme ignorance of the age made deeds and writings very rare, the county or hundred-court was the place where the most remarkable civil transactions were completed, in order to preserve the meaning of them, and prevent all future disputes. Here testaments were made known, slaves manumitted, bargains of sale concluded, and sometimes, for greater security, the most considerable deeds were inserted in the blank leaves of the extant portion of the sacred volume, which thus became a kind of register, too hallowed to be falsified. It was not unusual to add to the deed an imprecation on all those who should be guilty of such a crime.

Barbarous as these times are considered, the people had more to do with poetry than ourselves. Verse commonly preserved a record of facts, and inculcated doctrines confided to the memory. The achievements of ancestors were celebrated in song; and even legal formulæ were enshrined in verse. Greatly did the Anglo-Saxons delight in rhythm and harmony. The harp went round from hand to hand at their festivals; and he who could not join in the *glee* was considered as unfit for respectable company. When Aldhelm, Bishop of Sherbourne, wished to engage the attention of his townsmen, he did not assemble them in the chamber of a splendid episcopal residence, but he stood on the bridge, and sung a ballad which he had composed.

Some persons, too, became *glee-men*, and went about from place to place, visiting alike the castle of the noble and the hut of the peasant, singing songs, telling amusing tales, and every where receiving a cordial welcome. Verse, amongst the northern nations, was often composed extemporaneously; and, according to the practice of the improvisatori in Italy, to the sound of an instrument, or at least in song. Thus the sleepy were roused to listen to their voice, and the wakeful, as they hearkened, became more cheerful. Even in war-time, these glee-men, or minstrels, could travel without danger; no one felt unkindly to them, or would inflict on them the slightest injury. The seeds of poetry, indeed, are the events of dark ages, increased by tradition, and expanding with the growing imagination of men, who are passing from obscurity into light. These traditions, after receiving the colour of the popular fancy, are moulded by that of the earliest bards, thus preparing the way for some mighty genius to give them their last form—a form glorious and immortal. Such was Homer—such were his works; but though in the times of the Anglo-Saxons there were materials on which to operate, there was no mind approaching his, to whom we owe—

"The Tale of Troy divine."

Of the sacred poems of the Anglo-Saxons, none were more celebrated or more singular than those of Cædmon, who had passed beyond the middle stage of life before he was able to repeat a stave. Sooner than sing in his turn, he would rise as he saw the harp approaching him, and retire, absorbed by a sense of his inferiority. On one such occasion, it is stated, he took refuge in a stable, when it was his turn to tend the cattle, and there he fell asleep in the straw. In the slumbers of that lonely dormitory he dreamt that a stranger came and asked him to sing, on which he replied, "Nay, do I know how to sing? And is not that the reason why I have left the good company?" But still urged, and the subject of the Creation being proposed, Cædmon poured forth an unpremeditated song, which remained firmly imprinted on his memory when he awoke. To the lines thus prepared he added many others, which led to his introduction, by the reeve, or steward of his village or township, now called Whitby, to the abbey of St. Hilda, where a large and learned auditory had assembled. Doubting his ability after hearing his hymn, he was required to put a subject from sacred history into verse; and on the following day, he produced his composition, which met with great applause. He became a monk; and though he could not read, his more learned brethren taught him portions of sacred history from time to time, and, after much consideration, he sang his lessons to his teachers in a metrical form. Thus he completed a selection of portions from Scripture, referring to the creation and redemption of mankind, besides many hymns and devotional poems. And well would it be if all poets had merited the eulogium pronounced by Bede, "Never did Cædmon compose an idle verse!"

In the language spoken by this ancient people, however, a great variety of literary relics has been preserved. "The Anglo-Saxon literature," says Professor Rask, "possesses, in many respects, even for its own sake, no small degree of interest. The numerous ancient laws throw considerable light upon the laws of the old Germans and Scandinavians, as well as upon their customs and civil institutions. The old chronicles and genealogies are important sources for the ancient history of the Low German and the Scandinavian nations. The various documents illustrate much in English history. Even the theological remains, showing the constitution and doctrine of the ancient church, are not devoid of value for ecclesiastical history, especially to the modern English and Scottish churches. The translation of several parts of Scripture may likewise be advantageously employed in biblical researches. But, of all, the poetical pieces are the most interesting, especially the great Anglo-Saxon Poem, in forty-three cantos, published at Copenhagen, in 1815, by the royal Archivarius, G. J. Thorkelin, which, from its commencement, he has aptly entitled *Scyldingis.* This is, perhaps, the only Anglo-Saxon piece possessing value on account both of its matter and style, particularly for the nations of the north, the principal hero being Swedish or Gothic, though the action lies in Denmark. This ancient poem, more generally known by the name of *Beowulf*, has been translated into Danish verse by Dr. Grundtvig, and ably illustrated by Mr. Conybeare."

It has been intimated that music was early married to verse,—music, which has been as universal as poetry; but like poetry, it has every where existed in various degrees of refinement. Among savages it is exceedingly rude and noisy, but it approaches or attains to excellence in proportion to the progress of civilisation. In the drawings or the manuscripts of the Anglo-Saxons we recognise the horn, the trumpet, the flute, and the harp. Bede, who describes the drum and the cymbals, says also: "An organum is a kind of tower made with various pipes, from which, by the blowing of bellows, a most copious sound is issued; and that a becoming modulation may accompany this, it is furnished with certain wooden tongues from the interior part, which, the master's fingers skilfully repressing, produce a grand and also a most sweet melody."

The introduction of Christianity, though in a corrupt state, had cast a faint gleam over the thick darkness that had prevailed, and greatly tended to improve the literary as well as the moral character of the people. In proof of this, Ethelbert, the earliest christian king, first reduced the English laws to a system, and committed them to writing; and Sigbert, king of East Anglia, founded a school, or college, similar to those long established on the continent. Aldhelm, too, lived at this period, who is described as "a man of universal erudition, having an elegant style, and eminently conversant with books, both philosophical and religious." He was the first Englishman who wrote in Latin with any degree of purity; but, unhappily, the greater part of his productions has perished.

Theodore, a native of Tarsus, in Cilicia, who filled the see of Canterbury, and Adrian, the abbot of the Augustine convent in that city, also obtained for themselves this honourable testimony: "These great men, excelling in all parts of sacred and civil literature, gathered round them multitudes of pupils, whom they instructed daily in the sciences, and to whom they read lectures on poetry, astronomy, and arithmetic, as well as on divinity and the sacred Scriptures."

The Venerable Bede is also fully entitled to remembrance. The collection of his works, still extant, in eight folio volumes, contains treatises on almost every subject of philosophy and religion; a remarkable proof of his industry and learning, a deduction from the value of which must, however, be made from his great credulity.

Books were, however, extremely rare among the Scandinavian and other northern nations. Before their communication with the Latin missionaries, wood appears to have been the material on which their Runes were chiefly *written;* and the verb *write,* derived from a *root—ritzen* or *reissen*—signifying to *scratch* or *tear,* is one testimony to this usage. The

Cymri, or people of Wales, adopted the same plan. Their poems were graven on small staves or rods, one line on each face of the rod; and the old English word 'stave,' as applied to a stanza, is probably a relic of the practice, which, in the early ages, prevailed in the West. In the East the same custom appears; the slips of bamboo on which the inhabitants of the Indian Archipelago now write or scratch their compositions with a bodkin, are substantially the same as our ancient staves. The place of these materials was afterwards supplied by vellum or parchment. Real paper, manufactured from the pellicle of the papyrus, or Egyptian reed, was still occasionally used in Italy, but it was seldom exported to countries beyond the Alps.

The name of Alfred shines forth from the darkness of the period in which he lived with a radiance without parallel. He was wholly ignorant of the first elements of literature when he had reached his twelfth year, though at an early period of life he could bend the bow and wind the horn, hunt and hawk, and had acquired great skill in the art of the chase. His genius was first roused by the Saxon verses, recited in his father's halls by the minstrels and the glee-men, the masters of Anglo-Saxon song. Thus stimulated, he soon learned to read them, then proceeded to acquire a knowledge of the Latin language, in which he met with authors better adapted to the culture of his mind; and would have made still further attainment, had he not been called to the throne, and compelled to oppose the ravages of the Danes.

Alfred carried in his bosom memorandum leaves, in which he made collections from his studies, and took so much pleasure in the frequent examination of this journal, that he called it his *hand-book*, because day and night he ever had it in hand with him. It appears to have been the repository of his own occasional literary reflections.

The Anglo-Saxons had no clocks or watches, nor even hour-glasses; and yet Alfred was careful to lose no time. Eight hours sufficed for rest and refreshment; and the other sixteen he divided equally, giving one part to reading, devotion, and improving his mind, and the other to governing and improving his subjects. He measured his time by wax candles, marked with rings of various colours, and, to prevent their being blown out by the wind, he invented a kind of lantern, made of horn. Six candles, each twelve inches long, being made of a certain quantity of wax, were lighted one after another, and each one burned four hours; thus the six lasted twenty-four hours, or one day. He, therefore, easily divided his time into three portions of eight hours each. Persons were appointed to attend the candles, and to tell him how the time passed.

A foe to ignorance, in any circumstances, he gave valuable lessons to the people in apologues, parables, and apothegms, couched in poetry, partly the produce of his own mind, and partly that of others. He also translated the book of Psalms. To him indeed belongs the honour of having raised the literature of England from a state of deep degradation to an elevation it had never before attained. He promoted education among all classes of his subjects. By an express law, he obliged all parents possessed of a hide of land, to give their children a liberal education; and by another, he instituted benefit of clergy, or a remission of the first offence in the case of such criminals as could read and write.

But even the clergy of that period were very ignorant. "Very few were they," says Alfred, "on this side the Humber (the most improved parts of England) who could understand their daily prayers in English, or translate any letter from the Latin. I think there were not many beyond the Humber; they were so few, that I indeed cannot recollect *one single instance* on the south of the Thames, when I took the kingdom." The earls, governors, and servants of Alfred were equally ignorant. It is amusing to remember that in these times aldermen, and mayors, and governors were forced to go to school, under pain of forfeiting the offices and emoluments they held. Those who could not learn from age or extreme feebleness of mind, had to send a son, or a near kinsman, for instruction, and failing here, a vassal, or even a slave.

Alfred erected various castles and fortresses, thus making the whole kingdom like one great garrison; and built ships, something like the galleys of the Greeks and Romans, each one having an iron prow, or sharp projecting point, so that in war one vessel might injure another by striking against it. Thus we discover the first movement towards the formation of that naval force on which Great Britain mainly relies to maintain her own independence and her ascendency over foreign nations.

Alfred invited from all quarters industrious foreigners to repeople his country, which had been desolated by the Danes. He introduced and encouraged various manufactures, rewarding each inventor or improver of any ingenious art. He urged men of activity to navigation and commerce; and a portion of his own revenue was set apart to maintain a number of workmen, whom he constantly employed in rebuilding the ruined cities, castles, palaces, and monasteries. 17, 762

Still arts and manufactures were long in a very humble state. Neither the workmen nor their customers, however elevated in society, showed much imagination or taste. Utility, glaring gaudiness, and material value, were the chief objects of general estimation. No commendation called forth delicacy and ingenuity of workmanship, and none sought to acquire them. Real necessity was for some time the great spring of action; the productions of the artisans and manufacturers were therefore few, inartificial, and unvaried. But by degrees the manumission of slaves enlarged the number of the independent part of the lower orders; and the augmentation of society, or its increased activity, produced an amount of property beyond the daily consumption, which acquired a permanent state in the country, in some form or other, and thus constituted its wealth.

War and agriculture need the smith; of this artisan frequent mention is made, and a distinction is drawn between such workers in iron and those in silver, copper, and gold.

The former were so highly regarded in those warlike times, that every military officer had such an attendant to keep his arms and armour in order. The chief smith was a person of considerable dignity in the court of the Anglo-Saxon and Welsh kings, where he enjoyed many privileges. In the Welsh court the king's smith sat next to the domestic chaplain, and was entitled to a draught of every kind of liquor that was brought into the hall. Another important occupation was that of the carpenter in modern phrase, but in Saxon, the *tree* or *wood-workman*, and there were others variously denominated. Besides the persons who made such trades their business, some of the clergy appear as labouring to excel in the mechanical arts. Thus Dunstan was not only able to draw and paint the patterns for a lady's robe, but he was also a smith, and worked in all the metals. Among other products of his industry, he made two great bells for the church at Abingdon; and his friend Ethelwold, the Bishop, made two other bells for the same place, of a smaller size; and a wheel full of small bells, much gilt, to be turned round for its music on feast days. He also displayed great art in making a large silver table of curious workmanship. Stigand, the Bishop of Winchester, made two images and a crucifix, and having gilded them, assigned them a place in the cathedral of his diocese. Edgar, indeed, issued a command that every priest should diligently learn some handicraft.

It is a very curious fact, that Alfred wore an ornament, probably fastened to a necklace, made of gold and enamel, which being lost by him at Athelney, was found there, entire and undefaced, in the seventeenth century. It is now preserved in the Ashmolean Museum, at Oxford; and the inscription, "Alfred het meh gewircan"—"Alfred caused me to be (worked) made,"—places its origin beyond all doubt.

The manufacture of glass was unknown in England in the seventh century, when Benedict, the abbot of Wearmouth, procured men from France, who not only glazed the windows of his church and monastery, but taught the Anglo-Saxons the art of making glass for windows, and various uses. There appears, however, to have been but little progress made, as in the next century Bede, addressing a Bishop of France, begs such persons to be sent, and promises that they shall be well received. Still it was not till the eleventh century that glass windows may be said to be used, either in private dwellings or in public religious edifices. Previously to this time, light was imperfectly transmitted through linen cloths or wooden lattices. The houses of the common people were some centuries longer without this luxury, and were then greatly behind the inhabitants of Italy and France.

Aldhelm shows that the Anglo-Saxons had the arts of weaving, embroidering, and dyeing; and he says, "We do not negligently despise the woollen stamina of threads worked by the woof and the shuttles, even though the purple robe and silken pomp of emperors shine." Again, "the shuttles not filled with purple only, but with various colours, are moved here and there among the thick spreading of the threads, and by the embroidering art they adorn all the woven work with various groups of images." Edward the Elder had his daughters taught to exercise their needle and their distaff. So common indeed was spinning, that as in later times unmarried ladies have been called spinsters, Alfred, in his will, styled the female portion of his family the *spindle* side.

Nor were the people unacquainted with defensive body-armour. The enigma of Aldhelm proves that, so early as the eighth century, they were familiar with the *byrne* or tunic of rings, derived from the Phrygians.

"I was produced," runs the enigma, "in the cold bowels of the dewy earth, and not made from the rough fleeces of wool; no woofs drew me, nor at my birth did the tremulous threads resound; the yellow down of silkworms formed me not; I passed not through the shuttle, neither was I stricken with the wool-comb; yet, strange to say, in common discourse I am called a garment: I fear not the darts taken from long quivers." It is probable, however, that the byrne did not become general till the constant descent of the heavily-armed Danes compelled the Saxons to wear defences equal to those of their enemies. The weapons of the people were all formed of iron, and consisted of long broad-swords, double-edged daggers, javelins, and long spears, some of which were barbed, and others broad and leaf-shaped. They had also axes with long handles, which they called bills.

The partial civilisation and the poverty of the great body of the people limited their demand for foreign goods. Still the visiting of distant parts, for the sake of traffic, had already begun. Alfred gives an interesting account of the voyage of Ohthero towards the North Pole, and of that of Wulfstan in the Baltic. He says that men went to the north both for traffic and discovery; that they pursued whales for their teeth, and made ropes of the hides. We read of merchants from Ireland landing at Cambridge with cloths, and exposing their merchandise to sale. London, even in the seventh century, is mentioned as a port which ships frequented; and we find merchants' ships sailing to Rome. The trading vessels sometimes joined together, and went out armed for their mutual protection; but it may be supposed that, from the prevalence of piracy, navigation was not frequent.

From the death of Alfred, the decline of learning was gradual, but complete. The university of Cambridge is said to have been founded by Edward the Elder, which, with its sister college, was afterwards plundered and destroyed by the Danes. Athelstan completed the translation of the Scriptures into the vernacular tongue—a work which Alfred had left unfinished.

Much is owing, too, to some of the monks of former days. In their larger buildings, there was almost always a chamber set apart for writing and other quiet employments. The transcribers were constantly occupied in making copies of old books, for the use of the monasteries; and thus many of our valuable histories have been preserved. They did this with great nicety and skill. For erasures, they used pumice-stone; and they had also an awl to make the dots, and metal pens for writing, until after the seventh century, when quills were brought into use for pens. Ink, composed of soot, or ivory-black, with gum, was used on the vellum—for paper was not introduced until the tenth century. Hence the ancient manuscript books are so *distinct as well as durable. But they were very costly, and large estates were frequently* set apart to purchase them. The materials used were very expensive. In many instances the leaves were of purple vellum, to show off more fully letters of gold and silver. The binding, though rudely formed, was often gorgeous. The ordinary covering was a rough, white sheepskin, pasted on a wooden board, with immense bosses of brass; but the exterior of those intended for the church service was inlaid with gold, or silver, or ivory plates. Some books had leaden covers, and some had wooden leaves; but, at an early period, binding in velvet, with silver clasps and studs, began to be adopted in presents to great persons.

The splendid volumes produced by some of the monks not only proved their unfailing industry, but also their great ingenuity. The letters at the beginning of each section or chapter were adorned with the most curious devices; and often a painting, called an illumination, was introduced, resplendent with gold and crimson and blue. But the satisfaction derived from these efforts was confined to a few. These volumes were unclasped only on solemn days, by the mitred abbot or the prior, and then returned, like rare and costly jewels, to their worm-eaten and dusty cases.

As to the sciences, some persons arose among the Anglo-Saxons who endeavoured to learn what former ages had known, and who freely disseminated what they had acquired. Prior to the introduction of the Arabian figures, they followed the path of the ancients. They divided the even numbers into the useless arrangement of equally equal, equally unequal, and unequally equal; and the odd numbers into the simple, the composite, and the mean. They considered them again, as even or odd, superfluous, defective, or perfect, and under a variety of other distinctions as unnecessary for practical purposes. Aldhelm said, that the labour of all his other acquisitions was small compared with his toil in studying arithmetic; yet still the Anglo-Saxons attained in calculation great practical skill.

The Venerable Bede, in his treatise on the nature of things, endeavoured to introduce them to the study of natural philosophy. His work brings into one focus the wisest opinions of the ancients on the subjects he discusses; and though the imperfect state of knowledge prevented his discerning the true causes of the phenomena of nature, he discovers a mind of sound philosophical tendency, and calculated to guide his countrymen to just thoughts on them. To teach that thunder and lightning were the collisions of the clouds, and that earthquakes were the effect of winds rushing through the spongy caverns of the earth, was indeed to give erroneous conclusions, yet they were far superior to the superstitions of other nations, and they directed the mind into the right path of reasoning. Bede collected and taught more natural truths with fewer errors than any Roman book on the same subjects had accomplished; and thus his work exhibits not a retrogression, but an advance in human knowledge.

The astronomy of the Anglo-Saxons was such as they could comprehend from Greek and Latin treatises; Bede pursued it indefatigably, but did not cultivate the mathematical investigations of the Alexandrian Greeks. All the studious men applied to it, more or less, though many used it for astrological superstitions. Indeed it was then studied by all men of science in two divisions; and what is called astrology—the legacy of the Chaldeans—was for a long time the more popular. It was probably on this account that our ancient chroniclers are usually minute in noticing the eclipses which occurred, and the comets and meteors which occasionally appeared.

The knowledge they possessed of geography must have been improved by Adamnan's account of his visit to the Holy Land, which Bede abridged; and by the sketch given of general geography in Orosius, which Alfred gave to his countrymen by his translation and masterly additions. Still the most incorrect and absurd notions prevailed concerning the other parts of the globe, as is evident from some manuscript treatises, two of which are in the Cotton Library. They tell us, for instance, that "there is a place in the Red Sea which contains red hens, and that if any man touches them, his hand and all his body are burnt immediately; that there was a white human race, fifteen feet high, with two faces on one head, long nose, and black hair; that there were men of three colours, with heads like horns, and mouths like the sails of a windmill;" and that there were ladies, who were—as unsightly and repulsive as the fair of our own land are lovely and attractive. But as bulls, ancient as those contained in the Facetiæ of Hierocles, have been by common consent fathered on the natives of the green and fruitful sister isle, let us not suppose, by a similar error, that all those fables originated with our ancestors; on the contrary, they were not more credulous or ignorant than the Roman population, and it will be found that most of these were gravely recorded by Pliny.

So early as the seventh century they had men who made the science of medicine a study, and who practised it as a profession. Their remedies were usually vegetable medicines, often directed by superstition. Thus they considered it dangerous to bleed when the light of the moon and the tides were increasing, and at other times except during certain hours of the day. Tales were at hand to support this credulity—such as that of a "physician, who let his horse blood" on one of the unpropitious days, "and it lay soon dead!" Incantations and charms, too, were in common use.

While the mind thus appears to have been grievously enthralled, fearful indeed was the moral degradation. The great novelist of modern times has described one person who had on his neck a collar of silver, bearing the inscription, "Wamba, the son of Witless, is the thrall of Cedric of Rotherwood;" and at that period abject slavery was common. Nor was this all,—for the Anglo-Saxon nobility are accused, it is to be feared with too good reason, of selling their female servants as slaves to foreigners. In the canons of a council, held in London in 1102, is the declaration, "Let no one from henceforth presume to carry on that wicked traffic, by which men in England have hitherto been sold like brute animals." And Giraldus Cambrensis says, that the English, before the conquest, were generally in the habit of selling their children and other relations to be slaves in Ireland, without having even the pretext of distress or famine, till the Irish, in a national synod, agreed to emancipate all the English slaves in the kingdom.

At the period on the verge of which we now stand, the Anglo-Saxons, originally the fiercest nation of the predatory north, had become an unwarlike people; but their condition was rather degeneracy than civilisation. Feebleness, ignorance, and servility were the three prominent characteristics of the sovereigns, the clergy, and the people. The venerated forms of their institutions existed, but their spirit was gone. A mental torpidity long pervaded the country. Canute roused them from it for a short time, but a relapse soon followed into lethargy and sensuality. Slumbering in this wretched state, the Norman conquest shook the whole fabric to its base, infused a vital and vigorous spirit through all classes of the community, and prepared for that advance which we now proceed to contemplate.

# THE

# AGE OF CIVILISATION.

## THE AGE OF CIVILISATION.

A. D. 1066—1420.

WHEREVER may have been seated the principal forges of the period, it is certain that the army of Harold was well supplied with swords, spears, and defensive armour; and also that a considerable degree of expertness had been acquired in the fabrication of articles on the anvil. One of our historians observes, that immediately before the conquest, "the art of working in iron and steel had arisen to such a state of improvement, that even the horses of some of the chief knights and barons were covered with steel and iron armour."

These means of defence were not however accompanied by corresponding advantages; for although the Saxons, Romans, and even, according to some writers on antiquity, the ancient Britons, had castles built of stone, yet these were now both few in number, and, through neglect or invasions, either destroyed or so much decayed that little more than their ruins remained. This is assigned as a reason for the facility with which William the Norman made himself master of the country.

The want of proper defence he did not therefore overlook; and in order effectually to guard against assaults from without, as well as to awe his newly-acquired subjects, he immediately began to erect castles all over the kingdom, and also to repair and augment the rest. Besides, as he had parcelled out the lands of the English among his followers, they, to protect themselves from the resentment of the despoiled natives, built strongholds and castles on their estates. The most ancient buildings we can trace in this island, after the departure of the Romans, were circular towers of no great size, of which many remain in Scotland, erected either on a natural eminence, or on an artificial mound of earth. Such too are Conisborough Castle in Yorkshire, and Castleton in Derbyshire, built perhaps before the conquest. To the lower chambers of these gloomy keeps there was no admission of light or air, except through long narrow loopholes, and an aperture in the roof. Regular windows were made in the upper apartments. Were it not for the vast thickness of the walls, and some marks of attention both to convenience and decoration in these structures, we might be induced to consider them as rather intended for security during the transient inroad of an enemy, than for a chieftain's usual residence. They bear a close resemblance, except by their circular form and more insulated situation, to the peels or square towers, of three or four stories, which are still found contiguous to ancient mansion-houses, themselves far more ancient, in the northern counties, and seem to have been designed for places of refuge.

In the course of time, the barons who owned these castles began to covet a more comfortable dwelling. The whole site of the castle was therefore surrounded by a deep and broad ditch, sometimes filled with water, and sometimes dry, called the *fosse*. Before the great gate was an outwork, called a *barbacan*, or *antemural*, which was a strong and high wall, with turrets upon it, designed for the defence of the gate and draw-bridge. On the inside of the ditch stood the wall of the castle, about eight or ten feet thick, and between twenty and thirty feet high, with a parapet, and embrazures or apertures, called *crennels*, upon the top. Upon this wall, at proper distances, square towers of two or three stories high were built, which served for lodging some of the principal officers of the proprietor of the castle, and for other purposes; and on the inside were erected lodgings for the common servants or retainers, granaries, storehouses, and other necessary offices. Upon the top of this wall, and on the flat roofs of these buildings, stood the defenders of the castle, when it was besieged, and from thence they discharged arrows, darts, and stones, on the besiegers. The great gate of the castle stood in the course of this wall, and was strongly fortified with a tower on each side, and rooms over the passage, which was closed with thick folding doors of oak, often plated with iron, and with an iron *portcullis* or grate let down from above. Within this outward wall, was a large open space or court, called, in the largest and most perfect castles, the *outer bayle* or *ballium*, in which stood commonly a church or chapel. On the inside of this outer bayle, was another ditch, wall, gate, and towers, inclosing the inner bayle or court, within which the chief tower or *keep* was built. This was a very large square fabric, four or five stories high, having small windows in prodigiously thick walls, which rendered the apartments within it dark and gloomy. This great tower was the palace of the prince, prelate, or baron, to whom the castle belonged, and the residence of the constable or governor. Under ground were dismal dark vaults, for the confinement of prisoners, which sometimes led to its being called the *dungeon*. In this building also was the great hall, in which the owner displayed his hospitality, by entertaining his numerous friends and followers.

At one end of the great hall of castles, palaces, and monasteries, there was a place raised a little above the rest of the floor, called the *dais*, where the chief table stood, at which persons of the highest rank dined. Though there were unquestionably great variations in the structure of castles, yet the most perfect and magnificent of these seem to have been constructed nearly on this plan.

The Norman conquest proved fatal to the entire race of the Anglo-Saxon nobility, many of whom lost their lives, and almost all of them their property. Not a few of the number sought refuge in different monasteries. Some of them became abbots, and others closed their career as monks. The lands of the Saxon earls were occupied by the Norman barons, who must have had but little intercourse with their vassals, whom they probably did not respect, and whom they had much reason to fear.

Still one advantage was derived from the conquest—it gave a new stimulus to the national mind. The higher ranks had enfeebled the Anglo-Saxon intellect, thus precluding its improvement and impeding the operation of the wise institutions of Alfred and his forefathers. The universal destruction of the Anglo-Saxon nobility, and the sufferings and consumption of a portion of the Anglo-Saxon population terminated a state of affluent weakness. A new race of men was spread over the whole island, urged on by a love of glory, which made every human mind restless till it had acquired personal improvement and distinction. The wealth and situation of England opened new avenues to fame, and drew from all parts of Europe the most aspiring and the most able to acquire honours and profit. A new creative vigour afterwards appeared in every path of human effort. Activity and emulation became the prominent qualities of the nation, and the different classes, giving themselves to various pursuits, infused the spirit and enlarged the boundaries of improvement in all. In literature and trade, the Anglo-Normans became fervent and indefatigable, as they were also in amusements, war, and religion. A steady and effective judgment, combined with perseverance, appeared in their exertions; and though they sometimes deviated into civil turbulence, yet the progress of the nation as a whole never intermitted.

The influence of the Norman conquest on the language of England has been compared to that of a great inundation, which at first buries the face of the landscape under its waters, but which at last subsiding, leaves behind it the elements of new beauty and fertility. The vassals retained their native tongue, and seldom acquired any other. For a long period the peasantry continuing unmixed with foreign settlers, persevered in cultivating the same soil, and when the written language of the kingdom had received many foreign accessions, the rustic dialect preserved its primitive elements, with very few material changes. Much of the patois of different countries consists, not in adulterations of the modern, but in remnants of the ancient language. Many Anglo-Saxon words and idioms, unintelligible to persons of a refined education, are still current among the rural population of particular districts of England.

The English monarchs of the Norman race were liberal patrons of such literature as they themselves understood. French poetry seems to have been much relished at the court of England; and, according to a very competent judge, M. de la Rue, it was from England and Normandy that the French received the first works which deserve to be cited in their language. The works of many Anglo-Norman poets have been preserved, and they certainly form a curious subject of literary research. In this department, a learned lady, Marie de France, makes a prominent figure. Her poems have been recently edited by M. de Roquefort; and one of the historical poems of Wace, still more recently by M. Pluquet.

The French language, which had begun to prevail at court from the time of Edward the Confessor, had now a more complete predominance among the higher classes of society. It became also the language of all the courts of law. The pleadings of counsel and the decisions of judges were couched in a dialect which is commonly described as Norman French, but which, in the mouths of English lawyers, became utterly barbarous; and more curious specimens of composition are scarcely to be found than those which occur in the reports of cases written in a jargon half-French half-English. Lawyers have, in all ages, been conspicuous for their adherence, with or without reason, to those forms and maxims in which they themselves have been duly trained. Long after French had ceased to be the language of legal proceedings, they adhered to the practice of reporting cases in the motley dialect used by their predecessors; for, as Blackstone remarks, "the practisers being used to the Norman language, and therefore imagining that they could express their thoughts more aptly and more concisely in that than in any other, still continued to take their notes in law French; and of course, when those notes came to be published, under the denomination of reports, they were printed in that barbarous dialect; which, joined to the additional terrors of a Gothic black letter, has occasioned many a student to throw away his Plowden and Littleton, without venturing to attack a page of them."

The Normans, whose ancestors, but a hundred and fifty years before, had been fierce pirates, became, however, the revivers of literature, from the presence and energy of one individual—the celebrated Lanfranc. It is a curious fact, that he was a Lombard, and that his people were the most barbarous of all the Gothic invaders; yet among them the literary studies of Italy first revived, its most celebrated schools were established, and its most cultivated states and most enterprising citizens were formed; and from them, and their cities, Pavia and Pisa, learning was planted, under Charlemagne, in France, and replanted both there and in England, under Lanfranc and his friends and pupils.*

This remarkable man, once a schoolmaster in the obscure village of Bec, was appointed soon after the conquest Archbishop of Canterbury. But wealth and dignity did not rob him of literary taste; he exerted himself with unabated zeal and proportionate success to establish in England a knowledge of the Latin language, and the study of its authors; he encouraged the formation of schools, and the progress of the scholars; and he even assisted those of slender means.

* Note C.

Notwithstanding his well-merited celebrity, which is entitled to grateful remembrance, there appears no striking accordance between his attainments and his usefulness. His compositions exhibit great poverty of knowledge, with nothing uncommon in intellect; but they are happily and entirely free from the ancient rhetoric, which had often proved exceedingly pernicious.

Aldhelm, for instance, had indulged in violent metaphors; he spoke of the "golden necklace of the virtues, the purple flowers of modesty, the swan-like hoariness of age, the importunate dragon of gluttony, and of unbarring the folded doors of dumb taciturnity." He dealt, too, in long paragraphs of confused figures, such as, "the leaky bark of our feeble ingenuity, shaken by the whirlwind of a dire tempest, may attain late its port of silence by laborious moving of the arms, yet we trust that the sails of our yards, swelling with the blasts of every wind, will, notwithstanding their broken cables, navigate happily between the Scyllas of solecism and the gulf of barbarism, dreading the rocky collisions of vain glory, and the incautious whirlpools of self-love." And this is only a solitary specimen of his prose run mad,—as *we* should say, though, in his time, it was tolerably sane.

The writings of Lanfranc, absolutely free from all such tasteless redundancies, tended, therefore, to produce soundness of judgment, and to preserve the Anglo-Normans from the tinsel and frippery with which so many of the works of both the Greek and

Latin fathers are encumbered. He spread, too, by his exhortations and example, a desire to acquire what was then attainable in letters; and to raise the Norman and English mind to the level of the Romans was to urge forward its progress, and to prepare it for other and advancing means of improvement.

The most informed ecclesiastics on the continent were now invited from all parts into England, and placed in its great ecclesiastical dignities, to the rapid advancement of the country. Every where a taste for architecture was introduced, and the spirit of learning was excited. In the way of its gratification, however, there were difficulties from which our path is happily free. Thus among the constitutions given to the monks of England by Archbishop Lanfranc, the following injunction occurs. At the beginning of Lent, the librarian is ordered to deliver a book to each of the religious. A whole year was allowed for the perusal of this book; and, at the returning Lent, those monks who had neglected to read the books they had respectively received, are commanded to prostrate themselves before the abbot, and to supplicate his indulgence. This regulation was partly occasioned by the low state of literature which Lanfranc found in the English monasteries; but, at the same time, it was a matter of necessity, and is in a great measure to be referred to the scarcity of copies of useful and suitable authors, which long continued.

In an inventory of the goods of John de Pontissara, Bishop of Winchester, contained in his capital palace, all the works which appear are nothing more than seventeen kinds of books on divers sciences. This was in the year 1294. The same prelate, in the year 1299, borrowed of his cathedral convent of St. Swithin at Winchester, Bibliam bene glossatam; that is, the Bible, with marginal annotations, in two large folio volumes; but gave a bond for the due return of the loan, drawn up with great solemnity. This Bible had been bequeathed to the convent in the same year by Pontissara's predecessor, Bishop Nicholas d' Ely; and in consideration of so important a bequest and one hundred marks in money, the monks founded a daily mass for the soul of the donor.

When a single book was bequeathed to a friend or relative, it was seldom without many restrictions and stipulations. If any person gave a book to a religious house, he believed that so valuable a donation merited eternal life; and he offered it on the altar with great ceremony. The most formidable anathemas were peremptorily denounced against those who should dare to alienate a book presented to the cloister or library of a religious house. The prior and convent of Rochester declared that they would every year pronounce the irrevocable sentence of damnation on him who should purloin or conceal a Latin translation of Aristotle's Physics, or even obliterate the title.

Sometimes a book was given to a monastery on condition that the donor should have the use of it during his life; and sometimes to a private person, with the reservation that he who received it should pray for the soul of his benefactor. The gift of a book to Lincoln Cathedral by Bishop Repingdon, in the year 1422, occurs in this form, and under these curious circumstances. The memorial is written in Latin with the bishop's own hand, which is given in English, at the beginning of Peter's Breviary of the Bible. "I Philip of Repyndon, late Bishop of Lincoln, give this book, called Peter de Areolis, to the new library to be built within the church of Lincoln; reserving the use and possession of it to Richard Trysely, clerk, canon, and prebendary, of Miltoun, in fee, and to the term of his life; and afterwards to be given up and restored to the said library, or the keepers of the same, for the time being, faithfully, and without delay. Written with my own hand, A.D. 1422."

When a book was bought, the affair was of so much importance, that it was customary to assemble persons of consequence and character, and to make a formal record that they were present on this occasion. Among the royal manuscripts in the book of the Sentences of Peter Lombard, an archdeacon of Lincoln has left this entry:—"This book of the Sentences belongs to master Robert archdeacon of Lincoln, which he bought of Geoffrey the chaplain, brother of Henry vicar of Northelkington, in the presence of master Robert de Lee, master John of Lirling, Richard of Luder, clerk, Richard the almoner, the said Henry the vicar, and his clerk, and others; and the said archdeacon gave the said book to God and St. Oswald, and to Peter, abbot of Barton, and the convent of Barden."

About the year 1225 Roger de Insula, Dean of York, gave several Latin Bibles to the University of Oxford, with a condition that the students who perused them should deposit a cautionary pledge. The library of that university, before the year 1300, consisted only of a few tracts, chained or kept in chests in the choir of St. Mary's church. In the year 1327 the scholars and citizens of Oxford assaulted and entirely pillaged the opulent Benedictine abbey of the neighbouring town of Abingdon. Among the books they found there were one hundred psalters, as many grayles, and forty missals, which undoubtedly belonged to the choir of the church; but besides these there were only twenty-two codices, which may be considered books on common subjects.

Although the invention of paper at the close of the eleventh century contributed to multiply manuscripts, and consequently to facilitate knowledge, yet, eve so late as the reign of Henry VI. the following remarkable instance occurs of the inconveniences and impediments to study which must have been produced by a scarcity of books. It is in the statutes of St. Mary's College at Oxford—"Let no scholar occupy a book in the library above one hour, or two hours at most, so that others be hindered from the use of the same."

The academical library of Oxford, in 1300, consisted of a few tracts kept in chests under St. Mary's church. That of Glastonbury Abbey, in 1248, contained four hundred volumes, among which were Livy, Sallust, Lucan, Virgil, Claudian, and other ancient writers. But no other, probably, of that age was so numerous or so valuable. Richard of Bury, Chancellor of England, under Edward III., spared no expense in collecting a library, the first, perhaps, that any private man had formed. But the scarcity of valuable books was still so great, that he gave the abbot of St. Albans fifty pounds' weight of silver for between thirty and forty volumes. Charles V. increased the royal library at Paris to nine hundred volumes, which the Duke of Bedford purchased and transported to London. His brother Humphrey, Duke of Gloucester, presented the university of Oxford with six hundred books, which seem to have been of extraordinary value, one hundred and twenty of them having been estimated at one thousand pounds. At this time such a library would not have been thought remarkably numerous beyond the Alps; but England had made comparatively little progress in learning.

John of Salisbury, who had been instructed both at Oxford and Paris, became notwithstanding eminent in grammar, rhetoric, logic, and the philosophy of Aristotle, and he composed works on each of these branches of science as well as on many other literary topics. Peter de Blois, who appeared at a later period, was not inferior in learning.

The intercourse which the Norman conquest opened with France gave a stimulus to the advancement of learning, notwithstanding the checks it suffered from a scarcity of books, frequent wars, and feudal despotism. Many who intended to take orders, were educated at the university of Paris, which always contained scholars who were greatly distinguished. The Norman sovereigns, too, induced some men of erudition to settle in England; and thus the universities of Oxford and Cambridge were raised from their deep depression. Other colleges and universities of learning also appeared.

For another source of great improvement we must now look to Arabia, a country in several respects highly interesting, from its association with the earliest scenes and events of holy writ. Of the annals of its people during the vast interval of historical silence, little more is known than may be inferred from the permanence of that wild character among the roving tribes of the desert, which was first dimly traced by the finger of prophecy, and is still stamped with the enduring impression of immemorial antiquity. Even now they appear as a pastoral people, dwelling by hordes and in tents, and restlessly wandering with their sheep, camels, and horses, in search of the scanty spots of herbage and of water which relieve the arid expanse of the wilderness.

The Bedoween, or man of the desert, like his forefathers through countless generations, is still brave and imaginative. His intellectual qualities are strongly reflected in his physiognomy and mien; his eye is full of fire and vivacity; his speech at once voluble and sententious; his countenance intelligent and penetrating; and his whole bearing expressive of that lofty spirit of freedom, which is the inheritance and generic attribute of his race.

The Arabs, in the year 640 of the Christian era, were engaged in a fearful work of destruction. Filled with the enthusiasm of their militant religion, they ravaged that vast country which stretches from the east to the southern confines of Europe. All the cultivators of the arts and sciences, who from every part had taken refuge in Alexandria, were driven away with ignominy, or fell by the swords of their conquerors: the former fled into remote countries, to drag out the remainder of their lives in poverty and distress. These carried with them some remnant of that general learning for which the school of Alexandria had been so celebrated; but still, destitute of books and instruments, and probably of the means of subsistence without manual labour, very little of that great mass of learning could have been preserved, and still less accumulated, had not the Arabians themselves, within less than two centuries of the fatal conflagration of the valuable library of Alexandria, become the admirers and supporters of the very sciences they had before, in their bigoted fury, so nearly annihilated. Fortunately for geometry and the sciences in general, these men now studied the works of the Greeks with the greatest assiduity; and if they added little to the general stock of knowledge which they found contained in the few manuscripts that escaped the general wreck, they became at least sufficiently masters of many of the subjects to comment upon them, and to set a due estimation on these valuable relics of ancient knowledge.

The extended intercourse of the nation with Spain and its Mohamedan population, now caused the Arabic sciences freely to flow into England. To some of the Arabian mathematicians of the middle ages, Europe is indebted for most valuable improvements in Arithmetic. The invention of this useful and important science has been traced to very remote antiquity, though it cannot be certainly determined in what era, or among what people it originated. Several distinct periods can also be pointed out in which the art of numerical calculation underwent material improvements; but the most valuable one was introduced, if not invented, by the mathematicians of Arabia, about the eighth century.* The knowledge of Algebra, was unquestionably transmitted to Europe by the Arabs; but its invention must be sought for much farther to the East, probably not nearer than Hindostan. Algebra is that branch of mathematical science in which number and quantity, and their several relations, are made the subjects of calculation by means of certain signs and symbols. If the quantities are of a value known or determined, they are usually expressed by the first letters of the alphabet, a, b, c; but if the quantities are of an unknown value, they are denoted by the last, as x, y, z.

* Note D.

The effect of the means thus possessed are sometimes not a little remarkable; as while an arithmetical problem can only be worked by signs, the value of which is known, one in Algebra may be passed through with signs of unknown value, and the value of them may, after a short process, be accurately determined. For example, a person going into a bookseller's shop, asks the price of his stock of books; to which the bookseller replies, "I will sell them at the rate of four shillings per volume." The person rejoins, "I have not money enough by five pounds to pay for them at that price, but I will buy them at the rate of three shillings and four pence per volume, and I shall then have five pounds remaining;" it is required, therefore, to be demonstrated what number of volumes the bookseller had, and how much money the person had who made the proposal. Now, though a mere arithmetician would not be able to solve this problem, the algebraist can tell you in a few seconds that the bookseller had just three hundred volumes, and that the applicant had fifty-five pounds.

Algebra derives its immense superiority over the ancient analysis from the very complete system of notation which it has at length attained. Each step of an investigation being now registered in the clearest and most precise manner, the mind is relieved from the fatigue of carrying forward the whole of a continuous chain of reasoning. It can rest at any place, and again resume the process of deduction with the greatest facility.

But the most important service rendered by the Arabian mathematicians to geometrical science consists in their preserving many works of the ancients, which, but for them, had been inevitably lost. Some are only known through the medium of Arabic versions; but the originals of others, which were long supposed to have perished, have been brought to light by the researches of scientific men in later ages. The Elements of Euclid, with other valuable treatises, were all perpetuated and handed down to posterity by their means.

The testimony of Professor Playfair to the author of the Elements is as just as it is honourable: 'The elementary truths were connected by Euclid into one great elementary chain, beginning from the axioms and extending to the five regular solids; the whole digested into such admirable order, and explained with such clearness and precision, that no similar work of superior excellence has appeared, even in the present advanced state of mathematical science." Nor should it be overlooked, that while the science of trigonometry was, perhaps, the most defective part of the geometry of the ancients, the Arabian mathematicians of the middle ages first applied to this department the simple and commodious method of calculation which is now generally adopted.*

At the same period Astronomy was cultivated by the Arabs; and though the far greater number of the literati were geometricians, algebraists, and

* Note E.

astronomers, some appear to have made a considerable proficiency in mechanics and optics; and to the Arabs especially must be traced the origin of chemistry—than which perhaps none, in the whole circle of science, has been productive of more valuable results.

The name employed to designate such efforts was "Alchemy," an Arabic term, denoting a knowledge of the substance or composition of a thing. The two leading objects proposed to be accomplished were, the transmutation of common metals into gold and silver, and the discovery of an universal medicine, which, by the prevention or removal of disease, should give to its possessor immortality. Observing that metallic ores and many other natural substances changed their appearances, and displayed new qualities, when variously combined or exposed to the action of heat, it was natural that in these times some chimera should be produced. When the mantle of night has been thrown over the face of the earth, a post or a tree has often been mistaken for a man; and in the mental darkness of that period it was far more likely that the philosopher's stone should be chased than that the objects should be exclusively pursued which the clear light of modern times has shown to be desirable and attainable.

If, however, the alchemists failed as to their grand project, many useful discoveries arose while vainly spending their time and labour in attempting to make silver and gold. Some important combinations were produced by which pharmacy has been enriched and the science of medicine promoted.

The method of preparing alcohol, aquafortis, volatile alkali, vitriolic acid, and many other chemical compounds, might have remained much longer unknown but for the persevering labours and patient experiments of the alchemists of the middle ages.

A visit to the Grecian as well as the Arab states would show the advantage of superior knowledge, and awaken a desire for its possession. It would seem, too, that the Greeks tried to awaken the surprise of their barbarous visitants, for one of them relates that he saw at Constantinople a metallic tree, on whose branches gilt birds were made to sing, and a throne, supported by gilded lions, that roared at his approach; and he describes the horse-laugh with which his astonishment at other shows and tricks was received by the conceited courtiers. Still their tasteful architecture, their elegant sculptures, their fine manuscripts, their celebrated loquacity, and the fame of their poets and philosophers, must have powerfully impressed the minds of many, and have created that feeling of deficiency and that desire of emulation which are the certain parents of improvement. So great, indeed, became now the enthusiasm for learning, that besides the cathedral and conventual schools, others arose in many parts of the country; and as soon as the improvement of the scholars had exhausted the knowledge of their instructors, they became emulous of travelling to other countries wherever teachers of celebrity were established, or new subjects of study appeared.

The Crusaders appear, also, to have imported into Europe the substance which, mistaking it for natron, they called saltpetre, and of which they had learned the deflagrating property; together with the compass. That invaluable instrument was at first very rudely formed, consisting merely of a piece of the native mineral, fixed to a broad cork, and set to float in a dish of water. An artist of the opulent town of Amalphis, the great emporium of the East, in the direct route of the Crusaders, improved the construction, and marked the north point by a fleur-de-lis, the armorial bearing of the kingdom of Naples. From its directive property, it was now called in English the loadstone, or leading-stone. About a century afterwards, the method of communicating magnetism by the touch was probably discovered, the needle or small bar of steel so treated being then applied to a card suspended on a pivot. The Germans bisected successively the eight cardinal divisions, which had satisfied the Roman and the Chinese, into sixteen and thirty-two points, to which they gave those compound names which are still retained.

In order to ascertain what industry, agriculture, and commerce gained by the relations with the East, it is necessary to attend to the state of these two sources of wealth among the Orientals at the period of the Crusades. Before this time the Saracens had manufactures of various stuffs, such as silk, woollen, and linen. At Damascus and in the towns of Egypt, they worked in metals with greater perfection than in the West. The Christians of Palestine often went to Damascus to purchase arms. At Tripoli, in Syria, camlets were manufactured; and in the same town, as well as in several of the cities of Greece, there were a great number of trades connected with the preparation and manufacture of silk. All this could not escape the observation of the merchants and pilgrims who visited the East. We find, in fact, that, about the middle of the twelfth century, Roger II., King of Sicily, caused several of these artisans to be brought over to Palermo; that this was the result of an expedition to the coasts of Greece; that the mulberry tree throve in the fine climate of Italy as well as in that of the Morea; and that the Sicilians soon surpassed the Greeks in this valuable species of industry.

Several useful inventions were also derived from the East; among which windmills have been mentioned. Tyre was then renowned for its glass ware, which the fine sand in the neighbourhood enabled its workmen to bring to a degree of perfection unknown in other countries; and to this place the Venetians were indebted for instruction in an art in which they afterwards greatly excelled.

During the fourth crusade, Boniface, of Montferrat, sent maize and wheat from Turkey to Italy; the plum of Damascus was imported by a Duke of Anjou, who had visited Jerusalem; our gardens owe to the holy wars the ranunculus, so dear to the Orientals, and the echalottes, which derive their name from Askalon; and the knowledge, or rather the use of saffron, of alum, and of indigo, is also due to the Crusades. In the territory of Tripoli, in Syria, the Crusaders beheld, for the first time, the sugar cane, which was transported to Sicily about the middle of the twelfth century, and thence passed into other countries. It was transferred by the Spaniards to Madeira, whence it is supposed to have been carried, at a subsequent period, to the New World. Natural history, which is connected with the progress of industry and agriculture, was enriched with some useful discoveries during the Crusades. The productions of distant climates were exchanged, and Europe acquired a knowledge of several animals peculiar to Africa and Asia.

The seeds of knowledge, liberally sown, yielded in due time an abundant harvest. The great not only patronized the students, but excited them to exert their talents in composition. Thus the Count of Gloucester desired Malmesbury to write his history. He was fond of curious research even from childhood, and seems in his youth to have formed the design of collecting the antiquities of his country. The diligence with which he investigated what is obscure or doubtful in that portion of English history which he wrote is his chief merit. The Bishop of Lincoln also induced Henry of Huntingdon to compile his Annals. Literary pursuits becoming a source of distinction and preferment, all ranks caught the flame; and on the diffusion of vernacular literature, intelligence no longer dwelt within the cells of a cloister or the walls of a school;

it adorned the chamber of the lady, the hall of the baron, and the court of the prince; even the knight found the smile he valued must be gained by knowledge adorning his iron mail and trophied lance; and some ladies learned not merely to read and judge, but also to write. After the twelfth century, ignorance became discreditable, the mark of a barbarous country, a vulgar origin, or a degraded taste.

Poetry bears the honour of first producing in England an original vernacular literature. Its itinerant minstrels were its earliest instruments; but at length the possibility was seen of separating the poet from the minstrel, as well as from the musician; of cultivating that art, so popular in the streets and in the festive hall, in the study and in the cloister; and of connecting it with better subjects than those which pleased at the banquet, or excited and corrupted the populace. It was among the Anglo-Norman clergy, and from the patronage of the Anglo-Norman ladies, that our first national poetry arose, as distinct from the recitation of minstrels. This occurred in the reign of Henry I. His first queen, Matilda, was fond of poems made by scholars; and these must have been written in the language of her husband and his court. Thus royal patronage and female taste raised poetry from the pollutions of the minstrels,—who singing for hire, adapted themselves to the grossness which was acceptable,—to the cultivation of the studious, whose taste had been refined by Latin literature, whose memories had stored its recorded facts, and who sought for fame by respectable composition. Once esteemed in the higher circles of life, such poetry became generally attractive.

The encouragement given to literature in England, from the happy taste of Henry I., his queen, court, and clergy, spread so diffusively the desire to attain it, that even the stormy reign of Stephen did not impede its culture. This wasteful period of civil misery was one in which the Anglo-Norman mind was extensively engaged in self-improvement.

A taste for historical information now prevailed; and the British history of Geoffrey of Monmouth electrified the literary mind of Europe. His Latin dress was accessible only to the clergy; in Anglo-Norman verse the lady and the knight could understand and appreciate it; and a work was consequently produced by Wace, not so much a translation, but what was more improving, a narrative poem made in rhyming couplets. Other histories of the same kind soon followed; easy of comprehension, they provided an agreeable occupation for the leisure of the affluent, and thus made literature one of the needful luxuries of life.

The vernacular literature of the Anglo-Normans slowly advanced from rhymed chronicles to rhymed romances, and by deviating in the romances into prose, they began to form a prose style of narrative composition, which must have improved that of conversation, and increased the power of expressing the new varieties and combinations of thought that were now arising in the minds of the studious.

None of the principal modern languages was so late in its formation, or in its application to the purposes of literature, as the English. This arose out of the Saxon branch of the great Teutonic stock,* spoken in England till after the conquest. From this mother dialect our English differs less in respect of etymology than of syntax, idiom, and flexion. The question of identity is almost as perplexing in languages as in individuals; but in the reign of Henry II. a version of Wace's póem of Brut, by one Lyamon, a priest of Ernly upon Severn, exhibits, as it were, the chrysalis of the English language, in which, however, he can as little be said to have written as in Anglo-Saxon.

Very soon afterwards the new formation was better developed, and some metrical poems, referred by critics to the earlier part of the thirteenth century, differ but little from our legitimate grammar. How to fix on any precise time when the national speech can be said to have ceased to be Saxon and began to be English, is pronounced by Dr. Johnson to be impossible; and if his assertion be disputed, the decision must be considered extremely difficult, from the gradually progressive nature of language, as well as from the doubt with regard to dates, which hangs over the small number of specimens of the early tongue which we possess.

Henry II. is described as devoting to reading and conversation every interval he could obtain from his royal duties and sports of exercise. Conferences

* Note F.

with his most literary friends, and discussions on intellectual subjects, are stated to have been his daily occupations. His knowledge of history was great, and he encouraged and rewarded its popular writers. His queen, Eleanora, was a Troubadour by birth.*

Fernel, the physician to the king, wrote several treatises on pure mathematics and on astronomy, which were highly scientific; but his mathematical fame chiefly rests on his having been the first of the moderns who attempted the exact measurement of the earth. The means employed were imperfect, but the result gained was very near the truth.

Other rays of brightness beam forth from the days of Henry III. All nations are benefited by intercourse with each other. Wealthy states are improved by the mixture of a poorer and hardier population, as well as by the residence of the more enlightened. Civilisation becomes more varied, industry stimulated, and knowledge enlarged, by the settlement of new families, with new habits and pursuits. The reign of Henry connected England with Armenia, whose friars came for a refuge from the Tartars; with Germany, whose emperor married his sister; with Provence and Savoy, from which both he and his brother had their wives; with Spain, where his son was knighted and wedded; with France, which he visited with much pomp; with its southern regions, Guienne and Poitou, which he retained; with the countries on the Rhine,

* Note G.

where his brother went to obtain the empire; with the north of Italy, where he sent knights to assist the emperor against Milan; with the south of it, by the intercourse of himself and his clergy with the pope, and by the crowds of Italians whom the pontiff poured into England; with Constantinople, whose exiled emperor sought his support; with Jerusalem, whither the English still went in crusades; and even with the Saracens, who implored his aid against the Tartars. This extensive range of intercourse imparted and excited great improvements through all the classes of society. The knowledge of natural history was increased by the new animals that were imported into England, the presents of merchants or foreign potentates; and the arts began now to receive an attention which makes this reign the first epoch of their appearance in this country.

A great part of England affords no stone fit for building; and the vast, though unfortunately not inexhaustible resources of her oak forests were easily applied to less durable and magnificent structures. A frame of massive timber, independent of walls, and resembling the inverted hull of a large ship, formed the skeleton, as it were, of an ancient hall; the principal beams springing from the ground naturally curved, and formed a Gothic arch over head. The intervals of these were filled up with horizontal planks; but in the earlier buildings, at least in some districts, no part of the walls was of stone.

Stone houses, however, are mentioned as belonging to citizens of London, even in the reign of Henry II.; and, though not often perhaps of regularly hewn stones, yet those scattered over the soil, or dug from flint quarries, bound together with a very strong and durable cement, were employed in the construction of manorial houses, especially in the western counties, and other parts where that material is easily procured. Gradually, even in timber buildings, the intervals of the main beams, which now became perpendicular, not throwing off their curved springers till they reached a considerable height, were occupied by stone walls, or, where stone was expensive, by mortar or plaster, intersected by horizontal or diagonal beams, grooved into the principal piers. This mode of building continued for a long time, and has been, or is still familiar in the older streets of the metropolis and other towns, and in many parts of the country.

The most remarkable architectural works are the religious edifices, erected in the twelfth and three following centuries. These structures, blending sublimity of general composition with the beauties of variety and form, intricacy of parts, skilful, or at least fortunate effects of light and shadow, and in some instances with extraordinary mechanical science, are apt to lead to exaggerated estimates of the times in which they were founded. But it was the favourite employment of ecclesiastical wealth, to erect, enlarge, repair, and decorate cathedral and conventual churches; and on such buildings an immense capital must have been expended between the conquest and the reformation. The Anglo-Norman cathedrals were perhaps as much distinguished above other works of man in their own age, as the more splendid edifices of a later period. The science manifested in them is not however very great, and their style, though not destitute of lesser beauties, is on the whole an awkward imitation of Roman architecture, or perhaps more immediately, of the Saracenic buildings in Spain, and those of the Lower Greek empire. But about the middle of the twelfth century this style began to give place to what has been called the Gothic architecture, of which the pointed arch, formed by the segments of two intersecting semicircles, struck from points equidistant from the centre of a common diameter, has been deemed the essential characteristic. A very oriental character also appears in the vast profusion of ornament, especially on the exterior surface, which is as distinguishing a mark of Gothic buildings as their arches, and greatly contributes to their beauties and their defects. This, however, rather applies to continental than to English churches, and to the later than the earlier state of architecture. The Gothic style is thought by some to have reached its perfection, considered as an object of taste, by the middle of the fourteenth century, or at least to have lost something of its excellence by the corresponding part of the next age; an effect of its early and rapid cultivation. Yet this, if true at all, seems applicable only to

England. The mechanical execution at least continued to improve, and is so far beyond the apparent intellectual powers of those times, that some have ascribed the present ecclesiastical structures to the fraternity of Freemasons—depositaries of a concealed and traditionary science.

Considered in its higher departments, the art of civil architecture is the principal boast of the middle ages. Some of the finest Gothic buildings we have were built in the reign of Henry III. The ponderous Saxon and early Gothic styles were now succeeded by one of much greater elegance and richness of ornament. Instead of heavy, thick shafts to the pillars, they had one small shaft in the centre, surrounded by many slender ones, so as to form unitedly one bulky column composed of many parts. The carved work of all kinds was more elaborate, and the outsides of the churches were adorned with pinnacles, and with loftier steeples than formerly. Such very curious and complicated buildings could not be executed by common workmen. A number of the best artificers incorporated themselves into companies, and went about from place to place as they were wanted. They lived in temporary huts, near the great buildings in which they were employed, and called themselves *Free masons*: and this is the origin of the society which still bears the name. The cathedral of Salisbury, finished in 1258, may justly be considered as one of the best specimens of the age in which it was built.

Bridges of stone are of an earlier date. Thus Stow tells us that "Maude, many years before, when she saw the ford to be dangerous for them that travelled over the river Lue, for she herself had been well washed in the water, caused two stone bridges to be built, of which one was situated over the Lue, at the head of the town of Stratford, now called Bow, because the bridge was arched like a bow. A rare piece of work," he says, "it was; for before that time the like had never been seen in England."

The first building of London Bridge in stone was begun in 1176, was about thirty-three years in building, and was finished in 1209. For this purpose they had to cut a canal from Rotherhithe to Battersea, through which the waters flowed, while the men worked in the bed of the river. What improvements have taken place since then! Men who could descend to the bottom of the river, and labour there, have completed the new London Bridge in six years.

Edward I. introduced a more splendid and convenient style of castles, containing many habitable towers, of which Carnarvon and Conway are familiar examples. The next innovation was the castle-palace, of which Windsor, if not quite the earliest, is the most magnificent instance. Alnwick, Naworth, Harewood, Spofforth, Kenilworth, and Warwick, were all built on this scheme during the fourteenth century; but subsequent enlargements have rendered caution necessary to distinguish their original remains. The odd mixtures thus presented of convenience and magnificence, with cautious designs for protection and defence, and with the inconveniences of the former confined plan of a close fortress, is very striking. The provisions for defence became now, however, still more nugatory; large arched windows, like those of cathedrals, were introduced into halls; and this change in architecture manifestly bears witness to the cessation of baronial wars, and the increasing love of splendour in the reign of Edward III.

To these succeeded the castellated houses of the fifteenth century, such as Hurstmonceux in Sussex, Haddon Hall in Derbyshire, and the older part of Knowle in Kent. They resembled fortified castles in their strong gateways, their turrets and battlements, to erect which a royal license was necessary; but their defensive strength could only have availed against a sudden affray, or attempt at forcible dispossession. They were always built round one or two court yards, the circumference of the first, when there were two, being occupied by the officers and servants' rooms, and that of the second by the state apartments. Regular quadrangular houses. not castellated, were sometimes built during the same age, and under Henry VII. became universal in the superior style of domestic architecture. The quadrangular form, as well from security and convenience, as from imitation of conventual houses, which were always constructed on that model, was generally preferred; even when the dwelling-house, as indeed was usual, only took up one side of the enclosure, and the remaining three contained the offices, stables, and farm buildings, with walls of communication. Several very old parsonages appear to have been built in this manner. It is, however, very difficult to discover any fragments of houses inhabited by the gentry, before the reign, at the earliest, of Edward III. not only from the ravages of time, but because very few considerable mansions had been erected by that class.

Early in the fourteenth century the art of building with brick, which had been lost since the Roman dominion, was introduced, probably from Flanders. Though several edifices of that age are constructed with this material, it did not come into general use till the reign of Henry VI. Many considerable houses, as well as public buildings, were erected with bricks during his reign, and that of Edward IV. chiefly in the eastern counties, where the deficiency of stone was most experienced. Few, if any, brick mansion-houses of the fifteenth century exist, except in a dilapidated state; but Queen's College and Clare Hall at Cambridge, and part of Eton College, are still witnesses to the durability of the material as it was then employed.

His method of building the castle of Windsor may serve as a specimen of the condition of the people in that age. Instead of engaging workmen by contracts and wages, he assessed every county in England to send him a certain number of masons, tilers, and carpenters, as if he had been levying an army.

The passage from place to place, it may here be observed, was no easy matter. Travelling, indeed, in early times was often a very serious affair. As the only way of proceeding any distance was on horseback, the infirm, or those who were invalids, could scarcely ever leave their homes. The Rozinante, poor brute perhaps, at best, on which the traveller set out, must go on till he was tired; if he fell lame, his rider must wait till he was sound; if he died, he might buy another—if he could—but sometimes a horse could not be obtained for love or money, and then he must stop or go on afoot. But suppose such disasters did not happen, the comfort of the rider was dependent on the roads, and these were in a miserable plight. Fatigue was inevitable, and often danger was imminent. Instead of the firm footing now given to our quadrupeds, the horse might suddenly plunge into a marsh; or from there being no passage over a river, an attempt might be made to ford the stream, in which both the rider and his horse might be lost. Then the road might lie through a forest, where silence was broken by the cry of wolves; and escaping these, the bright light of a modern inn did not cheer his last steps by the anticipation of a well-spread table and a glowing fire; frequently he must seek repose on the cold earth, while the winds whistled round him, find a refuge from the falling rains in some roofless ruin, or having gathered a little warmth from the dying embers of a wretched hut, sink into welcomed slumber on the sod from which it rose.

The first toll we read of in England for mending the highways was imposed in the reign of Edward III.; it was one for repairing the road between St. Giles' and Temple-bar.

The domestic circumstances of our ancestors were equally inferior to our own. We know but little of the way in which they warmed their habitations. It has been supposed that the people living in the earliest buildings of which we have any account must have lighted a fire in the middle of a room, the roof of which had an opening by which the smoke might escape, as indeed is the case in some countries at the present day.

In the year 1200 chimneys were scarcely known in England: one only was allowed in a religious house, one in a manor house, and one in the great hall of a castle, or a lord's house; but in other houses they had only the *rere dosse*, a sort of raised hearth, where the inmates dressed their food and dined, and from which the smoke found its way out as it best could. The origin of chimneys has, indeed, been referred to the Venetians and the middle of the fourteenth century; but they are certainly of greater antiquity in England.

Whitaker, in his "History of Manchester," mentions a grant of some lands made by the Abbey of Peterborough, dated A. D. 853, which proves, as it should seem, that coal fuel was known, and in use amongst us, while the Saxons were masters of Britain. By this grant certain boon and payments in kind were reserved to the monastery; as one night's entertainment,—ten vessels of Welsh and two of common ale, sixty cart loads of wood, and twelve of fossil or pit coal. In 1239 Henry III. is said to have granted a charter to the townsmen of Newcastle-upon-Tyne, for liberty to dig coals in the vicinity of that place.

We have no distinct notice of the earliest shipment of coal for London, though the use thereof in the metropolis was prohibited in 1306 by royal proclamation! Nevertheless, within about twenty years afterwards, it appears to have been used in the royal palace; as in the "Petitiones in Parliamento," A. D. 1321, 1322, a claim is made for ten shillings on account of fuel of that sort, which had been ordered by the Clerk of the Palace, and burnt at the King's coronation, but neglected to be paid for. In 1325 a vessel belonging to Thomas Rente, of Pontoise, a town in the ancient dominions of the kings of England, in France, is mentioned as trading to Newcastle-upon-Tyne with corn, and returning with a freight of sea-coals. Coal is said to have been in general use in London about 1400.

In what particular manner, or to what extent, it might be burned at the latter period, is not very clear: wood billets, however, long remained the principal fuel of the south; and the apparatus for burning such fuel with economy and effect may be regarded as the most ancient deviation in metal from the rude simplicity of the *rere-dosse* towards the close fire-grate, and the endless and elegant varieties of the modern stove. This appeared in those useful iron tressels, called hand-irons, or and-irons, formerly so common in this country, and still occasionally to be met with in old mansions, under the appellation of dogs. When in use, the irons were placed beside each other, at such a distance as might be required from the length of the brands intended to be burnt. Before the making of close fire-places they were found not only in the houses of the better sort of people, but in the bedchamber of the king himself.

We have reached in this age so high a pitch of luxury, that we can hardly believe or comprehend the frugality of ancient times; and have in general formed mistaken notions as to the habits of expenditure which then prevailed. Accustomed to judge of feudal and chivalrous ages by works of fiction, or by historians who embellish their writings with accounts of occasional festivals and tournaments, and sometimes inattentive enough to transfer the manners of the seventeenth to the fourteenth century, we are not at all aware of the usual simplicity with which the gentry lived under Edward I. or even Henry VI. They drank little wine; they had no foreign luxuries; they rarely or never kept male servants, except for husbandry; their horses, as we may guess by the price, were indifferent; they seldom travelled beyond their county; and even their hospitality must have been greatly limited, if the value of manors were really no greater than we find it in many surveys. Twenty-four seems a sufficient multiple when we would raise a sum mentioned by a writer under Edward I. to the same real value expressed in our present money, but an income of 10*l.* or 20*l.* was reckoned a competent estate for a gentleman; at least, the lord of a single manor would seldom have enjoyed more. A knight who possessed 150*l.* per annum passed for extremely rich.

A gentleman's house, with three or four beds, at that time was extraordinarily well provided; few, probably, had more than two. The walls were commonly bare, without wainscot or even plaster; except that some great houses were furnished with hangings, and that, perhaps, hardly so soon as the reign of Edward IV. Of course neither libraries of books nor pictures could have found a place among furniture. Silver plate was very rare, and hardly used for the table. A few inventories of furniture extant exhibit a miserable deficiency. And this was incomparably greater in private gentlemen's houses than among citizens, and especially foreign merchants. In an inventory of the goods belonging to Contarini, a rich Venetian trader, at his house in St. Botolph's-lane, there appear to have been not less than ten beds, in 1481, and glass windows are specially noticed as moveable furniture. No mention, however, is made of chairs or looking-glasses.

We have another inventory of the goods of "John Port, late the king's servant," who died about 1524. He seems to have been a man of some consideration, and probably a merchant. The house consisted of a hall, parlour, buttery, and kitchen, with two chambers, and one smaller, on the floor above; a napery, or linen-room, and three garrets, besides a shop, which was probably detached. There were five bedsteads in the house, and, on the whole, a great deal of furniture for those times; much more than has been seen in any other inventory. His plate is valued at 94*l.*; his jewels at 23*l.*; his funeral expenses came to 73*l.* 6*s.* 8*d.* And yet, from a similar inventory of furniture in Skipton castle, the great honour of the earls of Cumberland, and among the most splendid mansions of the north, the baronial residence was provided in an inferior manner, for there were not more than seven or eight beds in this great castle; nor had any of the chambers chairs, glasses, or carpets, even after almost a century had elapsed of continual improvement.

A better notion of the accommodations usual in the rank immediately below, may be collected from an inventory published by Strutt, of Mr. Fermor's house at Easton. The parlour had wainscot, a table, and a few chairs; the chambers above had two best beds, and there was one servant's bed; but the inferior servants had only mattresses on the floor. The best chambers had window shutters and curtains. Mr. Fermor, being a merchant, was probably better supplied than the neighbouring gentry. His plate, however, consisted of only sixteen spoons, and a few goblets and ale pots. These details, trifling as they may appear, are absolutely necessary, in order to give an idea, with some precision, of a state of national wealth so totally different from the present.

Passing now to the exterior of ancient dwellings, it may be observed, that gardening, which had been revived in France under Charlemagne, was probably introduced into England with the Norman conqueror, at the end of the eleventh century. Henry I., it is said, had a park at Woodstock; and it may not be too much to conjecture that this park was the same that would be appropriated by the owner of the magnificent Roman villa, whose extensive ruins, occupying nearly six acres, have been recently dug up on the Duke of Marlborough's estates in that neighbourhood. Blenheim, the finest residence in Britain, or perhaps Europe, as to general grandeur, may in this view be considered as the most interesting, in point of its relation to antiquity. Fitzsteven states, that the citizens of London, at the time of Henry II., had gardens to their villas, "large, beautiful, and planted with trees." In De Cerceau's Architecture, published in the time of Henry III. there is scarcely a ground-plot not laid out as a parterre or a labyrinth.

The houses of the nobility had commonly some sort of garden or "pleasance" attached to them; and all the monasteries had orchards and gardens, including a "herberie," or physic garden, the chief medicinal nostrums of the times being preparations from herbs. We hear nothing for many years of ornamental gardening; and the list of culinary vegetables cultivated at this time was very scanty, there being few besides carrots, parsnips, and cabbages, in general use.

Agriculture was greatly improved under the kings of the Norman race. Immediately after the conquest, many thousand husbandmen, from the fertile plains of Flanders and Normandy, settled in this island, obtained estates or farms, and employed the same methods in the cultivation of them which had proved so successful in their native country. The clergy, too, and especially the monks, rivalled the nobility in the art of improving the soil. It was, in fact, so much the custom for the regulars of this period to assist in the labours of the field, especially in seed-time, the hay season, and harvest, that the famous à Becket, even after he was Archbishop of Canterbury, used to sally out with the inmates of the convents near which he happened to reside, and take part with them in all the rural occupations of spring, summer, and autumn. It was decreed by the twenty-ninth canon of the General Council of Lateran, that "all presbyters, clerks, monks, converts, pilgrims and peasants, when they are engaged in the labours of husbandry, shall, together with the cattle in their ploughs, and the seed which they carry into the field, enjoy perfect security; and that all who molest and interrupt them, if they do not desist when they have been admonished, shall be excommunicated."

The implements of husbandry were of the same kind, in this period, with those which are employed at present, though some of them were less perfect in their construction. The plough, for example, had but one handle or stilt, as it is called, which the ploughman guided with one hand, while in the other he held an instrument both for cleaning the share and breaking the clods. The Norman plough had two wheels, and in the light soil, for which it was constructed, was commonly drawn by one, or, at most, two oxen; but in England, as the land is generally more heavy and tenacious, a greater number of cattle was necessary. The carts, harrows, scythes, sickles, and flails, appear, from the figures of them still remaining, to have been nearly of the same form as those now used.

Ingulfus, abbot of Croyland, supplies an early and interesting evidence of improvement. Richard de Rules, lord of Deeping, he tells us, being fond of agriculture, obtained permission from the abbey to enclose a large portion of marsh, for the purpose of separate pasture, excluding the Welland, by a strong dike, upon which he erected a town, and rendered those stagnant fens a garden of Eden. In imitation of this spirited cultivator, the inhabitants of Spalding and some neighbouring villages, by a common resolution, divided their marshes amongst them; when some converting them to tillage, some reserving them for meadow, others leaving them in pasture, found a rich soil for every purpose. The abbey of Croyland and the villages in that neighbourhood followed this example. This early instance of parochial inclosure is not to be overlooked in the history of social progress. By the statute of Merton, in the twentieth of Henry III., the lord is permitted to approve, that is, to enclose the waste lands of his manor, provided he leave sufficient common of pasture for the freeholders.

Still the culture of arable land was very imperfect. Fleta remarks, in the reign of Edward I. or II., that unless an acre yielded more than six bushels of corn, the farmer would be a loser and the land yield no rent. And Sir John Cullum, from very minute accounts, has calculated that nine or ten bushels were a full average crop on an acre of wheat. An amazing excess of tillage accompanied, and partly, it is probable, produced this imperfect cultivation. In Hawsted, for example, under Edward I., there were thirteen or fourteen hundred acres of arable, and only forty-five of meadow ground. A similar disproportion occurs almost invariably in every account we possess.

The petition of the elder Spenser to parliament, in the reign of Edward II., suggests some singular notions of the existing state of things. He complained that the barons had ravaged sixty-three manors, and that he had incurred a loss amounting to 138,000*l.* of our present money. From the items furnished, it is evident that the greater part of his vast estate, as well as the estates of the other nobility, was farmed by the landlord himself, managed by his bailiffs or stewards, and cultivated by his villains. Little or none of it was let on lease to husbandmen. Its produce was consumed in rustic hospitality by the baron and his officers. A great number of idle retainers, ready for any mischief or disorder, were maintained by him; and all who lived on his estate were absolutely at his disposal.

It is observable, too, that among the particulars of his loss was an immense quantity of salted meat. Now, as the outrage he complained of began in the early part of May, it is easy to conjecture what a vast store of the same kind he must have laid up at the commencement of the winter—a proof of the wretched state of ancient husbandry, which could not provide subsistence for the cattle during the winter, even in such a temperate climate as the south of England. There being few or no inclosures, except perhaps for deer, no sown grass, little hay, and no other resources for feeding cattle, the barons as well as the people were obliged to kill and salt their oxen and sheep in the beginning of winter, before they became lean on the common pasture. The salting of mutton, which was then common, has been now for a long time disused. The raising of corn was a species of manufactory, Hume remarks, which few, it appears, in that age, could practise with advantage.

Supplies for domestic and other purposes were now obtained to a large extent at fairs. Stow says, that, "to the priory of St. Bartholomew's, in Smithfield, King Henry II. granted the priviledge of a faire, to bee kept yeerly at Bartholomew-tide, for three daies, to wit, the eve, the day, and the next morrow, to the which the clothiers of England and drapers of London repaired, and had their booths and standings within the church-yard of this priory, closed in with wals and gates, locked every night, and watched for safety of men's goods and wares; a court of piepowders was daily during the faire holden, for debts and contracts. But," continues he, "notwithstanding all proclamations of the prince, and also the act of parliament, in place of booths within this church-yard (only letten out in the faire time, and closed up all the yeere after) bee many large houses builded, and the north wall towards Long-lane taken downe, a number of tenements are there erected, for such as will give great rents. The forrainers," he adds, "were licensed for three days, the freemen so long as they would, which was sixe or seven daies." This was the origin of Bartholomew fair, over which the charter of Henry II. gave the mayor and aldermen criminal jurisdiction during its continuance.

Institutions of this sort were peculiarly serviceable in the earlier stages of society, and in rude and inland countries. The number of shops, and the commodities in them, were then either comparatively limited, or they were but little frequented by dealers; so that it was for the advantage of all that fairs should be established, and merchants induced to give their attendance. For this purpose various privileges were annexed to fairs, and numerous facilities afforded to the disposal of property in them. To give them a greater degree of solemnity, they were originally, both in the ancient and modern world, associated with religious festivals. In most places, indeed, they are still held on the same day with the wake or feast of the saint to whom the church is dedicated; and, till the practice was prohibited, it was customary in England to hold them in church-yards; but since the growth of towns, and the opportunities afforded for the disposal and purchase of all sorts of produce at the weekly or monthly markets held in them, the utility of fairs, in this country at least, has very much diminished; they have also lost much of their ancient splendour; and though some of them are still well attended, and of real use, a considerable number might be advantageously suppressed.

The first commercial treaty to which this country was a party, was made between Henry III. and the King of Norway. The trade of England was chiefly carried on by Germans; and the principal commodities were wool, tin, and lead. These were brought to certain towns in different parts, called the *staple* towns, where the collectors of the king's customs were appointed to receive the duty. The goods were then sold to the German traders, who were called the merchants of the staple; and these people exported them abroad, and imported gold, silver, and various goods in return.

The woollen and linen manufactures have existed in this country from a very early period. England has been immemorially famous for its wool, of which it produced abundance, before any woollens, except of the coarsest kind, were made here: the wool was then chiefly exported to Flanders, where that manufacture was in a very flourishing state. So early, however, as the reign of Edward II. Manchester was a seat of the woollen manufacture. A *mill* for the *dyers*, on the banks of the Irk, is mentioned about the year 1313; and a few years after, a *fulling mill* turned by the same river, is noticed.

But the woollen manufacture was rude and insignificant until the reign of Edward III. Hitherto, Fuller tells us, the English knew no more what to do with their wool, as to any "artificial curious drapery," than the sheep that wear it; their best clothes then being coarse friezes, from their want of skill in making. But Edward having married the daughter of the earl of Hainault, sent emissaries among the Dutch, to tempt over their workmen, whose slavish and degraded condition made them anxious to find a better country. Persuaded by the promises made, many Dutch servants, therefore, left their masters, and came over to England, bringing "their trade and their tools." The Flemings were settled in York, Kendal, Halifax, Manchester, the districts of Rossendale and Pendle, Norwich, Essex, Kent, and the west of England. "Here," says the old historian just quoted, "they found fuller's earth, a precious treasure, whereof England hath better than all Christendom besides. And now was the English wool improved to the highest profit, passing through so many hands, every one having a fleece of the fleece,—sorters, combers, carders, spinners, weavers, fullers, dyers, pressers, packers; and these manufactures have been heightened to the highest degree of perfection." With a more correct idea of perfection than the historian, we are warranted in giving to this great improvement a later date.

Norwich, in a very few years, became the most flourishing city in England, by means of its great trade in worsteds, fustians, friezes, and other woollen manufactures; for now the English wool being manufactured by English hands, "an incredible profit," Blomefield says, "accrued to the people by its passing through and employing so many."

In the year 1357 Blackwell Hall was appointed by the mayor and common council of London for a market, which was to receive the cloth goods exposed to sale.

During the reign of Henry VI. the exportation of woollen yarn was prohibited. Two *cloth-searchers* were appointed for every hundred throughout the realm, with authority to inspect and seal all cloths, even that made in private families, which was sent to the fulling-mill, and to levy a penny on each piece. In the same reign it was enacted that, "if our woollens were not received in Brabant, Holland, and Zealand, then the merchandise growing or wrought within the dominions of the Duke of Burgoine, shall be prohibited in England, under pain of forfeiture." Hence it appears that we were beginning to supply these countries with the kind of goods which we had been taught, by their weavers, to work only a century before.

A new order of things was now arising. So feebly were the laws at one time maintained, that no subject could trust to their protection. Men openly associated themselves, under the patronage of some great baron, for their mutual defence. They wore public badges, by which their confederacy was distinguished. They supported each other in all quarrels, extortions, robberies, and murders; and hence the perpetual turbulence, disorders, factions, and civil wars that arose. Their chief was more their sovereign than the king himself, and they were more connected with their own band than with their country.

Still it is easy to observe from these voluntary associations, that the whole force of the feudal system was in a manner dissolved, and that the people had nearly returned in that particular to the state in which they were before the Norman conquest. It was, indeed, impossible that such a system could long subsist under the perpetual revolutions to which landed property is every where subject. When the great feudal baronies were first erected, the lord lived in opulence in the midst of his vassals. He was in a situation to protect, cherish, and defend them. The quality of patron united itself with that of superior, and thus two principles of authority yielded mutual support. But when property became divided and mixed, and the distance at which the baron lived from his vassal forbade the shelter and countenance he could once afford, the tie gradually became more fictitious than real. New connexions were formed from neighbourhood or other causes. Protection was sought by voluntary services and attachment. The appearance of abilities, energy, or valour, greatly extended the influence of an individual, and paved the way for an advancement that could not previously have occurred.

Of the language spoken by the great body of the people about a century after the conquest, some judgment may be formed from the following specimen of Lyamon's translation of Wace's Brut d'Angleterre. The translator describes himself as a priest of Erulye upon Severn, and he is supposed to have completed his task about the year 1180.

> " Tha the masse wes issingen,
> Of chirecken heo thrungen.
> The king mid his folke
> To his mete verde,
> And muche his duzethe:
> Drem wes on hirede.
> Tha quene, an other halve,
> Hire hereberwe isohte:
> Heo hafde of wid-monne
> Wunder ane moni en."

In other words—" When the mass was sung, out of the church they thronged. The king amid his folk to his meat fared, and many of his nobility: joy was in the household. The queen, on the other side, sought her harbour (or lodging): she had wonderfully many women." Here, and in a much more ample specimen of the same work, we perceive no mixture of French words. The idiom is essentially Anglo-Saxon, but with some indications of its being already in a state of transition: the vestiges of the language, in its more modern form of English, may be distinctly traced. We may, on the whole, consider the style of Lyamon to be as nearly the intermediate state of the old and new languages as can be found in any ancient specimen: —something like the new insect stirring its wings before it has shaken off the aurelia state.

About the beginning of the reign of Edward I. Robert, a monk of Gloucester, composed a metrical chronicle from the history of Geoffrey of Monmouth, which he continued to his own time. This work, and a similar chronicle of Robert Manning, a monk of Brunne or Bourne in Lincolnshire, nearly thirty years later, stand at the head of our English poetry. The romance of Sir Tristrem has recently laid claim to somewhat higher antiquity: it is attributed to Thomas of Erceldoune, surnamed the Rhymer, a Scottish minstrel.

The work entitled "Visions of William concerning Piers Plowman," and the origin, progress, and perfection of the christian life, which is the earliest known original poem of any extent in the English language, is ascribed to Robert Langlade, a secular priest, educated at Oriel College, Oxford. His allusions to contemporary life afford some amusing glimpses of its manners. There is room to suspect that Spenser was acquainted with his works; and Milton, either from accident or design, has the appearance of having had one of Langlade's passages in his mind, when he wrote the sublime description of the lazar-house, in Paradise Lost.

Robert of Gloucester has a remarkable passage, which proves that, in his time, somewhere about

1270, the superior ranks continued to use the French language. Ralph Higden, about the early part of Edward III.'s reign, though his expressions do not go the same length, asserts, that "gentlemen's children are taught to speak French from the time they are rocked in the cradle; and uplandish (country or inferior) men will liken themselves to gentlemen, and learn with great business for to speak French, for to be the more told of." Notwithstanding, however, this predominance of French among the higher class, it appears that some modern critics are not warranted in concluding that they were in general ignorant of the English tongue. Men living on their estates among their tenantry, whom they welcomed in their halls, and whose assistance they were perpetually needing in war and civil frays, would hardly have permitted such a barrier to obstruct their intercourse. For we cannot, at the utmost, presume that French was so well known to the English commonalty in the thirteenth century as English is at present to the same class in Wales and the Scottish Highlands. It may be remarked also, that the institution of trial by jury must have rendered a knowledge of English almost indispensable to those who administered justice. There is a proclamation of Edward I. in Rymer, where he endeavours to excite his subjects against the king of France, by imputing to him the intention of conquering the country, and abolishing the English language (linguam delere Anglicanam), and this is frequently repeated in the proclamations of Edward III. In his time, or perhaps a little before, the native language had become more familiar than French in common use even with the court and nobility. Hence the numerous translations of metrical romances, which are chiefly referred to this reign. An important change was effected in 1362; for by the 36th Edward III. c. 15, it was enacted, that for the future all pleas should be pleaded, shown, defended, answered, debated, and judged in the English tongue, but should be entered and enrolled in Latin. The statutes of the realm long continued to be promulgated in French; and it was only from the accession of Richard III. that Englishmen were governed by laws written in their native tongue.

The earliest English instrument known to exist is said to bear the date of 1343; and there are not more than three or four entries in our own tongue on the rolls of parliament before the reign of Henry VI. after whose accession its use becomes very common. Sir John Mandevile, about 1350, may pass for the father of English prose, no original work being so ancient as his Travels; but the translation of the Bible and other writings by Wicliffe, nearly thirty years afterwards, taught us the copiousness and energy of which our native dialect was capable; and it was employed in the fifteenth century by two writers of distinguished merit, Bishop Peacock and Sir John Fortescue.

The following is a specimen of prose, selected from the seventh chapter of the Acts of the Apostles, as translated by John Wicliffe. The translator was born about the year 1324, and died in the year 1384. He was the author of various works in Latin as well as English; but the most important of his literary labours was a complete version of the Scriptures. He was the great precursor of Luther, who appeared after an interval of one hundred and fifty years; and it may perhaps be safely affirmed, that to him the cause of the reformation was more deeply indebted than to Luther himself.

"This Moises lèdde hem out, & dide woundris and signes in the londe of Egipte and in the Reed See, and in desert fourti gheeris. This is Moises that seide to the sones of Israel, God schal reise to ghou a prophete of ghoure britheren; as me ghe schulen heere him. This it is that was in the chirche in wildernesse with the aungel that spak to him in the mount Syna and with oure fadris, which took wordis of lyf to ghyue to us: to whom oure fadris wolden not obeie, but puttiden him awei, & were in turned awei in hertis into Egipte, seiynge to Aaron, Make thou to vs goddis that schulen go bifore us; for to this Moises, that ledde us out of the lond of Egipe, we wite not what is don to hym. And thei maden a calf in the daies, & offriden a sacrifice to the mawmet, and thei weren glad in the werkis of her hondis; and God turnyde & bitook hem to serue to the knyghthood of heuene; as it is writen in the book of prophetis, Whether ghe hous of Israel offriden to me slayn sacrifices, either sacrifices of oostis fourti gheer in desert?"

Still, in the most celebrated schools of this age, the field of instruction was confused and barren. In philosophy, nothing was studied but mathematics and logic, and the latter was taught in a trifling and useless manner from the book attributed to Augustine. Neither preceptor nor pupil was at this time to be found who desired or dared to attempt greater things. The circle of instruction, or the *liberal arts*, as the term was then understood, consisted of two branches, the *trivium* and the *quadrivium*. The trivium included grammar, rhetoric, and dialectics;—the quadrivium comprehended music, arithmetic, geometry, and astronomy. These seven heads, which were supposed to include universal knowledge, were thus quaintly expressed in the barbarous Latin of that age.

"*Gramm.* loquitur, *Dia.* vera docet, *Rhet.* verba colorat,
"*Mus.* canit, *Ar.* numerat, *Geo.* ponderat, *Ast.* colit astra."

He who was master of these was thought to have no need of a preceptor to explain any books, or to solve any questions, which lay within the compass of human reason—the knowledge of the *trivium* having furnished him with the key to all language; and that of the *quadrivium* having opened to him the secret laws of nature.

The logic of that period was often vain and unprofitable. One of the subtle questions which agitated the world relating to dialectics, and concerning *universals* (as, for example, man, horse, dog, &c.) signifying not this or that in particular, but *all* in general. They distinguished *universals*, or what we call abstract terms, by the *genera et species rerum;* and they never could decide whether these were *substances* or *names*, that is, whether the abstract idea or form of a horse was not really a being as much as the horse or rider!

The following question was a favourite topic of discussion, and the acutest logician never resolved it:—" When a hog is carried to market with a rope tied about its neck, which is held at the other end by a man, whether is the hog carried to market by the rope or the man?"

"The logic of the schoolmen, indeed," says Enfield, " was rather the art of sophistry than that of reasoning, for it was applied to subjects which were not understood, and employed on principles which were not ascertained. Their whole business being disputation, they sought out such thorny questions as were likely to afford sufficient exercise for their ingenuity. Their whole care was to conduct themselves *secundum artem*, and their whole ambition to obtain the victory." The object proposed by these logical prize-fighters, was not so much to elucidate truth, as to bear away the palm from their antagonists; and become celebrated in the schools, as the acutest reasoners of their age. And it must be admitted, that some of the scholastic philosophers were eminently successful in their object.

Champeaux, Abelard, and a few others, displayed an extraordinary degree of talent in this science: by continual exercise, they became skilful adepts in the art of reasoning; prompt, ingenious, and subtle in debate; so as frequently, when discussing the most intricate subjects, to obtain the applause of multitudes, who assembled in the schools, not for instruction, but to witness the triumph or defeat of their respective masters.

The influence of Aristotle was at this time extraordinarily great. A far more moderate regard would have accorded more nearly with justice, and been at the same time subservient to greater utility. For "his writings," says Dr. Reid, "carry too evident marks of that philosophical pride, vanity, and envy, which have often sullied the character of the learned. He determines boldly things above all human knowledge, and enters on the most difficult questions, as his royal pupil, Alexander of Macedon, entered upon a battle, with full assurance of success. He delivers his decisions oracularly, and without any fear of mistake. Rather than confess his ignorance, he hides it under hard words and ambiguous expressions, of which his interpreters can make what they please. There is even reason to suspect that he wrote often with affected obscurity, either that the air of mystery might procure great veneration, or that his books might be understood only by the adepts who had been initiated into his philosophy."

It was not till long after the other branches of literature had been cultivated with success in England, that poetry began to flourish. The monks had, indeed, been long accustomed to string together their miserable rhymes in barbarous Latin, by hundreds and by thousands; but it was not till towards the close of the fourteenth century, that the first genuine English poet appeared. This was Geoffrey Chaucer, whose poems are still read and admired by persons of taste, notwithstanding the obsolete style in which they are composed. He has been called the father of English poetry. Chaucer was the first great improver and reformer of our language—the "well of English undefiled"—and even now he maintains his reputation for those "ditees and songes glade," through which he

> "Made first to distylle and rayne
> The gold dew dropys of speche and eloquence
> Into our tunge."

His Canterbury Tales suggest a trait of the private life of our ancestors, who wanted the diversions and engagements of modern times to relieve a tedious evening. When, therefore, a company was assembled, if a juggler or a minstrel were not present, it was the custom to entertain themselves by relating or hearing a series of adventures. Thus the general plan of the poem alluded to, which, at first sight, seems to be merely an ingenious invention of the poet, to serve a particular purpose, is in great measure formed on a fashion of former days; and Chaucer, in supposing each of the pilgrims to tell a tale as they are travelling to Becket's shrine, only makes them adopt a mode of amusement which was common to the conversations of his age.

"Chaucer's forte," says Campbell, "is description; much of his moral reflection is superfluous; none of his characteristic painting. His men and women are not mere ladies and gentlemen, like those who furnish apologies for Boccaccio's stories. They rise before us minutely traced, profusely varied, and strongly discriminated. Their features and casual manners seem to have an amusing congruity with their moral characters. He notices minute circumstances as if by chance; but every touch has its effect to our conception so distinctly, that we seem to live and travel with his personages throughout the journey.

"What an intimate scene of English life in the fourteenth century do we enjoy in those tales, beyond what history displays by glimpses, through the stormy atmosphere of her scenes, or the antiquarian can discover by the cold light of his researches! Our ancestors are restored to us, not as phantoms from the field of battle, or the scaffold, but in the full enjoyment of their social existence. After four hundred years have closed over the mirthful features which formed the living originals of the poet's descriptions, his pages impress the fancy with the momentary credence that they are still alive; as if Time had rebuilt his ruins, and were re-acting the lost scenes of existence." We will take one specimen of Chaucer from his poem on "the Floure and the Leafe."

"When that Phœbus his chair of gold so hie
Had whirlid up the sterrie sky aloft,
And in the Bole was entrid certainly;
When shouris sote of rain descendid soft,
Causing the ground fele timis and oft,
Up for to give many an wholesom air;
And every plain was clothed faire

"With newe grene; and maketh smale flours
To springin here and there in field and mede,—
So very gode and wholesom be the shours,
That they renewin that was old and dede
In wintir time; and out of every sede
Springith the herbe; so that every wight
Of this seson wexith richt glad and light."

The reign of French metrical romance may be chiefly assigned to the latter part of the twelfth, and the whole of the thirteenth century; that of English metrical romance to the latter part of the thirteenth, and the whole of the fourteenth century. Those ages of chivalrous song were, in the meantime, fraught with events which, while they undermined the feudal system, gradually prepared the way for the decline of chivalry itself. Literature and science were commencing, and even in the improvement of the mechanical skill employed to heighten chivalrous or superstitious magnificence, the seeds of arts, industry, and plebeian independence were unconsciously sown. One invention, that of gunpowder, is eminently marked out as the cause of the extinction of chivalry; but even if that invention had not taken place, it may well be conjectured that the contrivance of other means of missile destruction in war, and the improvement of tactics, would have narrowed that scope for the pre-eminence of individual prowess, which was necessary for the chivalrous character, and that the progress of civilisation must have ultimately levelled its romantic consequence. But to anticipate the remote effects of such causes, is scarcely within the ken of philosophy, and still less within the reach of poetry. The progress of civilisation even ministered to its external importance. The early arts made chivalrous life, with all its pomp and ceremonies, more august and imposing, and more picturesque as a subject for description. Literature, for a time, contributed to the same effect, by her jejune and fabulous efforts at history, in which the athletic worthies of classical story, and of modern romances, were gravely connected by an ideal genealogy. Thus the dawn of human improvement is said to have smiled on the fabric, which it was ultimately to destroy; as the morning sun gilds and beautifies those masses of frost work, which are to melt before its noon-day heat.

A few sparks of learning survived throughout a long and dreary winter, but their preservation can only be ascribed to Christianity. Religion alone formed the bridge which was thrown across the chaos of that age, and linked the two periods of ancient and modern civilisation.

Of the literature of the middle ages it may generally be said, Montgomery admirably remarks, that it was "voluminous and vast. Princes, nobles, and even priests then were often ignorant of the alphabet. The number of authors was proportionably small, and the subjects on which they wrote were of the driest nature in polemics—such were the subtleties of the schoolmen; of the most extravagant character in the paths of imagination—such were the romances of chivalry, the legends and songs of troubadours; and of the most preposterous tendency in philosophy, so called—such were the treatises on magic, alchemy, judicial astrology, and the metaphysics. To say all that could be said on any theme, whether in verse or prose, was the fashion of the times; and as few read but those who were devoted to reading by an irresistible passion or professional necessity—and few wrote but those who were equally impelled by an inveterate instinct—great books were the natural produce of the latter, who knew not how to make little ones; and great books were requisite to appease the voracity of the former, who, for the most part, were rather gluttons than epicures in their taste for literature. Great books, therefore, were both the fruits and the proofs of the ignorance of the age: they were usually composed in the gloom and torpor of the cloister, and it almost required a human life to read the works of an author of the first magnitude, because it was nearly as easy to compound as to digest such crudities. The common people, under such circumstances, could feel no interest and derive no advantage from the labours of the learned, which were equally beyond their purchase and their comprehension. Those *libri elephantini* (like the registers of the Roman citizens, when the latter amounted to millions) contained little more than catalogues of things, and thoughts, and names, in words without measure, and often without meaning worth searching out; so that the lucubrations, through a thousand years, of many a noble, many a lovely mind, which only wanted better direction how to unfold its energies, or display its graces, to benefit or delight mankind, were but passing meteors, that made visible the darkness out of which they rose, and into which they sunk again, to be hid for ever."

The number of practical philosophers who flourished in Europe during the same period, whose names have been preserved with any records of their labours, is extremely small. Many more, indeed, may have pursued their favourite studies silently and unobserved, at a time when the discoveries of science were attributed to witchcraft and the agency of demons. But if there were such, their memory and works have alike nearly perished amidst the darkness of the times in which their lot was cast.

Of the earlier writers on chemistry, no one is more deserving notice that the celebrated Roger Bacon, a native of Somersetshire, who flourished in the thirteenth century. His writings, though marred and polluted by the reigning absurdities of alchemy, contain many curious facts and judicious observations. To him the discovery of gunpowder has been attributed. "From saltpetre and other ingredients," he says, "we are able to form a fire which will burn to any distance." And again, attending to its effects, "a small portion of matter, about the size of the thumb, *properly disposed*, will make a tremendous sound and coruscation, by which cities and armies might be destroyed." Such are the claims of Roger Bacon to a discovery which soon changed the whole art of war; but some, it should be stated, have doubted their adequacy.

To him mechanics as well as all other physical sciences, were greatly indebted. One of his biographers ascribes to him a variety of mechanical contrivances for the rarefaction of air, which probably prepared the way for the important invention of the air-pump. His experiments in optics are also proofs of his intelligence and unwearied assiduity. Considering the ignorance of the age in which he lived, and that of the monks with whom he associated, his almost universal knowledge demands that he should be considered a prodigy of genius and erudition. Few indeed have surpassed him in originality of invention or in profound research, either in ancient or modern times.

Mr. Brande observes, that one of his principal works "breathes sentiments which would do honour to the most refined periods of science, and in which many of the advantages likely to be derived from that mode of investigation insisted upon by his great successor (Chancellor Bacon) are *anticipated*." This remark might have been still more prospective, for a celebrated French experimentalist named

Homberg, availing himself of some hints of chemical combinations suggested by him, has, at a much later period, made some important discoveries in that science.

A considerable advance was made by Albert, surnamed the Great, who is said to have chiefly excelled in mechanical science; in proof of which it is stated that he constructed the automaton figure of a man, who opened the door of the machine in which he was placed, and uttered certain articulate sounds, as if in reply to questions addressed to him. It is also recorded, that the renowned Doctor Thomas Aquinas was so terrified on hearing the vocal sounds uttered by this figure, as to break it in pieces with his staff, supposing he had thereby obtained a signal victory over the Prince of Darkness!

The century following that in which Albert lived was still more favourable to mechanical science. Machines of greater utility were then constructed, and applied to the ordinary purposes of life. Among these the invention of paper-mills, attributed to Ulmar Strame, a senator of Nuremberg, who flourished about the year 1350, must be considered of great importance. The manufacture of clocks, moving by weights and pullies, is also attributed to this age, though the original inventor is unknown. Of those who excelled in this department of mechanical science, great honour is due to an English monk, named Wallingford, who wrote a scientific treatise on the subject, still preserved in the

Bodleian Library, and constructed a chronometer, the movements of which pointed out the courses of the sun and moon, the state of the tides, with other curious effects, which were then considered almost miraculous.

The more abstruse sciences had now fallen into neglect. Natural philosophy, astronomy, and the different branches of the mathematics, seem scarcely to have maintained their ground, much less did they advance beyond the discoveries of Bacon. But some of the more polished arts, and those branches of knowledge which throw an external splendour over the face of a country, were cultivated with a considerable degree of success.

Medical science was at a low ebb, if we are to judge of it from a prescription for the small-pox, given by a learned physician in the reign of Henry III., which directed that the patient should be wrapped in red cloth, and that the hangings and quilt of the bed should be of the same colour.

A singular fact may also be mentioned as to surgery. On the first introduction of fire-arms, the army-surgeons supposed that there was something venomous in gunpowder, which poisoned all gunshot wounds, and the practice was to pour boiling oil into them. A deviation from it arose in a singular manner. A young surgeon in the army of Francis I. having on one occasion expended all his oil, was obliged to dress the remainder of the soldier's wounds without it. He states that he could scarcely sleep all night for thinking of his patients, and, rising early in the morning, he expected to find all those whose wounds had not been scalded, either dead or "empoisoned." But, to his great surprise, he found they had rested well, and were free from pain, while the others were in fevers with inflamed wounds, "which being the case," he adds, "I resolved with myself never to burn gunshot wounds any more."

Of the ignorance that prevailed as to geography, one fact will afford a sufficient illustration. In 1344, Pope Clement VI. created Louis of Spain prince of the *Fortunate Islands*, meaning the Canaries, which lie in the North Atlantic ocean, near the continent of Africa; and in consequence the English ambassador at Rome and his retinue were seized with an alarm that Louis had been created king of England, and forthwith hurried home in order to convey this *important* intelligence. It might be supposed, from this circumstance, that the minds of few, if any, were engaged in the pursuit of knowledge;—yet what was the fact? Such was the ardour of study at this time, that there were thirty thousand students in the University of Oxford alone. It may therefore be fairly asked and answered in the words of Hume:—"What was the occupation of all these young men? To learn very bad Latin and still worse logic."

Improvement, however, afterwards appeared to be manifestly advancing. Civil employments and occupations became honourable among the English. They rose above others because their situation did not render a constant attention to war so necessary as it was among their neighbours. The gentry, and even the nobility, began to deem an acquaintance with the law a necessary part of education. They were less diverted than afterwards by other sciences from studies of this kind, and in the age of Henry VI. it is said there were in the inns of court about two thousand students, most of them men of honourable birth, who applied themselves to this branch of civil knowledge, a circumstance which proves that a considerable progress was already made in the science of government, and which was the prognostic of a still greater.

To such engagements great importance will be attached, when it is remembered that it is after governments are moulded into a fixed shape, and exert a defined influence, and after the series of events has commenced which constitute the history of the nation, that what is truly the national mind is formed, and that the genius of the nation rises to proportionate heights at successive intervals, as if responding to the national achievements.

# THE

# AGE OF DISCOVERY.

## THE AGE OF DISCOVERY.

A. D. 1420—1554.

The literature formed during the fourteenth century was derived from the peculiarity of the Gothic genius, and from the revival of classical learning; but neither was kept within proper limits; and as it is more easy to borrow than invent, the learned men of Europe were likely to become servile, but successful imitators of Grecian and Roman models. Happily, however, a new influence arose in the art of printing, which, with other changes that followed, has borne the human mind on a voyage of unceasing enterprise and research. Although unknown in Europe till towards the middle of the fifteenth century, it was practised in China at an extremely remote period, but the mode employed greatly differed from that pursued by those who followed them in its exercise.

The Europeans had, however, the honour of inventing this art for themselves, ere the passage to the east by the Cape of Good Hope was discovered, and, of course, ere they had any knowledge of the existence of that distant country. But while this fact is unquestionable, the circumstances connected with it are not so easily explained. Three cities have severally laid claim to this distinction—Haarlem, Mentz, and Strasburg. The claims of the former, however, appear to be well established, while the second contributed not a little to the improvement of the art.

Laurentius Coster (so called from his father's holding the office of custos of the cathedral of Haarlem) seems to have been the inventor of the art of printing. He began with carving letters on the rind of beech trees, and impressing them on paper, for the amusement or instruction of his grandchildren. Having happily succeeded in printing one or two lines, he invented, with the aid of his son-in-law, Thomas Peter, a more glutinous writing-ink, because he found the common ink sunk and spread; and then formed whole pages of wood, with letters cut on them; "of which sort," says Hadrian Junius, "I have seen some essays in an anonymous work printed only on one side, entitled 'Speculum Nostræ Salutis;' in which it is remarkable, that in the infancy of printing (as nothing is complete at its first invention), the back sides of the pages were pasted together, that they might not, by their nakedness, betray their deformity."

At what period printing was thus invented has not been exactly ascertained. Laurentius died in 1440. The works he produced, considering the difficulties he had to encounter, and that they were all printed with separate wooden types, fastened together with thread, must have required years in the execution; and it has thus been conjectured that the invention took place about or soon after 1420. If, however, Laurentius be thus allowed the honour of the invention, he cannot be regarded as having brought the art to a high state of improvement. On the contrary, the few works which he printed are remarkable only for rudeness and inelegance. The pages are not numbered; there are no divisions at the end of lines; no direction-words to aid those who put the books together; and in his most clumsy performance there is no punctuation; the lines are uneven, and the pages are not always of the same size or shape.

The art of taking impressions from lines cut in relief on blocks of wood, was soon applied to the multiplication of copies of designs which were in demand amongst the people of Italy and Germany. The representations of saints and of scriptural histories, which the limners in the monasteries had for several centuries been painting in their missals and Bibles, were copied in outline; and being divested of their brilliant colours and rich gilding, presented figures exceedingly rude and grotesque. In the collection of Earl Spencer there is a very curious print from a wood block, representing St. Christopher carrying the infant Saviour, which bears date 1423, and is the earliest undoubted document which precisely determines the period when wood-engraving was generally applied to objects of devotion.

Of all the works printed from wooden blocks, the Biblia Pauperum, or Poor Man's Bible, is perhaps the rarest as well as the most ancient; it is a manual, or a kind of catechism of the Bible, for the use of young persons and of the common people, whence it derives its name, and who were thus enabled to obtain, at a comparatively low price, an imperfect knowledge of some of the events recorded in the Scriptures. Being much in use, the few copies of it which are at present to be found in the libraries of the curious, are, for the most part, in bad condition; but the extreme rarity of this book, and the circumstances under which it was produced, concur to impart to it a high degree of interest.

The Poor Man's Bible consists of forty plates, with extracts and sentences agreeing with the figures and images represented therein; the whole are engraved on wood on one side of the leaves of paper, so that when folded they are placed opposite to each other. Each plate or page contains four busts, two at the top and two at the bottom, together with three historical subjects: the two upper busts represent the prophets, or other persons, whose names are always written beneath them; the two lower busts are anonymous. The middle of the plates, which are all marked by letters of the alphabet in the centre of the upper compartment, is occupied by three historical pictures, one of which is taken from the New Testament; this is the type or principal subject, and occupies the centre of the page between the two antitypes of other subjects which allude to it. The inscriptions which occur at the top and bottom of the page consist of texts of Scripture and Leonine verses, the ends of which rhyme to the middle, and are so named from Leo, the inventor.

To the wooden blocks at first employed, there soon succeeded letters separately cut on wood, which were transposable into new combinations after each page had been printed off, in the same manner as our modern types. Books printed with these characters are still extant, and are distinguishable by the difference in the size and shape of similar letters. To engrave the letters on bits of brass, or other metal, was an obvious improvement actually adopted; it was soon, however, superseded by the discovery of a method of casting the types of lead, which was brought to comparative perfection about the year 1450, by John Faust, of Mentz, a considerable city on the Rhine.

The first types were cut, so far as possible, to resemble the characters used by the scriveners of that time; and perhaps on this circumstance is founded the story of Faust's selling the first printed Bibles for written ones, in Paris, and of his being charged with magic, in producing them so rapidly, so cheaply, and so exactly alike. The similarity to the manuscript works of the time was much favoured by the circumstance, that all the capital letters were left to be delineated with the pen, and beautified by the process of illumination practised by ingenious artists on most books then known.

The collections of types possessed by the first printers were far from including even the necessary varieties for ordinary purposes, so that abbreviations in spelling, and blanks left to be filled up with the pen, were very common in the earliest printed books; Greek characters, particularly, were of much later introduction than the original fusile types, which were a rude Gothic, mixed with the letter called Secretary. The first points used were only the colon and the full stop, as still retained in some old versions of the Psalms; the appearance of the hyphen, where words are broken at the end of lines, and even the spacing out of the lines themselves to an equal length, are indications of improvement in the art. An intermixture of rubrics or red letters was very common at an early period.

The character now called Italic was invented by Aldus, a famous Venetian printer, and called from him, Aldine: it was used in printing quotations, until set aside in this respect by the double commas, or Guillemets, as they were at first called, after their inventor, a French printer.

The art of printing is generally allowed to have been brought into England by William Caxton, about the year 1470. He set up his presses, and carried on his operations in the old almonry of Westminster Abbey, where he printed a great number of books, considering the infancy of the typographic art. The types with which this eminent man printed were peculiar, being that mixture of the Secretary and Gothic shape already mentioned; the size that is known among printers as great primer. He had under him several excellent workmen, particularly

Wynkin de Woorde, a Dutchman, and Richard Pynson, a citizen of London, both of whom afterwards became printers of reputation. Whether or not Caxton cast his own types, may be doubted; as he certainly imported the art from abroad, so he might also the materials, which he never altered or improved: on the other hand, the founding of types was at that early period a chief feature of the skill and credit of the practisers of the recent invention. Of Wynkin de Woorde, who greatly improved the art, we are told that, on setting up for himself, his first care was to cut a new set of punches, which he sunk into matrices, and cast therefrom several sorts of printing letter, which he afterwards used. Palmer mentions a singular circumstance, which induced him to think this celebrated printer was also his own letter-founder; namely, that in some of his first printed books the letter he made use of (which is called great primer, and two-line great primer black,) is the very same as that "used by all the printers in London to this day" (1730). Mr. Palmer adds his belief that these letters were actually cast from matrices struck by the punches of De Woorde, who was the first English printer in whose works we find the Roman letter, which he used with his black, or Gothic, to distinguish any thing remarkable, as we intermix Italic with the Roman. The fine old English, or black letter, used by printers in this country in the beginning of the sixteenth century, was imported, as were also other sorts, chiefly from Holland.

Such was the origin of this great power, which has "reformed religion, and new-modelled philosophy; has infused a new spirit into laws, and overrules governments with a paramount authority; makes the communication of mind easy and instantaneous beyond example; confers a perpetuity, unknown before, upon institutions and discoveries, and gives those wings to science which it has taken from time."

If, however, some results were remote, others were immediate. "For us," says Dugald Stewart, "who have been accustomed from our infancy to the use of books, it is not easy to form an adequate idea of the disadvantages which those laboured under who had to acquire the whole of their knowledge through the medium of universities and schools; blindly devoted, as the generality of students must then have been, to the peculiar opinions of the teacher, who first unfolded to their curiosity the treasures of literature and the wonders of science. Thus error was perpetuated; and, instead of yielding to time, acquired additional influence in each succeeding generation. But the art of printing, by rendering the *taught* less dependent on their *teachers*, and by opening more widely the sources of knowledge, served quickly to break down these ancient barriers, and emancipated the human mind from its bondage."

Thus, in particular, was Aristotle brought down from his elevated station. His authority had been for many years scarcely inferior in the schools to that of the Scriptures; and in some universities it was supported by statutes, requiring the teachers to promise, on oath, that in their public lectures they would follow no other guide.

At this period other events arose of transcendent importance. Prince Henry of Portugal had already traced the African shores to the Cape Verd Isles, and meditated a passage round the Southern Cape to the rich kingdoms of the East; and an obscure yet bolder navigator contemplated a shorter route across the wild and heretofore unknown waste of the western waters, where it had long been surmised that a vast transatlantic territory gave rotundity and balance to the world. The tradition was then remembered, that at a period of time indefinitely remote, there existed a vast insular territory, stretching beyond the coasts of Africa and Europe, which was called Atlantis; and that for three days this western land was shaken to its foundations by the incessant and hourly increasing concussions of an earthquake, when it at length yielded to the irresistible and unseen mysterious power, and sunk with its immense population beneath the bosom of the ocean. Nor were the chronicles of Wales forgotten; namely, that Madoc, son to Owen Quineth, Prince of Wales, seeing his two brethren at debate who should inherit, prepared certain ships, with men and munition, and left his country to seek adventures by sea. Leaving "Ireland N. he sailed W. till he came to a land vnknown: returning home and relating what pleasant and fruitfull countries he had seene, without inhabitants, and for what barren ground his brethren and kindred did murther one another, he provided a number of ships, and got with him such men and women as were desirous to liue in quietnesse, who arrived with him in this new land, in the yeare 1170."

As if, in confirmation of these statements, pieces of curiously carved wood, large jointed reeds, and trees of a kind unknown in Europe, were picked up to the westward of Cape St. Vincent, and at the Azores, after long-continued westerly winds. At Flores, the bodies of two human beings were washed ashore, whose colour and features were distinct from those of any men who had before been seen; and a singularly wrought canoe was also driven on the same coast. Several Portuguese navigators thought they had seen these islands when driven far to the westward, and the sons of the discoverers of Terceira perished in seeking them, while the legends of the Scandinavian voyagers told of a mysterious Vin-land, enveloped in danger, and surrounded by the awful superstitions of the northern mariners.

Urged by these and many other indications, as also by some sound geographical reasonings, Columbus, a Genoese seaman, of a hardy character, and chivalrous spirit, imbued with the enthusiasm of the times, and impelled also by an intense desire of fame, engaged in the service of Ferdinand and Isabella, sailed from Palos with two barks or caravals, and a decked ship, on August 3d, 1492, and on October 12th set at rest a long agitated question, and realized what Montgomery has thus so beautifully pictured.

> "When first his drooping sails Columbus furl'd,
> And sweetly rested in another world,
> Amidst the heaven-reflecting ocean, smiles
> A constellation of Elysian isles;
> Fair as Orion when he mounts on high,
> Sparkling with midnight splendour from the sky.
> They bask beneath the sun's meridian rays,
> When not a shadow breaks the boundless blaze;
> The breath of ocean wanders through their vales
> In morning breezes and in evening gales;
> Earth from her lap perennial verdure pours,
> Ambrosial fruits and amaranthine flowers;
> O'er the wild mountains and luxuriant plains,
> Nature in all the pomp of beauty reigns;
> In all the pride of freedom—NATURE FREE
> Proclaims that MAN was born for liberty."

Another cause of advancement was the discovery of America, which, in the influence it is destined to exert on the human race, is probably second, and only second, to the art of printing.

Sebastian Cabot, a celebrated navigator, and who lays a successful claim to this honour, was the son of John Cabot, a Venetian merchant, residing in England. Although the subject of much dispute for a long time, it is now placed beyond a doubt that our country was the place of his birth. In an ancient collection of Voyages and Travels by Richard Eden, a learned writer and contemporary of Sebastian, the author says in a note—"Sebastian Cabote tould me, that he was born in Brystowe (Bristol), and that at iiii yeare oulde he was carried with his father to Venice, and so returned agayne into England with his father after certayne years, whereby he was thought to have been born in Venice." It appears that he returned, when still young, to England, and remained there till he grew up to manhood.

The brilliant discoveries of Columbus awakened a spirit of enterprise throughout the enlightened nations of Europe; and England was not inattentive to movements, from which great and important advantages might result to her dominions. Her monarch, Henry VII., however avariciously inclined, evinced great readiness to facilitate and promote adventure in the novel career thus opened to human ambition. The all-important and engrossing object was to discover a route to India; and an expedition, in a north-westerly direction, ostensibly to reach what was called Cathay, or the Land of Spice, was speedily, after the discoveries of Columbus, projected by Sebastian Cabot, and fitted out under the auspices of the English government. The first patent, which bears date the 5th of March 1496, was given to John Cabot and his three sons, Lewis, Sebastian, and Saucius, and authorizes them "to seek out, discover, and find whatsoever isles, countries, regions, or provinces of the heathen and infidels, whatsoever they be, and in what part of the world soever they be, which before this time have been unknown to all Christians." The patentees were further empowered to set up the royal banner, and occupy and possess all the "newly found" lands in the name of the king, who reserved a fifth of the profits. It was also stipulated that the vessels should return to Bristol, and that the privilege of exclusive resort and traffic belonged to the patentees.

Although the patent was conferred on John Cabot and his three sons, there can be no doubt, even if the father did accompany the expedition, that its success was entirely owing to the genius of Sebastian. The inaccuracies which have arisen from the loose investigation and immature consideration of several ancient and modern writers, are now satisfactorily traced to certain perverted statements of Hakluyt; and their exposition, which we owe to the industry and acumen of the author of a recent memoir of Cabot, is worthy of attentive examination. Suffice it here to remark, that from a singular misinterpretation of some documents, and the omission of others, John Cabot, who was not the discoverer, but only a part owner of an expedition to discover new lands, erroneously obtained the credit, not only of his son Sebastian's discovery of the American continent, but also of possessing powers of mind and scientific knowledge which were scarcely inferior to those possessed by Columbus himself.

To Sebastian Cabot, therefore, belongs the undoubted glory of the first discovery of the *terra firma* of the western world. The expedition, consisting of the ship commanded by Sebastian, and three or four smaller vessels, sailed from Bristol in the beginning of May 1497; and an ancient Bristol manuscript records the fact, that, "in the year 1497, the 24th June, on St. John's day, was Newfoundland found by Bristol men, in a ship called the Mathew." On the authority of Peter Martyr, we learn, that after quitting the north, where he reached latitude sixty-seven and a half, Cabot proceeded along the coast of the continent, to a latitude corresponding probably with that of the Straits of Gibraltar. Indeed he is said to have gone far southward; but a failure of provisions compelled him to desist from further pursuit, and the expedition returned to England.

The second patent, which, for the first time, has been published in the memoir referred to, is dated 3d February 1498, and gives authority to "John Kabotto, or his deputies," to take at pleasure six English ships, and "them convey and lede to the loñde and isles of late found." Shortly after the date of this patent John Cabot died; and it is said that his sons Lewis and Saucius went to settle in Italy. Sebastian, however, did not abandon an enterprise in which he had embarked; and a second voyage was zealously undertaken under his superintendence. A ship, equipped at the King's expense, along with four small vessels, sailed from Bristol in the spring of the year 1498. It is curious, that although, both from the language of the patent, and the circumstance of three hundred men embarking, colonization seems to have been contemplated, the leading object of the voyage was to effect the discovery of a north-west passage. The result is, unfortunately, wrapt in much obscurity. Gomara alone furnishes us with what may be a correct account. According to this author, Cabot "directed his course by the tracte of islande, uppon the Cape of Labrador, at lviii. degrees; affirmynge that, in the monethe of July, there was such could, and heapes of ise, that he durst passe no further; also, that the dayes were very longe, and in maner without nyght, and the nyghtes very clear. Certayne it is, that at the lx. degrees, the longest day is of xviii. houres. But, consyderynge the coulde, and the straungeness of the unknowen lande, he turned his course from thense to the west, followynge the coast of the lande of Baccalaos unto the xxxviii. degrees, from whense he returned to Englande."

The results of this second voyage were not sufficiently important to induce Henry to equip another expedition. We have good authority for believing, however, that Cabot, in 1499, "with no extraordinary preparations, sett forth from Bristoll, and made greate discoveries." This is confirmed by the navigator Hojeda having, in his first voyage, found "certain Englishmen" in the neighbourhood of Caquibacoa. It is highly probable, from the unlikelihood of any other English seamen pursuing such a route, that these were Cabot and his companions. But the narrative of Cabot's life, for the fifteen years subsequent to the departure of his second expedition, is meagre and unsatisfactory. One circumstance deserves notice, that during that period Amerigo Vespucci, in company with Hojeda, crossed the Atlantic for the *first time*, whilst Sebastian was prosecuting his third voyage; yet, as the author of his memoirs says, "while the name of the one overspreads the new world, no bay, cape, or headland recals the name of the other."

After the death of Henry VII. on the invitation of Ferdinand, Sebastian Cabot went to Spain; and Vespucci, who held the office of pilot-major, having died, he was appointed his successor. He was soon employed in a general revision of maps and charts; and his public and private character endeared him to most of the learned and good men in Spain. He had, however, like Columbus, many enemies; and the death of Ferdinand put an end to an expedition then in contemplation. The ignoble commencement of the reign of Charles V. frustrated all further hopes of its prosecution; and Cabot, in disgust, returned to England, where, under Henry VIII. he obtained honourable employment, and performed another westwardly voyage in 1517, which, however, from various causes, proved unsuccessful.

Sebastian Cabot may be justly regarded as one of the most illustrious navigators the world has ever seen. His life exhibits one continued devotion to the mighty impulses of his genius. England owes him a debt of imperishable gratitude. The author of the Memoir which has rescued so much of his life from obscurity says, "He ended as he had begun his career, in the service of his native country, infusing into her marine a spirit of lofty enterprise, a high moral tone, a system of mild but inflexible discipline, of which the results were not long after so conspicuously displayed. Finally, he is seen to open new sources of commerce, of which the influence may be distinctly traced on her present greatness and prosperity."

America was, however, uncultivated and almost unpeopled; containing no manufactures and little raw produce in a state for use, the consequence not of deficient fertility, but of the incapacity of the natives to prepare it for sale, or to bring it to the coast to be shipped. Ages elapsed before the influx of settlers from Europe, and the increase of the native population, rendered the exports of merchandise from America, her coffee, sugar, cotton, cochineal, or indigo, of importance to the commerce of Europe: the chief effect produced during the century following its discovery arose from a different cause—from the increased supply of gold and silver.

The influx of the precious metals from America gave a considerable impulse to the productive industry of Europe. At that time the chief trading towns of that part of the earth were in Italy, the Netherlands, and, in a much less degree, in France, Italy, and Germany. In the latter countries the towns were very small, not being peopled to the extent of one-third of their present numbers. Nothing shows more clearly the backwardness of manufactures in that age, the imperfect division of employment, or the limited communication between one province and another. There were, in those days, few lines of intercourse entitled to the name of roads, or fit for conveying corn or merchandise by wheel carriages. Even in countries comparatively level, such as the south of England and the north of France, there were no carriage-roads, and goods were conveyed on the backs of mules and horses, in the same manner as over the mountainous regions of the Alps; nor were there at that time post-office establishments, for the service of either government or merchants.

An increase in town population is the best evidence of improvement in agriculture as in commerce. In a rude state of cultivation, the labour of seventy or eighty persons is required to raise provisions for a hundred; so that three-fourths of the inhabitants are obliged to live in country districts, for the mere purpose of raising subsistence. But as machinery and implements become improved, and the art of husbandry is better understood, the farmer can render the labour of himself and his servants more effectual; there remains a greater surplus of provisions for the support of the inhabitants of towns, and somewhat more of the population are enabled to attach themselves to employments distinct from agriculture, namely, those of mechanics and manufactures. To this improved condition Europe was slowly advancing, when the discovery of the silver mines of America had the effect of materially quickening its progress.

Other discoveries were now being made. As a spirit like that of Prince Henry animated his successors, the Portuguese pursued the course on which they had entered, in the reign of John II. a ruler of profound sagacity and extensive views, with equal ardour and success. Captain Diaz passed the extreme point of Africa, to which he gave the name of the Stormy Cape; but the king, who saw more fully the importance of that discovery, styled it the Cape of Good Hope. Emmanuel, too, pursued the same great projects. He sent out a fleet of four ships, under the command of Vasco de Gama, in order to complete the passage to India by sea. This admiral possessed adequate knowledge for such an expedition. After being assailed by tempests, he doubled the Cape of Good Hope, and ranging through unknown seas, happily arrived at the city of Calicut, on the coast of Malabar.

Calicut was at that time the emporium of India. Thither the Arabs resorted for all the rich products and valuable manufactures of the East. These they carried in ships to the ports of the Red Sea, and sold at Alexandria to the Italian merchants. This information Gama had received at Melinda, on the coast of Zanguebar; and he there engaged a pilot, who conducted him into the harbour of Calicut, when the trade was at its height. Here he fortunately met with a native of Barbary, named Monzaida, who understood the Portuguese language, and whose admiration of that people overbalanced the prejudices of religion and country. This admiration determined Monzaida to do every thing in his power to serve strangers who had committed themselves to him without reserve. He procured Gama an audience of the Samorin, or Emperor, who received him very favourably; and a treaty of commerce was set on foot in the name of the King of Portugal. But this negotiation, when almost completed, was broken off by the jealousy of the Arabs, who represented so strongly the danger of such an alliance, and the ambition of the Portuguese, that the Samorin ungenerously resolved to put to death those bold navigators, whom he had lately treated with kindness, and whose friendship he seemed to desire. Informed of his danger by the faithful Monzaida, Gama sent his brother on board of the fleet. "Should you hear," said he, "of my death or imprisonment, I prohibit you, as your commander, from attempting to release me or to avenge my fate... set sail immediately, and inform the king of the success of our voyage; I am happy to have performed his orders, and discovered a passage to India for Portugal." Happily matters were not pushed to such an extremity; the Samorin permitted Gama to join his fleet, and he departed soon after for Europe, the herald of his own success. No language can express the joy of the Portuguese on his return. They saw themselves, by one daring enterprise, in possession of the richest commerce in the world; and with superstition equal to their avarice, they flattered themselves with the prospect of extending their religion with their dominion. This hope was further encouraged by the Pope. Glad of an occasion to assert his universal sovereignty, he granted to the Portuguese all the countries which they had discovered, or should discover in the East, on condition that they should there plant the Catholic faith. The whole nation was seized with the enthusiasm of conversion and of conquest. They presented themselves in crowds to man the new fleet destined for India; and thirteen ships sailed, as soon as the season would permit, from the Tagus to Calicut.

Far distant, it is said, were the days of *our* first communication with India. Alfred caused several ships to be built and equipped, for the special object of embarking in the Indian trade; but, for a long time after his death, England was supplied with the productions of the East by the Venetians and Florentines. After the Norman conquest, a ship of considerable burthen was sent annually from Venice to the port of Southampton, laden with the various products of India. As the English barons advanced in civilisation and wealth, they acquired a taste for luxuries, and the demand for eastern commodities was consequently increased. Five ships were now employed by the Venetian merchants in the English trade; and the principal part of the cargoes of these vessels consisted of sugar, spices, and aromatics, which were much used at the tables of men of rank. These valuable articles, together with silks, and cotton stuffs, were paid for partly in specie, and partly in woollens, untanned leather, and tin; but as the prices of the eastern commodities were very exorbitant, the balance of trade was in favour of the Venetians. Yet, notwithstanding this circumstance, and the superiority of English shipping and seamen to those of any other country, neither the statesmen nor merchants of England used any endeavours to embark in this lucrative department of commerce; a sufficient proof of the total absence of that speculative spirit, which is the living principle of all commercial pursuits, and of the want of a trading capital. But when the discovery of the passage round the Cape of Good Hope threw the Indian trade into the hands of the Portuguese, and Lisbon thereby became the great repository for the productions of the East, the merchants of London imported them from that city on their own account, and conveyed them to the Thames in their own ships.

By the discovery of the West Indies, the New World, and of the passage to India by the Cape of Good Hope, connexions were formed by the inhabitants of far distant regions, for the supply of wants which they had never before experienced. The productions of climates situated near the equator, were consumed in countries bordering on the pole; the south was enriched by the industry of the north; the inhabitants of the west were clothed with the manufactures of the east, and a general intercourse of opinions, laws, customs, and expedients, was established among men.

Most truly has it been observed by an eminent living author,* that "Every branch of modern science abounds with instances of remote correspondences between the great system of the world, and the artificial (*the truly natural*) condition to which knowledge raises him. If these correspondences were single or rare, they might be deemed merely fortuitous; like the drifting of a plank athwart the track of one who is swimming from a wreck. But when they meet us on all sides and invariably, we must be resolute in atheism not to confess that they are emanations from one and the same centre of wisdom and goodness. Is it nothing more than a lucky accommodation which makes the polarity of the needle to subserve the purposes of the mariner? Or may it not safely be affirmed, both that the magnetic influence (whatever its primary intention may be) had reference to the business of navigation—a reference incalculably important to the spread and improvement of the human race; and that the discovery and the application of this influence arrived at the destined moment in the revolution of human affairs, when, in combination with other events, it would produce the greatest effect? Nor should we scruple to affirm that the relation between the earth's axis and the auspicious star which, without a near rival,

* The author of Natural History of Enthusiasm, &c.

attracts even the eye of the vulgar, and shows the north to the wanderer on the wilderness or on the ocean, is in like manner a beneficent arrangement? Those who would spurn the supposition that the celestial locality of a sun immeasurably remote from our system should have reference to the accommodation of the inhabitants of a planet so inconsiderable as our own, forget the style of the Divine works, which is, to serve some great or principal end, compatibly with ten thousand lesser and remote interests."

These discoveries, like the art of printing, loosened the fetters of authority, and cast a shade over the ancients,—for now it was manifest that they occupied but a very limited space on the surface of the earth, and that they knew but little of the world they inhabited. It was evident, therefore, that there were acquisitions to be made which they had not reached, and pursuits to them unknown, which would excite and reward subsequent exertion.

Long had the people now endured the oppressions of the nobles; but the power of the latter being much diminished by the long civil wars, the people began gradually to emerge from slavery. Henry's policy also was to depress the nobles. He restricted the number of their retainers; and thus those who had before spent their time in following some great lord to the wars, or in hanging about his gates in time of peace, were driven to apply themselves to industrious efforts, and from helpless dependants became useful subjects. Commerce, too; began greatly to alter the condition of the middle ranks; and he facilitated their rise by diminishing the strictness of entails, and so enabling the nobles to sell their estates, many of which came in consequence into the possession of rich commoners. With the change of property came a great change in the condition of all classes of the people. The landowners found it advantageous to commute the services of their villeins for money, and made them pay rent for their lands and cottages; and thus from villeins they became tenants. It is difficult to trace every step of the lowest orders of the people from villeinage, which at some periods of our history was a state of mere slavery, to freedom. The progress was so various and gradual, that the state of villeinage seemed to decline insensibly; and after this time it is no more mentioned. But for this rise of the lower orders of the people, the advantages derived from the invention of printing would have been extremely limited. A certain degree of ease and independence is absolutely necessary to awaken in the bosom the desire of knowledge, and to afford leisure for its pursuit, and it is only by the encouragement which such a state of society presents to industry and ambition, that the selfish passions of the multitude can be interested in the mental advancement of their children. So long, too, as education and books are confined to one privileged class, they but furnish an additional engine for debasing and misleading their inferiors. Nor should it be overlooked that the shock and collision of different and opposing prejudices gradually clears truth from any admixture of error, which is commonly acquired whenever the course of public opinion is forcibly constrained and guided within certain artificial channels, marked out by the narrow views of human policy.

A memorable revolution was commenced when the multitude was addressed in their own vernacular tongue, though, as it was indignantly said, "all the splendid distinctions of mankind were thereby thrown down; and the naked shepherd levelled with the knight clad in steel." The sacred books were, in almost all the kingdoms and states of Europe, translated into the language of each respective people, and the effect of this single circumstance in multiplying the number of readers and of thinkers, and in giving a certain stability to the mutable forms of oral speech, may be easily imagined.

Other means of improvement were now brought into operation; for amidst the darkness of the past there were enlightened individuals, who made various but vain efforts to communicate to others what they had acquired; and thus there was, in preceding ages, a faint twilight, like that auspicious gleam which, "in a summer's night, fills up the interval between the setting and the rising sun," and therefore the continuity seems never to have been entirely interrupted. Some were always found to preserve, amidst the general wreck, the precious remains of Greek and Roman refinement, and to keep alive, during the lapse of centuries, those scattered sparks of truth and science, from which so bright a flame was afterwards kindled. The revival of letters may be considered as coeval with the fall of the Eastern empire, towards the close of the fifteenth century. In consequence of this event, a number of learned Greeks took refuge in Italy, when the taste for literature already introduced by Dante, Petrarch, and Boccacio, together with the liberal patronage of the illustrious house of Medici, secured them a welcome reception. A knowledge of the Greek tongue soon became fashionable; and the learned, encouraged by the rapid diffusion which the art of printing now gave to their efforts, presented the Greek authors, by means of Latin translations, to a still wider circle of readers. Still the progress of knowledge was for a long time extremely slow; but the immense stock of materials which the ancient authors supplied to the reflections of speculative men, and which, though frequently accumulated with little discrimination or profit, had yet a favourable tendency to the development of taste and genius. This was aided, moreover, by the Protestant Reformation, in consequence of which, theological opinions so long consecrated by time, were renounced, and a creed more pure in its principles and more liberal in its spirit, was adopted—a memorable event, which could not fail to encourage, on all other subjects, a congenial freedom of inquiry.

The coincidence of the art of printing with the spirit of the times in which it had birth, must be regarded as singularly providential. Had it been made known at a much earlier period, it would have been disregarded or forgotten, from the mere want of materials on which to exercise it; and had it been further postponed, it is probable that many works would have been totally lost which are now regarded as among the noblest monuments of the human intellect.

Now the Genius of the human race seems, all at once, to have awakened with renovated and giant strength from his long sleep. In less than a century from the invention of printing, Copernicus discovered the true theory of the planetary motions, and, a very few years afterwards, was succeeded by the three great precursors of Newton—Tycho Brahe, Kepler, and Galileo.

Towards the end of the sixteenth century Wolsey founded in Oxford the first chair for teaching Greek—a novelty which rent that university into factions, bearing the names of Greeks and Trojans, and sometimes fighting with as much animosity as was displayed by those hostile nations in ancient times. The introduction of a new and more correct method of pronouncing Greek also divided the Grecians themselves into parties; and it was remarked, that the Catholics favoured the former, while the Protestants countenanced the new pronunciation. Gardiner employed the authority of the king and council to suppress innovations in this particular, and to preserve the corrupt sound of the Greek alphabet. How small must then have been the amount of liberty! To adopt the new pronunciation was to incur the penalties of whipping, degradation, and expulsion; and the bishop declared, that rather than permit an innovation in pronouncing the Greek alphabet, it were better that the language itself were totally banished the universities. The introduction of the Greek language into Oxford excited the emulation of Cambridge. Wolsey intended to have enriched the library of his college at Oxford with copies of all the manuscripts that were in the Vatican. The countenance given to literature by the king and his ministers contributed to render it fashionable in England. Some curious instances occur, however, of prevailing ignorance . . . thus, in a letter dated 1516, there is an account of a seditious paper, which was stuck up on St. Paul's church, and in order to discover who had written it, the aldermen of London and the privy councillors were ordered to go round all the wards, "and see all write who could." Country gentlemen, it appears, were not better scribes than the citizens; for in a book written about this time on agriculture, it is suggested, that those gentlemen who could not write, might note down any thing they wished to remember by cutting notches on a stick.

An analogous circumstance may here be mentioned. An almanack, in early times, was usually of wood, inscribed with various figures and Runic characters, and used by the ancient northern nations in their computations of time, both civil and ecclesiastical. The Danes introduced them into England. One of these clogs, as they were sometimes called, was found in Staffordshire. Sometimes they were cut on one or more wooden leaves, bound together after the manner of books; sometimes on the scabbards of swords, or even daggers; sometimes on tools and implements; sometimes they were made of brass or horn; sometimes of the skins of eels, which being drawn over a stick properly inscribed, retained the impressions of it; but the most usual form was that of walking staves or sticks, which were carried about and taken to church as well as market. Each of these staves is divided into three regions: the first indicates the signs, the second, the days of the week and year, and the third, the golden number. The saints' days are expressed in hieroglyphics, significative of some endowment of the saint, or of some circumstance in his history. Against the notch for St. David's day, the first of March, is represented a harp; against Crispin's day, the twenty-fifth of October, a pair of shoes; against St. Lawrence's day, the tenth of August, a gridiron; and against New Year's day, a horn, the symbol of those deep potations in which our ancestors freely indulged at that period.

Sir John Fortescue, and a few other writers, have left favourable specimens of prose composition; and their successors made further improvements in style. Among these Sir Thomas More is entitled to honourable mention. He occupied a distinguished place among the literati of his age. So intimate and critical was his acquaintance with the Latin and Greek languages before he had reached maturity, that he wrote and conversed in both of them with elegance and ease. His celebrated and well-known work on government, entitled "Utopia," was quickly translated into most of the European languages. With him, too, must be associated Archbishop Cranmer, Sir Thomas Elyot, and Roger Ascham; but, from the death of Chaucer, more than a century elapsed before another writer, deserving the name of a poet, appeared in England. This writer was Henry Howard, Earl of Surrey, son and heir-apparent to the Duke of Norfolk, whom, however, he did not long survive. His name was conspicuous in all the military achievements of the age; and in 1544 he, as field-marshal, commanded the English army in an expedition against Boulogne; but the tide of his success was on the ebb. The despot Henry became jealous of his talents and popularity; certain frivolous and groundless charges were brought against him; the result was a mock trial, and, notwithstanding his manly and eloquent defence, he was executed in the thirtieth year of his age. Although thus cut off before the full maturity of intellectual vigour, he lived long enough to effect some very material improvements in English poetry. The versification of preceding poets was more properly rhythmical than metrical. Although some improvements had been introduced by Chaucer, he left the number of syllables too indefinite, and did not reach the harmony and compression of which this noble poet afterwards exhibited an example. One of the changes which he introduced was the use of the heroic blank verse. Langland and other poets had indeed dispensed with rhyme; but their alliterative lines were constructed in a very different manner.

The following is a passage from his works, in which he, a "prisoner in Windsor, recounteth his pleasure there passed."

"So cruell prison howe could betyde, alas!
As proude Windsor: Where I in lust and joye,
With a kynges sonne, my chyldysh yeres dyd passe,
In greater feast, than Priam's sonnes of Troye:
Where eche swete place returnes a tastfull sower:
The large grene where we were wont to rove,
Wyth eyes cast up into the Maydens tower,
And easy sighes, such as folkes draw in Love:
The stately seates, the ladies brighte of hewe;
The daunces short, long tales of greate delight
Wyth woordes and lookes, that tygers could but rewe.
Where eche of us dyd pleade the others ryghte.
The palme play, where despoyled for the game,
With dazed eyes oft we by gleames of love,
Have myst the ball, and gote sighte of our dame
To bayte her eyes, whyche kept the leads above.
The gravel grounde, wythe sleves tyde on the helme
On foamyng horse, with swordes and frendly hartes;
Wythe chere as though one should another whelme
Where we have fought, and chased oft wyth dartes.
With silver droppes the meade yet spreade for ruthe,
In active games of nimbleness and strength,
Where we did strayne trayned with swarmes of youthe
Our tender limmes, that yet shot up in lengthe.

The secrete groves which oft we made resounde,
Of pleasant playnte, and of our Ladies prayse,
Recordyng oft what grace eche one had founde,
What hope of spede, what dreade of long delayes."

Warton compares, very beautifully and justly, the appearance of Chaucer in our language to a premature day in an English spring; after which the gloom of winter returns, and the buds and blossoms which have been called forth by a transient sunshine, are nipped by frosts and scattered by storms. The causes of the relapse of our poetry, after Chaucer, seem but too apparent in the annals of English history, which, during five reigns of the fifteenth century, continue to display but a tissue of conspiracies, proscriptions, and bloodshed. Before the death of Henry VI. it is said one half of the nobility and gentry in the kingdom had perished in the field or on the scaffold. There was, indeed, a commencement of our poetry under Henry VIII. It was a fine but feeble one. To judge by the few minds entitled to be called poetical, which appear in the earlier part of the sixteenth century, it has been truly said, that the English muse had still a diffident aspect and a faltering tone. It was not till the time of Elizabeth that the national genius was completely emancipated from oppressive circumstances.

A brief sketch of the arts must now follow this reference to the literature of the period. That of masonry, which had declined with the Roman power, gradually acquired its former importance, from its application to the construction of castles, towers, and other places of defence; and eventually it gained a complete ascendency over the other building arts in the construction of such edifices as cathedrals and monasteries. In England it made an equal if not a greater degree of progress than on the continent.

The science of masonry appears to have attained the most perfect state it reached in those times, about the period when King's College Chapel at Cambridge was built (1512), which forms the architectural pride of this college and of the university, and is one of the grandest specimens of the Gothic style. It was begun by Henry VI., and carried only as far as a portion of the north and south wings. Henry VII. completed the outside, and Henry VIII. the stalls, carvings, and painted windows. The exterior of this building combines in a remarkable degree that species of size and solidity which is called "grandiose," with richness, elegance, and exquisite decorations of detail. The gigantic buttresses which support the walls are lightened and relieved in their effect by the chapels with which the architect has occupied the intervals; but the interior is the masterpiece of this Chapel and of architecture. A vast roof of stone, wrought like fanwork, hangs above the spectator, without the support of a single pillar. Sir Christopher Wren is said to have paid an annual visit to this grand and exquisitely-wrought roof—a singular proof of his great admiration. This inner roof of stone is covered by a second of wood, cased in lead, with an interval of about five feet between them. The west side of the interior, built at the time of the marriage of Henry VIII. with Anne Boleyn, is ornamented with bridal emblems; a melancholy association, and not out of unison with this scene of grandeur, as well as exquisite art and beauty. The softened, dimly-tinged, and mysterious light which comes through the painted windows, heightens the solemnity inspired by the aspect and grandeur of the choir.

Glass, with which we are now so familiar, is an advantage of recent date. The following curious entry, which occurs in the minutes of a survey of Alnwick Castle in the year 1567, makes it apparent that at that time the comfort of glazed windows was not considered as a matter of course, even in establishments where great state and magnificence were maintained.

"And because throwe extream windes the glasses of the windowes of this and other my lords castels and houses here in the country dooth decay and waste, yt were good the whole leightes of everie windowe at the departure of his lordshippe from lyinge at anie of his sade castels and houses, and dowring the time of his lordshippes absence or others lyinge in them, were taken doune and lade up in safetie; and at sooch tyme as ether his lordshippe or anie other sholde lye at anie of the sade places, the same might then be sét uppe of new with smale charges to his lordshippe; whereas now the decaye thereof shall be verie costlie and chargeable to be repayred."

We learn also from Ray's Itinerary, that "in Scotland, as late as 1661, the windows of the ordinary country houses were not glazed, and only the upper parts of those of even the King's palaces had glass, the lower ones having two wooden shutters to open at pleasure and admit the fresh air."

The coal-works at Newcastle, now so interesting a part of our mineral treasures, were wrought on a very small scale till after the year 1300, for the fuel in common use throughout England was wood, a great part of the country being covered with forests. Coals, when first brought to London, were used as they are at present in France, only by smiths, distillers, soap-boilers, and other manufacturers; not in dwelling-houses, the smoke being considered injurious to the health of a family. That prejudice continued during several centuries; but when it was at last removed, the superiority of coal as fuel, joined to the scarcity and high price of wood, rendered its use quite general in London.

A history of the various contrivances for producing artificial warmth in this country might be considered, to a certain extent, a record of the progress of domestic comfort through successive periods. Nothing is more certain than that the temperature of our habitable apartments generally is maintained and considered comfortable, if not healthful, at an elevation unknown to our forefathers in their sitting-rooms. In the process of cooking, the contrast between former and modern times seems to be less striking. Certainly, if we may believe various published descriptions of the baking, roasting, and boiling operations daily carried on in the ancient baronial kitchens—and the massive ranges still extant in some places seem to corroborate such descriptions—the temperature of a first-rate cookery establishment, in days of yore, must have been pretty high. This state of things, however, belongs to a period hardly earlier than the fourteenth century. Before that era, except for culinary and smithery purposes, our robust forefathers appear to have thought but little about the introduction of artificial heat into their dwellings, and not to have cared at all about it during the warmer months of the year of our variable climate. Even so late as the reign of Henry VIII. it seems no fire was allowed in the university of Oxford, if we may believe the writers who assert that the students, after supping at eight o'clock, went to their books till nine in winter, and then took a run for half an hour to warm themselves previously to going to bed.

We are now familiar with fire-irons—the fire-shovel, poker, and pair of tongs,—but all these were not found on the old hearths of this country; nor were they all necessary, when wood was burned on a fire-place like that already described. In a list of the articles of a respectable housekeeper in the time of Henry VIII. we only discover beside the "aund-irons," what was called "the fyer-forke." In the parlour of a knight, however, we discover "two large aund-irons, a fyer forke, a fyer pan, and a payer of tonges." The use of pit-coal and of close fire-places led to the employment of the poker, which is now so common.

In few things pertaining to domestic convenience has modern ingenuity effected greater innovation than by the almost universal substitution of potter's ware for pewter, among that class of the community in whose houses metal utensils were very plentiful and common, even within the memory of persons still living. At what period vessels of pewter were first used in this country it were impossible accurately to determine, though they are undoubtedly of very considerable antiquity, even if not coeval with the working of our tin and lead mines. During the reigns of the earlier Tudor monarchs, plates of this metal were plentiful in the sculleries of the better sort of houses; where, however, the wooden trencher was the ordinary platter, the former being far too valuable to be regarded other than as silver ware would be esteemed by the same class of housekeepers in the present day. Indeed, so late as the reign of Henry VIII. no small portion of the vessels of the nobility appear to have been of pewter; and in the celebrated "Household Booke" of the Duke of Northumberland of that reign, there is a charge for the *hire* of pewter vessels, though the description of them is not ascertained. Of the same date, we have the inventory of a gentleman's butlery, comprising "two basins and two ewers of pewter; one ale pot and two wine pots of the same; two dozen of pewter trenchers, five chargers, seventeen platters, two dozen of dishes, sixteen saucers, two porringers, two plates, a washing basin, a salte, and a bottle for water," all of the same metal.

Hand-mills, termed querns, were early used for grinding corn; and when corn came to be raised in greater quantity, horse-mills succeeded. That windmills were not known in England till the reign of Henry VIII. appears from the household-book already mentioned, stating an allowance for three mill-horses, "two to draw in the mill, and one to carry stuff to and from the mill." Water-mills for corn must have been of a later date.

As, during the greater part of the fifteenth century, England was engaged in civil wars, agriculture declined; the labourers called from the plough by royal proclamation, or the mandates of their lords, perished in battle, or by accident and fatigue, in immense numbers. Labour rose in price, notwithstanding various laws for its limitation, and this ultimately produced a great revolution in the state of agriculture. The prelates, barons, and other proprietors of land, kept extensive tracts around their castles, which were called their demesne lands, in their own immediate possession, and cultivated them by their villeins and by hired servants, under the direction of their bailiffs. But these great landholders having often led their followers into the fields of war, their numbers were gradually diminished, and hired servants could not be procured on reasonable terms. This obliged the prelates, lords, and gentlemen, to enclose the lands around their castles, and to convert them into pasture grounds. This practice of enclosing became very general in England about the middle of this period, and occasioned prodigious clamours from those who mistook the effect of depopulation for its cause.

In the book of Surveying and Improvements, published in 1539, we have some curious information "for a young gentylman that intendeth to thryve," and a "prolouge for the wives' occupation," rather too homely for later times. Among other things, she is to "make her husband and hirself some clothes;" and "she may have the lockes of the shepe, either to make blankettes and coverlettes, or both." But the writer afterwards goes so far as to say, "it is a wive's occupation to wynowe all manner of cornes, to make malte, to washe and wrynge, to make heye, shere corne, and, in time of nede, to helpe her husbande to fyll the muckewayne or dounge carte, drive the ploughe, to loade heye, corne, and suche other. And to go or ride to the market, to sel butter, chese, mylke, egges, chekyns, capons, hennes, pygges, gese, and all manner of cornes."

The corn crops cultivated for a long period seem to have been of the same species, though all of them probably much inferior in quality to what they are at the present day. Wheat, the most valuable grain, must have borne a small proportion, at least in Britain, to that of other crops, and its consumption was confined to the higher orders. Rye and oats furnished the bread and drink of the great body of the people of Europe. Cultivated herbage and roots were then unknown in the agriculture of Britain. It was not until the end of the reign of Henry VIII. that any salads, turnips, or other edible roots, were produced in England; the few of these vegetables that were used were imported from Holland and Flanders. Whenever Queen Catherine wanted a salad, a messenger was obliged to be dispatched thither that it might be obtained. The use of hops and the planting them were also introduced about this period.

The apricot, brought from America, was first known in Europe in the sixteenth century. An old French writer has remarked, that it was originally not larger than a damson, and that it was improved by our gardeners to the perfection of its present size and richness. One of these enthusiasts is noticed by Evelyn, who for forty years had in vain tried by a graft to bequeath his name to a new fruit; but persisting on wrong principles, this votary of Pomona has died without a name. Sir William Temple exultingly acquaints us with the size of his orange trees, and with the flavour of his peaches and grapes, confessed by Frenchmen to have equalled those of Fontainebleau and Gascony, while the Italians agreed that his white figs were as good as any of that sort in Italy; and of his "having had the honour" to naturalize in this country four kinds of grapes, with his liberal distributions of cuttings from them, because "he ever thought all things of this kind the commoner they are the better."

The greater number of our exotic flowers and fruits were carefully transported into this country by many of our travelled nobility and gentry; some names have been casually preserved. The learned Linacre first brought, on his return from Italy, the damask-rose; and Thomas Lord Cromwell, in the reign of Henry VIII., enriched our fruit gardens with three different plums. In the reign of Elizabeth, Edward Grindal, afterwards Archbishop of Canterbury, returning from exile, transplanted here the medicinal plant of the tamarisk: the first oranges appear to have been brought into England by one of the Carew family—for a century after they still flourished at the family seat at Beddington, in Surrey. The cherry orchards of Kent were first planted about Sittingbourne, by a gardener of Henry VIII.; and the currant-bush was transplanted when our commerce with the island of Zante was first opened in the same reign.

The very names of some products of our vegetable kingdom indicate their locality, from the majestic cedar of Lebanon to the small Cos lettuce. Cherries came from Cerasuntis, a city of Pontus; the peach, or persicum, mala Persica, or Persican apples, from Persia; the pistacio nut, from

Syria, where it is called psittacia. The chestnut, called in French, chataigne, and in Italian, castagne, came from Castagna, a town of Magnesia. Our plums are received chiefly from Syria and Damascus; the damson or damascene plum reminds us of its distant origin.

It is somewhat curious to observe, that there exists an unsuspected intercourse between nations in the propagation of exotic plants. Lucullus, after the war with Mithridates, introduced cherries from Pontus into Italy; and the newly-imported fruit was found so pleasing, that it was rapidly propagated, and, six-and-twenty years afterwards, Pliny testifies that the cherry-tree passed over into Britain. Thus, a victory obtained by a Roman consul over a king of Pontus, with which it would seem that Britain could not have the remotest interest, was the real occasion of our countrymen possessing cherry-orchards. The whole race of cherry-trees was, however, lost in the Saxon period, and was only restored by a gardener of Henry VIII., who brought them from Flanders.

There is some reason to think that there were people whose business it was to carry letters from place to place in the time of Edward III.; and it is certain that in the reign of Henry VIII. there were established letter carriers; but the system at that time was very imperfect and irregular. A letter from a nobleman of his court to Lord Shrewsbury was thus directed:—"To the right honourable and our very good lord the Earl of Shrewsbury, president of the King's Majesty's council in the north parts.

"Haste for thy life, post,—haste, haste, haste,—for thy life, post, haste!"

The letter does not appear to require any extraordinary haste; and indeed Lord Shrewsbury's correspondent apologizes for putting so much speed in the direction, and states, that "the only cause is that the posts be so slow."

Nothing is distinctly known of the progress of the woollen manufacture in Lancashire until the reign of Henry VIII., at which time it had certainly grown into considerable importance, so that wealth was acquired by the manufacturers, and many strangers from other parts of England and from Ireland resorted thither, with linen yarn and wool, to have them made into cloths.

In 1528 hostilities commenced between England and the Low Countries, and the inconvenience was soon felt by both parties. While the Flemings were not allowed to purchase cloth in England, the English merchants could not buy it from the clothiers, and they were obliged to dismiss their workmen, who, in consequence, began to be tumultuous for want of bread. To appease them, Wolsey sent for the merchants, and ordered them to buy cloth as before; they told him they could not dispose of it as usual, and notwithstanding his menaces, he could get no other answer from them. At last, therefore, an agreement was made to continue the commerce between the States, even during war.

The first notice of the silk manufacture in England appears in a prohibition having effect in the time of Edward III.; and about a century after a law was passed for the protection of the silk-women of London against the importation of foreign articles for five years; and from this it may be inferred, that the productions of our countrywomen did not equal, either in quality or cheapness, the manufactures sought to be excluded; and from other acts it appears, that no manufacture of broad silks was practised in this kingdom to the time of Henry VII.

Notwithstanding the magnificence and prodigality of Henry VIII., he was obliged to wear cloth stockings, except when, by great chance, he could obtain a pair of silk ones for gala days from Spain. Sir Thomas Gresham presented a pair of long Spanish silk stockings to Edward VI., and, from their rarity, the offering was deemed worthy of much notice.

Foreign artificers, in general, greatly surpassed the English in skill, industry, and frugality. A violent animosity therefore arose among the latter against the former. So great, indeed, was their number in the city of London, that at least fifteen thousand Flemings alone were at one time obliged to leave it, by an order in council, when Henry was jealous of their favouring Queen Catherine; he affirmed also that they greatly injured the natives, forbade them to have more than two foreigners in their houses, and discovered a similar jealousy against the foreign merchants. New duties were at the same time imposed on them, when it would have been far better to have encouraged foreign merchants and artisans, who would have stimulated the natives and improved their skill. Debt and crime now reached a very fearful height; and it is said that a subsequent improvement in morals was chiefly owing to the increase of industry and the arts, which were now so unwisely and grievously restricted.

THE

# AGE OF LEARNING.

## THE AGE OF LEARNING.

A. D. 1554—1644.

Of all his contemporaries Ludovicus Vives seems to have had the liveliest and most assured foresight of the new career on which the human mind had entered. "The similitude," he says, "which many have fancied between the superiority of the moderns to the ancients, and the elevation of a dwarf on the back of a giant, is altogether false and puerile. Neither were *they* giants, nor are *we* dwarfs, but all of us men of the same standard,—and *we* the taller of the two, by adding their height to our own: provided always, that we do not yield to them in study, attention, vigilance, and love of truth; for if these qualities be wanting, so far from mounting on the giant's shoulders, we throw away the advantages of our own just stature, by remaining prostrate on the ground."

Literature, which had hitherto been confined to ecclesiastics and scholars by profession, was, at the commencement of Elizabeth's reign, thrown open to the higher classes of general society. Of advancement in this respect she set, indeed, a memorable example. It will be remembered that she was for some time imprisoned at Woodstock, by her sister, Queen Mary. A New Testament is still preserved, which bears the initials of the captive princess, in her own beautiful hand-writing. Alluding to her solitary life and her religious consolations, she wrote in it: "I walk many times into the pleasant fields of holy scripture, where I pluck up goodly sentences by pruning, eat them by reading, chew them by musing, and lay them up at length in the high seat of memory; that having tasted their sweetness, I may the less perceive the bitterness of this miserable life." She is likewise said to have written some affecting verses with charcoal on a shutter of her chamber at Woodstock. Elizabeth certainly made great and various attainments. The Latin letters of her preceptor, Roger Ascham, which is said to be the first collection of private letters ever published by an Englishman, abound with anecdotes of his pupil.

Thus he says in one part of his correspondence: —"Never was the nobility of England more lettered than at present. Our illustrious King Edward, in talent, industry, perseverance, and erudition, surpasses both his own years and the belief of men. . . . . I doubt not that France will also yield the just praise of learning to the Duke of Suffolk, and the rest of that band of noble youths educated with the king in Greek and Latin literature, who depart for that country on this very day.

"Numberless honourable ladies of the present time surpass the daughters of Sir Thomas More in every kind of learning; but amongst them all, my illustrious mistress, the Lady Elizabeth, shines like a star, excelling them more by the splendour of her virtues and her learning than by the glory of her royal birth. In the variety of her commendable qualities, I am less perplexed to find matter for the highest panegyric than to circumscribe that panegyric within just bounds; yet I shall mention nothing respecting her but what has come under my own observation.

"For two years she pursued the study of Greek and Latin under my tuition; but the foundations of her knowledge in both languages were laid by the diligent instruction of William Grindal, my late beloved friend, and seven years my pupil in classical learning at Cambridge."

After alluding to his sudden illness and death, Ascham continues:—"I was appointed to succeed him in his office...... No apprehension can be greater than the Lady Elizabeth's, no memory more retentive. French and Italian she speaks like English; Latin, with fluency, propriety, and judgment: she also spoke Greek with me frequently, willingly, and moderately well. Nothing can be more elegant than her handwriting, whether in the Greek or Roman character. She read with me almost the whole of Cicero and a great part of Livy. The beginning of the day was also devoted by her to the New Testament in Greek, after which she read select orations of Isocrates and the tragedies of Sophocles.

"The Lady Elizabeth and I," Ascham writes on another occasion, "are reading together in Greek the orations of Eschines and Demosthenes. She reads before me, and at first sight she so learnedly comprehends not only the idiom of the language and the meaning of the orator, but the whole grounds of contention, the decrees of the people, and the customs and manners of the Athenians, as you would greatly wonder to hear."

Elizabeth wrote several books. It is pretended that she replied extempore in Greek to the university of Cambridge, who addressed her in that language; but it is certain that, without premeditation, she gave a very spirited reply in Latin to an ambassador, who had not treated her with due respect. Even after she was queen she did not entirely relinquish her literary ambition; and this seems to have been the object of her vanity next in rank to her desire of admiration for personal beauty. She translated the Consolation of Philosophy, by Boetius, in order, as she pretended, to allay her grief for Henry III.'s change of religion. The original copy of this work, partly in her majesty's hand-writing, and partly in that of her secretary, was discovered about five years since in the State-paper Office.

That the hand-writing of Elizabeth was extremely beautiful and correct may be seen on examining a little book of prayers, deposited in the British

Museum. In her first writing-book, preserved at Oxford in the Bodleian Library, the gradual improvement of her writing is honourable to her diligence; but the most curious thing is, the paper on which she tried her pens; this she usually did by writing the name of her beloved brother Edward, a proof of the early and ardent attachment she formed to that amiable prince.

Considering her age and station, the attainments of Lady Jane Grey were also not a little remarkable. Other learned females of this age, whom Ascham has complimented by addressing them in Latin epistles, are Anne, Countess of Pembroke, sister of Queen Catherine Parr; a young lady of the name of Vaughan; and Mrs. Clarke, a grand-daughter of Sir Thomas More. "Mildred Cecil," he says, "understands and speaks Greek like English."

Europe had assuredly never beheld a court so learned or so accomplished as that of Elizabeth. It was rare indeed to find a courtier acquainted with no language but his own. The ladies studied Latin, Greek, Spanish, Italian, and French. "The more ancient among them," it is said, "exercised themselves some with the needle, some with 'caul-work.'" (probably netting), "divers in spinning silk, some in continual reading either of the Scriptures or of histories either of their own or of foreign countries, divers in writing volumes of their own, or translating the works of others into Latin or English;" while the younger ones in the meantime applied to their "lutes, citharnes, pricksong, and all kinds of music." Many of the elder sort were also "skilful in surgery and distillation of waters; beside sundry artificial practices pertaining to the ornature and commendations of their bodies." "This," adds the author, whose words have been quoted, "I will generally say of them all:—that as each of them are cunning in something whereby they keep themselves occupied in the court, there is in manner none of them but when they be at home can help to supply the ordinary want of the kitchen with a number of delicate dishes of their own devising, wherein the *portingal** is their chief counsellor, as some of them are most commonly with the clerk of the kitchen."

Nothing can more forcibly paint Elizabeth's passion for books and learning than a passage in Harrison's unadorned but faithful description of her court:—"Finallie, to avoid idlenesse, and prevent sundrie transgressions, otherwise likelie to be committed and doone, such order is taken, that everie office hath either a bible, or the booke of the acts and monuments of the church of England, or both, besides some histories and chronicles being therein, for the exercise of such as come into the same; whereby the stranger that entereth into the court of England upon the sudden, shall rather imagine himselfe to come into some publike schoole of the universities, where manie give eare to one that readeth, than unto a prince's palace, if you conferre the same with those of other nations. Would to

* Note H.

God all honourable personages would take example of her grace's godlie dealing in this behalfe, and shew their conformitie unto these hir so good beginnings! which if they would, then should manie grievous offenses (wherewith God is highlie displeased) be cut off and restreined, which now doo reigne exceedinglie in most noble and gentlemen's houses, whereof they see no paterne within her grace's gates."

So prevalent, indeed, was the ardour for classical attainment among the learned and the great, that the mythology as well as the diction of the ancients became fashionable. The amusements, and even the furniture of the opulent, their shows and masques, the hangings and the tapestries of their houses, and their very cookery, assumed an erudite, and what would now be termed a pedantic cast. "Every thing," says Warton, speaking of this era, "was tinctured with ancient history and mythology. When the Queen paraded through a country town, almost every pageant was a pantheon. When she paid a visit at the house of any of her nobility, on entering the hall she was saluted by the Penates, and conducted to her privy chamber by Mercury. Even the pastry-cooks were expert mythologists. At dinner, select transformations of Ovid's metamorphoses were exhibited in confectionary; and the splendid iceing of an immense historic plumb-cake was embossed with a delicious basso-relievo of the destruction of Troy. In the afternoon, when she condescended to walk in the garden, the lake was covered with Tritons and Nereids; the pages of the family were converted into wood-nymphs, who peeped from every bower; and the footmen gamboled over the lawns in the figure of satyrs."

At the court of Elizabeth, too, the patronage of letters was not less a fashion than at that of Augustus. Every book, whatever might be its subject, was inscribed to some noble, "worshipful," or wealthy individual; and every author of the slightest pretensions to celebrity found his cover regularly spread at the table of a peer, bishop, minister of state, or other "person of honour." There is something at once gratifying and repulsive in this kind of patronage; gratifying by the appearance of a genial influence for the encouragement and reward of merit; repulsive, as tending to a submission which reflects no honour on the patron, while the client is degraded. True genius, indeed, resembles a proud steed, that, whilst he obeys the slightest touch of the kind hand of a master, revolts at the first indication of compulsion and restraint.

The quality of many of the products of this period is a sufficient proof that there ought to have been a different treatment of the intellectual soil. Complimentary effusions and *commanded* strains of congratulation or condolence, form the larger portion of the occasional poems of Spenser, Jonson, and the whole herd of minor poets; and these are on subjects then interesting only to few, and now to none. Writers, too, the favourites of their times, and considered as the first of poets, were celebrated by their literary contemporaries in loud and repeated panegyrics, while their names were familiar in every class of society. Now they are utterly neglected, and, except to those who think it necessary to be acquainted with the whole range of our literature, nearly or altogether unknown.

The fashion that *required* high-flown sonnets to some imaginary fair, was likely to deprave the taste, and to cause the substitution of quaintness and bombast, unmeaning similes and forced conceits, couched in stiff and rugged verse, instead of the free and harmonious flow of natural sentiment and lively imagery. It may be mentioned, however, as a singular proof that these purchased flatterers were generally acceptable, that Decker minutely describes one class of impostors who lived by them. These persons, it seems, travelled the country with some worthless pamphlet, headed by an epistle dedicatory *to let*—on the plan of Falstaff's love-letter—in which they contrived to insert successively the names of all the principal persons in the counties through which they passed; obtaining from each, in return for the compliment, a fee of three or four angels.

Men of distinguished honour were not, however, wanting. Among these was Sir Nicholas Bacon, than whom no one is recorded to have filled the office of Lord High Chancellor, under the humbler title of Lord Keeper, with superior assiduity, or a greater reputation for uprightness and ability. Several well-known traits afford a highly pleasing image of the general character of his mind. Of this number is his handsome reply to the remark of her majesty, that his house was too little for him; —"No, madam; but you have made me too big for my house." Even when, upon this royal hint, he erected his elegant mansion of Gorhambury, he did not lose sight of that idea of lettered privacy in which he loved to indulge; and his accomplishments were reflected in the decorations of his home. In the gardens, on which his chief care and cost were bestowed, arose a banquetting-house, consecrated to the seven sciences, whose figures adorned the walls, each subscribed with a Latin distich, and surrounded with portraits of their most celebrated votaries: a temple, in which we may imagine the youthful mind of that illustrious son of his, who "took all learning to be" his "province," receiving with delight its earliest inspiration! In his second wife—one of the learned daughters of Sir Anthony Cook, a woman of a keen and penetrating intellect, and much distinguished by her zeal for reformed religion in its austerer forms—Sir Nicholas found a partner capable of sharing his views and appreciating his character. By her he became the father of two sons; that remarkable man Anthony Bacon, and Francis, the light of science, the interpreter of nature, the admiration of his own age, and the wonder of succeeding ones; the splendid dawn of whose unrivalled genius his father was happy enough to behold; more happy still in not surviving to witness the calamitous eclipse which overshadowed his reputation at its highest noon.

The scholastic reputation of Henry Saville had procured for him the office of Greek preceptor to Elizabeth, who frequently commanded his attendance at her hours of privacy, for the benefit of his learned discourse. His annotated translation of the Annals of Tacitus, and of the Life of Agricola, had been eagerly welcomed by the reading public; and his collection of English chroniclers and historians, illustrated with chronological tables, had further advanced his reputation, and secured him the honour of Provost of Eton from his royal pupil: he was afterwards made a knight by James.

Archbishop Parker was such an admirer and collector of curious and valuable books, and of every thing that appertained to them, that, according to Strype, he kept constantly in his house "drawers of pictures, wood-cutters, painters, limners, writers, and book-binders." No expense was spared by this amiable and accomplished divine in procuring the most rare and costly articles; his library was daily increased through the medium of numerous agents, whom he employed both at home and abroad.

Criticism had also, at this period, her distinguished votaries. From the earliest dawn of the Reformation, the most celebrated works of the ancients were examined with critical research. In these literary efforts the amiable Erasmus had led the way, and his footsteps were closely followed by many eminent scholars, both in this country and in various parts of the continent. By their united efforts a flood of light was poured on the writings of the ancients; and the valuable relics of former ages have been transmitted to posterity in a purer and more intelligible form than they could otherwise have assumed.

Among historians Camden holds no ordinary rank. He devoted himself to a most laborious investigation of the antiquities of his native country, and took the utmost pains to collect materials for that purpose. These were afterwards embodied in his celebrated work, entitled, "Britannia; or, a Statistical History of England, Scotland, and Ireland." Camden enjoyed the patronage of Lord Burleigh and of James I. He maintained, during many years, an intimate correspondence with the most learned men on the continent of Europe, and particularly with the celebrated French historian, De Thou. His History of Queen Elizabeth is considered very honourable to his powers.

Camden speaks of Sir Philip Sidney as "the miracle" of his age. Arcadia, a beautiful romance, once the favourite of Shakspeare and of Milton, was written by him, chiefly for the gratification and amusement of his sister; and being afterwards revised and corrected by her pen, it has been, not unaptly termed, the Countess of Pembroke's Arcadia. It was once celebrated by all the wits and beauties of an age of gallantry, though probably not read through by six of either class during the last half century. Considering the era at which it was written, it is a very masterly piece of composition; and its loss of popularity appears to be chiefly owing, not to any radical defect in the work itself, but to the prodigious change in modes of thought and in manners, which has occurred in the lapse of more than two centuries.

The writings of Fulke Grevile, Lord Brooke, have an additional value if, as is believed, they represent the feelings and opinions of Sir Philip Sidney, as well as his own; and the friendship between these two great men and great poets was probably recorded in the following lines, in which the usual but strange practice of the older poets appears, in their addressing their friends by such endearing epithets as are now only applied to women :—

> " My true love hath my heart, and I have his,
> By just exchange one for another given,
> I hold his dear, and mine he cannot miss,
> There never was a better bargain driven.
> My true love hath my heart and I have his;
> His heart in me keeps him and me in one,
> My heart in him his thoughts and senses guide,
> He loves my heart, for once it was his own;
> I cherish his, because in me it bides;
> My true love hath my heart and I have his."

The writings of Lord Brooke, though not attractive as a whole, contain enough to establish his character as a poet, and afford abundant proof that he was an enlightened statesman, a good citizen, and a man of integrity—one, in short, worthy to bear the title he so much desired—"the friend of Sir Philip Sidney."

Raleigh is also entitled to notice. It is well known that twelve years of his life were spent in confinement. Happily, he had never ceased to cultivate literature with a zeal not often glowing in the bosom of a politician and soldier; and he now beguiled the tedium of his lot by an entire devotion to those studies which had only served before to diversify his more active and absorbing pursuits. Having cultivated his poetical talents, he continued to the end of his life the practice of pouring out his mind in verse. Spenser, his personal friend, speaking of his poetry, styles him "the summer nightingale," who was "himself as skilful in that art as any." One poem of his, called "the Lye," "the Soul's Errand," and "the Soul's Farewell," is transcendantly vigorous. He was also strongly inclined to mathematics, and studied them with much success, in the society, and under the guidance of his friend, Thomas Harriot, one of the most accomplished mathematicians of the age. Chemistry was another favourite pursuit, in which, according to the standard of his contemporaries, he made great progress. But the most important occupation of his imprisonment was the composition of his "History of the World," in which his deep and various learning is relieved and adorned by passages of genuine eloquence, which exhibit to great advantage the author's comprehensive mind and rich imagination.

"Among the numerous poets," says Campbell, "belonging exclusively to Elizabeth's reign, Spenser stands without a class and without a rival. In the other poets of his age we chiefly admire their language, when it seems casually to advance into modern polish and succinctness. But the antiquity of Spenser's style has a peculiar charm. Much of his expression is now become antiquated, though it is beautiful in its antiquity, and, like the moss and ivy on some majestic building, covers the fabric of his language with romantic and venerable associations.

"His command of imagery is wide, easy, and luxuriant. He threw the soul of harmony into our verse, and made it more warmly, tenderly, and magnificently descriptive than it was ever before, or, with a few exceptions, than it has ever been since. It must certainly be owned that in description he exhibits nothing of the brief strokes and robust power which characterise the very greatest poets; but we shall no where find more airy and expansive images of visionary things, a sweeter tone of sentiment, or a finer flush in the colours of language, than in this Rubens of English poetry. He is the poetical father of a Milton and a Thomson. Gray habitually read him when he wished to frame his thoughts for composition; and there are few eminent poets in the language who have not been essentially indebted to him.

> 'Hither, as to their fountains, other stars
> Repair, and in their urns draw golden light.'"

Poetry, and especially that species denominated dramatic, attained at this period a high degree of excellence; and the reign of Elizabeth has been called its "golden age." It was distinguished by richness of thought, luxuriant fancy, and vigorous language; but it betrayed a great want of taste, and a greater of moral purity. These remarks apply not only to the productions of Beaumont and Fletcher, Ben Jonson and Massinger, but in some degree to "the bard of Avon," and far more extensively to contemporary poets, compared with whom he towers aloft like a noble cedar,

> "Coeval with the sky—crown'd mountains' self,"

among the shrubs which are scattered round its base.

In such cases Johnson must be considered a competent witness, though some will hesitate at concurring in his decision. Of the literary character of that mighty genius he thus speaks:—"Shakspeare is above all writers, at least above all modern writers, the poet of nature—the poet that holds up to his readers a faithful mirror of manners and of life. His characters are not modified by the customs of particular places unpractised by the rest of the world—by the peculiarities of studies or professions which can operate but on small numbers—or by the accidents of transient fashions or temporary opinions; they are the genuine progeny of common humanity, such as the world will always supply, and observation will always find. His persons act and speak by the influence of those general passions and principles by which all minds are agitated, and the whole system of life is continued in motion. In the writings of other poets, a character is too often an individual—in those of Shakspeare it is commonly a species. The stream of time, which is continually washing the dissoluble fabrics of other poets, passes without injury by the adamant of Shakspeare."

Milton has also thus pronounced his eulogy in verse:—

"What needs my Shakspeare for his honoured bones
The labour of an age in piled stones;
Or that his hallow'd reliques should be hid
Under a starry pointing pyramid?
Dear son of memory, great heir of fame,
What need'st thou such weak witness of thy name?
Thou in our wonder and astonishment
Hast built thyself a live-long monument.
For whilst to th' shame of slow endeavouring art
Thy easy numbers flow, and that each heart
Hath from the leaves of thy unvalued book
Those Delphic lines with deep impression took;
Then thou our fancy, of itself bereaving,
Dost make us marble with too much conceiving;
And so sepulchred, in such pomp dost lie,
That kings for such a tomb would wish to die."

The fault of Cowley, like the error of all similar writers, is that of pursuing his thoughts to the last ramifications, and thus of showing in some of their happiest verses, that the distance is but short from the sublime to the ridiculous. In the ode entitled "The Muse," who goes to take the air in an intellectual chariot, to which are harnessed Fancy and

Judgment, Wit and Eloquence, Memory and Invention, he says :—

> " Let the *postilion* Nature mount, and let
> The *coachman* Art be set;
> And let the airy *footmen*, running all beside,
> Make a long row of goodly pride;
> Figures, conceits, raptures, and sentences,
> In a well-worded dress,
> And innocent loves, and pleasant truths, and useful lies
> In all their gaudy *liveries*."

A coal-pit has rarely found a poet; but when Cleveland assumed for it this character, he thus drew a parallel between it and the sun:—

> " Had he our pits, the Persian would admire,
> No sun but warms devotion at our fire,
> He'd leave the trotting whipster, and prefer
> Our profound Vulcan, 'bove that waggoner,
> For wants he heat or light? or would have sto
> Of both? 'tis here; and what can suns give m
> Nay, what's the sun, but in a different name,
> A coal-pit rampant, or a mine on flame!
> Then let this truth reciprocally run,
> The sun's heav'ns coalery, and coal's our sun."

Wotton's two lines, "on the Death of Sir Albert Morton's Wife," have been justly celebrated as containing a volume in seventeen words:—

> " He first deceas'd; she for a little tri'd
> To live without him; lik'd it not, and di'd."

Ben Jonson greatly admired a passage in Donne, in which a calm is described as so perfect, that

> -in one place lay
> Feathers and dust to day and yesterday."

A description so felicitous ought especially to be prized, if it be true that this poet was the "best good-natured man with the worst-natured muse."

One of the earliest attempts in England to naturalize the sonnet is to be found in the pages of the gallant Surrey, who, with his friend Wyat, has the merit of having "polished our rude and homely manner of vulgar poesie," and was "one of the chief lanternes of light to all others that have since employed their pennes." The sonnet, however, was much elevated by Drummond of Hawthornden.

"If any poems," observes Mr. Pinkerton, "possess a very high degree of that exquisite Doric delicacy which we so much admire in Comus, &c. those of Drummond do. Milton may often be traced in him; and he had certainly read and admired him. And if we had no Drummond, perhaps we should never have seen the delicacies of Comus, Lycidas, Il Penseroso, and L'Allegro."

Perhaps there is neither to be found a sonnet of greater sweetness, as to versification, or greater beauty, as to sentiment, than the one he addressed to the nightingale.

> "Sweet bird, that sing'st away the earely houres
> Of winters past, or comming void of care,
> Well pleased with delights which present are,
> Fair seasons, budding spraies, sweet-smelling flow'rs :
> To rocks, to springs, to rills, from leavy bow'rs,
> Thou thy Creator's goodnesse dost declare,
> And what deare gifts on thee he did not spare,
> A staine to humane sense in sin that low'rs.

What soule can be so sick, which by thy songs
(Attir'd in sweetnesse) sweetly is not driven
Quite to forget earth's turmoiles, spights, and wrongs,
And lift a reverend eye and thought to heaven?
Sweet, artlesse songster, thou my mind doest raise
To ayres of spheares, yes, and to angel's layes."

English literature, under the auspices of Elizabeth and her learned court, had been advancing with a steady and rapid progress; and it may be interesting to contemplate the state of one of its fairest provinces as exhibited by the pen of an able critic, who, in the year 1589, gave to the world an "Art of English Poesy." This work, though addressed to the queen, was published with a dedication by the printer to Lord Burleigh, for the author thought proper to remain concealed. On its first appearance its merit caused it to be ascribed to Spenser by some, and by others to Sidney; but it was traced at length to Puttenham, one of her Majesty's gentlemen pensioners, the author of some adulatory poems addressed to her, and called "Partheniads,"and of various other pieces, now lost.

The subject is here methodically treated in three books;—the first, "Of Poets and Poesy;" the second, "Of Proportion;" the third, "Of Ornament." After some remarks on the origin of the art and its earliest professors, and an account of the various kinds of poems known to the ancients, in which there is an absence of pedantry, of quaintness, and of every species of puerility, very rare among the didactic writers of the age, the critic proceeds to an enumeration of our principal vernacular poets, or "*vulgar makers*," as he is pleased to Anglicise the words.

Pursuing the subject of language, which, he says, "in our maker or poet must be heedily looked unto that it may be natural, pure, and the most usual of all his country;' after some other rules or cautions, he adds, "Our maker, therefore, at these days shall not follow Piers Plowman, nor Gower, nor Lydgate, nor yet Chaucer, for their language is now out of use with us; neither shall he take the terms of northern men, such as they use in daily talk, whether they be noblemen, or gentlemen, or of their best clerks, all is a matter; nor in effect any speech used beyond the river of Trent, though no man can deny but that theirs is the purer English Saxon at this day, yet it is not so courtly nor so current as our southern English is; no more is the far Western man's speech. Ye shall, therefore, take the usual speech of the court, and that of London, and the shires lying about London, within sixty miles and not much above. I say not this but in every shire of England there be gentlemen and others that speak, but especially write as good southern as we of Middlesex or Surrey do; but not the common people of every shire, to whom the gentlemen and also their learned clerks do for the most part condescend; but herein we are ruled by the English dictionaries and other books written by learned men, and therefore it needeth none other direction in that behalf. Albeit peradventure some small admonition be not impertinent, for we find in our English writers many words and speeches amendable; and ye shall see in some many inkhorn terms so ill affected, brought in by men of learning as preachers and schoolmasters; and many strange terms of other languages by secretaries, and merchants, and travellers; and many dark words, and not usual nor well-sounding, though they be daily spoken in court. Wherefore great heed must be taken by our maker in this point that his choice be good."

Puttenham modestly expresses his apprehensions that in some of these respects he may himself be accounted a transgressor; and he subjoins a list of the new foreign or unusual words employed by him in this tract, with reasons for their adoption. Of this number are—*scientific*, *conduict*, "a French word, but well allowed of us, and long since usual; it sounds something more than this word (leading) for it is applied only to the leading of a captain, and not as a little boy should lead a blind man;" *idiom*, from the Greek; *significative*, "borrowed of the Latin and French, but to us brought in first by some nobleman's secretary, as I think, yet doth so well serve the turn, as it could not now be spared; and many more like usurped Latin and French words,—as *method*, *methodical*, *placation*, *function*, *assubtiling*, *refining*, *compendious*, *prolix*, *figurative*, *inveigle*, a term borrowed of our common lawyers; *impression*, also a new term, but well expressing the matter, and more than our English word;" *penetrate*, *penetrable*, *indignity*, (in the sense of unworthiness) and a few more.

The whole enumeration is curious, and strikingly exhibits the state of language at this epoch, when the rapid advancement of letters and all the arts of social life was creating a daily want of new terms, which writers of all classes, and individuals in every walk of life, regarded themselves as authorised to supply, at their own discretion, in any manner and from any sources most accessible to them, whether pure or corrupt, ancient or modern. The pedants of the universities and the travelled coxcombs of the court, had each a neological jargon of their own, unintelligible to each other and to the people at large; on the other hand, there was a few persons of grave professions and austere characters, who, like Cato the Censor, during a similar period of accelerated progress in the Roman state, prided themselves on preserving, in all its unsophisticated simplicity, or primitive rudeness, the tongue of their forefathers.

The same writer has given several odd specimens of poems in the forms of lozenges, rhomboids, pillars, &c. and has contrived a defence for describing and making such trifling devices. He has even erected two pillars to the honour of Elizabeth; each pillar consists of a base of eight syllables, the shaft or middle of four, and the capital is equal with the base. The only difference between the two pillars consists in this: in the one "ye must read upwards," and in the other the reverse. "These pillars," it has been truly said, "notwithstanding this fortunate device and variation, may be fixed as two columns in the porch of the vast temple of literary folly."

It was at this period, when words or verse were tortured into such fantastic forms, that the trees or gardens were twisted and sheared into obelisks and giants, peacocks or flower-pots. Thus in a copy of verses, "To a hair of my mistress's eye-lash," the merit, next to the choice of the subject, must have been the arrangement, or *derangement*, of the whole poem into the form of a *heart*. But notwithstanding these and similar conceits, the progress of the mind continued. The rapid advancement of intellectual culture in England, between the years 1588 and 1640, a period of almost uninterrupted peace, has been remarked by Mr. Fox. "The general improvement," he observes, "in all arts of civil life, and, above all, the astonishing progress of literature, are the most striking among the general features of that period, and are in themselves causes sufficient to produce effects of the utmost importance. A country, whose language was enriched by the works of Hooker, Raleigh, and Bacon, could not but experience a sensible change in its manners and in its style of thinking; and even to speak the same language in which Spenser and Shakspeare had written, seemed a sufficient plea to rescue the Commons of England from the appellation of *brutes*, with which Henry VIII. had addressed them." The remark is equally just and refined. It is by means of an improving language that the progress of the mind is chiefly continued from one generation to another; and that the acquirements of the enlightened few are insensibly imparted to the many. Whatever tends to diminish the ambiguities of speech, or to fix more precisely the import of general terms; above all, whatever tends to embody, in popular forms of expression, the ideas and feelings of the wise and good, augments the natural powers of the understanding, and enables the succeeding race to start from a higher ground than was occupied by their fathers. Admirable, indeed, is the remark of Bacon,—"Although we think we govern our words, yet certain it is, words, as a Tartar's bow, distort back on the understanding of the wisest, and mightily entangle and pervert the judgment;"—not only as showing the power of language in certain cases to mislead, but also as suggesting the immense advantages it is capable of yielding.

Before the close of the sixteenth century the English language had in a great measure attained that form and structure which it continues to exhibit. A great improvement of taste had been introduced by a more critical and a more general study of the ancient classics. William Lilly, the famous grammarian, who had learned Greek at Rhodes, and who had afterwards acquired a polished Latinity at Rome, became the first teacher of Greek at any public school in England. This was at St. Paul's School in London, of which he was appointed the first master about the year 1500. The language soon began to be more regularly taught in the universities. At Cambridge the study of it was zealously and successfully recommended by Smith, Cheke, and Ascham, who were themselves distinguished by their proficiency. The elegancies of Latin style began to be better understood, and monkish barbarism was gradually banished. Ascham and Haddon acquired distinction by the style of their Latin prose; and some of the verses of Leland discover a classical vein previously unknown to his countrymen. Before the close of the century many of the Greek and Latin writers appeared in an English dress, and classical story, with classical mythology, was rendered familiar to the common reader.

At the period when Shakspeare was sent to school, the study of the classical languages had made, since the era of the revival of literature, a very rapid progress. Grammars and Dictionaries had been published by various authors; but the grammatical institute then in general use, both in town and country, was the Grammar of Henry VIII., which, by the order of Queen Elizabeth, was admitted to the exclusion of *all* others. Another initiatory book, which he most probably studied, was entitled ΕΙΡΗΝΑΡΧΙΑ, sive ELIZABETHA; the object of which was to panegyrize the characters and government of Elizabeth and her ministers, and it was therefore enjoined by authority to be read as a classic in every grammar-school, and to be indelibly impressed on the memory of every young scholar in the kingdom.

The French, Italian, and Spanish languages also attracted a great degree of attention; and from all of them, especially the two former, many works were likewise translated. New sources of knowledge, as well as of fancy, were thus opened, and the English tongue was enriched with a more copious and varied phraseology.

Education was, however, most erroneous and defective. Severe and indiscriminate discipline prevailed among the teachers of that time. "The diseases," says Peacham, "whereunto some of them are very subject, are *humour and folly* (that I may say nothing of the gross ignorance and insufficiency of many), whereby they become ridiculous and contemptible both in the schoole and abroad. I knew one, who in winter would ordinarily in a cold morning whip his boys over for no other purpose than to get himselfe a heat; another beat them for swearing, and all the while he sweares himselfe; he would forgive any fault saving that."

Still the orb of knowledge seems only to have irradiated the eminences of our land. An erudite taste did not pervade the bulk of the people, nor even the middle orders of society. Literature, though cultivated with enthusiasm in the metropolis, was confined even there to persons of high rank, or to those who were subservient to their education and amusement. In the country, to read and write were still considered rare accomplishments; and among the rural gentry of not the first degree, little difference, in point of literary information, was perceptible between the master and his menial attendant.

The intense interest in public events generally excited by the threatened invasion of Spain, gave rise to the introduction to this country of one of the most important inventions of social life—that of newspapers. Previously to this period all articles of intelligence had been circulated in manuscript; and all political remarks which the government had found itself interested in addressing to the people, had issued from the press in the shape of pamphlets, of which many had been composed during the administration of Burleigh, either by himself or immediately under his direction. But the peculiar convenience, at such a juncture, of uniting these two objects in a periodical publication, becoming obvious to the ministry, there appeared, some time in the month of April 1588, the first number of "The English Mercury," a paper resembling the present "London Gazette," and which must have come out almost daily; since No. 50, the earliest specimen of the work now extant, is dated July 23d of the same year.

The first newspaper in the collection of the British Museum is marked No. 50, and is in Roman, not in black letter. It contains the usual articles of news, like papers of the present day, and there is the following notice: "Yesterday the Scots ambassador, being introduced to Sir Francis Walsingham, had a private audience of her Majesty, to whom he delivered a letter from the King his master, containing the most cordial assurances of his resolution to adhere to her Majesty's interests, and to those of the Protestant religion. And it may not here be improper to take notice of a wise and spiritual saying of this young prince (he was twenty-two) to the Queen's minister at his court; viz.—That all the favour he did expect from the Spaniards was the courtesy of Polypheme to Ulysses, *to be the last* devoured." Mr. Chalmers defies the gazetteer of the present day to give a more decorous account of the introduction of a foreign minister. The aptness of King James's classical saying carried it from the newspaper into history.

So rapid was the progress of newspapers after this memorable introduction, that towards the close of the reign of James, Ben Jonson, in his *Staple of News*, alludes to them as fashionable among all ranks of people, and as sought after with the utmost avidity; one consequence of which was, that the greater part of what was communicated was fabricated on the spot. To this grievance the poet refers in an address to his readers, when, speaking of spurious news, he calls it "news made like the Times' news (a weekly cheat to draw money)," and says, "it could not be fitter reprehended than in raising this ridiculous office of the Staple, wherein the age may see her own folly, or *hunger and thirst after published pamphlets of news, set out every Saturday*, but made all at home, and no syllable of truth in them."

Great interest was excited by the arrival in Plymouth harbour, in November 1580, of the celebrated Francis Drake, from his circumnavigation of the globe. National vanity was flattered by the idea that this Englishman should have been the first commander-in-chief by whom this great and novel enterprise had been successfully achieved; and both himself and his ship became, in an eminent degree, the objects of public curiosity and wonder. The courage, skill, and perseverance of this great navigator were deservedly extolled; the wealth which he had brought home from the plunder of the Spanish settlements, awakened the cupidity which in that age was a constant attendant on the daring spirit of maritime adventure, and half the youth of the country were on fire to embark in expeditions of pillage and discovery.

The passage by the Cape of Good Hope, repeatedly accomplished by circumnavigators of this nation, had now ceased to oppose any formidable obstacle to the spirit of maritime enterprise; and the papal donation was a bulwark still less capable of preserving inviolate to the sovereigns of Portugal their own rich Indies. The first expedition ever fitted out from England for those eastern regions, where it now possesses an extent of territory, in comparison of which itself is but a petty province, consisted of three "tall ships," which sailed under the conduct of George Raymond and James Lancaster.

Although they met with some disasters, yet, as far as respected the eastern part of the expedition, their success was such as strongly to invite the attempts of future adventurers; and nine years after its sailing, Elizabeth was prevailed on to grant a charter of incorporation, with ample privileges, to an East India Company, under whose auspices Lancaster consented to undertake a second voyage. Annual fleets were from this period fitted out by these enterprising traders; and factories of their establishment soon arose in Surat, in Masulipatam, in Bantam, in Siam, and even in Japan.

These long and hazardous voyages of discovery, of hostility, or of commerce, began henceforth to afford an honourable employment to those among the youthful nobility and gentry who disdained the luxuries and servile idleness of the court, or, from other circumstances, wished to make some advance. But the promotion of the fortunes of individuals was by no means the principal or most permanent good which accrued to the nation by these enterprises. The period was still, indeed, far distant in which voyages of discovery were to be undertaken on scientific principles, and with extended views of general utility; but new animals, new vegetables, natural productions, or manufactured articles before unknown to them, attracted the attention even of these first unskilled explorers. Specimens in every kind were imported; and though fabulous or grossly exaggerated descriptions served at first to gratify and inflame the vulgar passion for wonders, a more familiar acquaintance disclosed their genuine properties and the purposes to which they might be applied at home. Thus the potato was introduced into

Ireland, and the adoption of tea gradually brought sobriety and refinement into the system of modern English manners.

Avarice and ambition had unquestionably their influence in these enterprises; but some who engaged in them were impelled by literary ardour, and an insatiable thirst for new discoveries in nature and art. Disastrous as many of these adventures proved, when politically or commercially considered, and unsuccessful as were most of the attempts then made to colonize newly-discovered climes, their influence on the literary character of the age was not inconsiderable, since the natural sciences gradually became objects of diligent research, and all the treasures of the globe were laid open to the investigation of the learned and scientific.

The latter part of the sixteenth century was a time at which England had enjoyed a hundred years of internal peace, and had reaped her full share of the benefit arising from the influx of the precious metals from America. But our towns were still small, and the inhabitants lived chiefly in the country, in villages and hamlets, though their situation, compared with that of their forefathers, was amended in various respects. The amount of the yearly exports and imports had increased; and so also had the personal comfort of all ranks, in food, clothing, and lodging.

Cottages in England seem generally to have consisted of a single room, without division of stories.

Chimneys were unknown in such dwellings till the early part of Elizabeth's reign, when a very rapid and sensible improvement took place in the comforts of our yeomanry and cottagers. Chimneys were not used in the farm-houses of Cheshire till after the beginning of the seventeenth century; the fire was in the midst of the house, against a hob of clay, and the oxen lived under the same roof.

The houses or cottages of the farmer were built in places abounding with wood, in a very strong and substantial manner; but in the open and champaigne country they were compelled to use somewhat flimsy materials, with here and there a girding, to which they fastened their splints, and then covered the whole with thick clay, to keep out the wind. "Certes this rude kind of building," says Harrison, who wrote in the age of Elizabeth, "made the Spaniards in quéene Maries daies to wonder, but chéeflie when they saw what large diet was used in manie of these so homelie cottages, in so much that one of no small reputation amongst them said after this manner: 'These English have their houses made of sticks and dirt, but they fare commonlie so well as the king.' Whereby it appeareth that he liked better of our good fare in such coarse cabins, than of their owne thin diet in their prince-like habitations and palaces." The cottages of the peasantry were thatched with straw or sedge; while the dwelling of the substantial farmer was coated with white lime or cement, and was very neatly roofed with reed; hence Tusser, speaking of the farm-house, gives the following directions for repairing and preserving its thatch in the month of May:

> "When houses be reeded (as houses have need),
> Now pare of the mosse, and go beat in the reed:
> The juster ye drive it, the smoother and plaine,
> More handsome ye make it, to shut off the raine."

Of the change which took place in rural economy towards the close of the sixteenth century, the following faithful and interesting picture has been drawn by the pencil of Harrison, who, noticing the additional splendour of gentlemen's houses, remarks: "In times past the costlie furniture staied *there*, whereas it has now descended yet lower, even unto manie farmers, who, by vertue of their old and not of their new leases, have for the most part learned also to garnish their cupbords with plate, their lined beds with tapistrie and silk hangings, and their tables with carpets and fine naperie, whereby the wealth of our countrie (God be praised, therefore, and give us grace to improve it well) dooth infinitlie appeare."

When Harrison wrote, though the greater number of manor-houses still remained framed of timber, yet he observes, "such as be latelie builded, are com'onlie either of bricke or hard stone, or both; their roomes large and comlie, and houses of office further distant from their lodgings." The old timber mansions, too, were then covered with the finest plaster, "which," says the historian, "beside the delectable whitenesse of the stuffe itselfe, is laied on so even and smoothlie, as nothing in my judgment can be done with more exactnesse:" and at the same time, the windows, interior decorations, and furniture, were becoming greatly more useful and elegant. "Of old time our countrie houses," continues Harrison, "instead of glasse did use much lattise, and that made either of wicker of fine rifts of oke in chekerwise. I read also that some of the better sort, in and before the time of the Saxons, did make panels of horne instead of glasse, and fix them in woodden calmes. But as horne in windows is now quite laid downe in everie place, so our lattises are also growne into lesse use, because glasse is come to be so plentifully and within a verie little so good and cheape if not better then the other. The wals of our houses on the inner sides in like sort be either hanged with tapisterie, arras worke, or painted cloths, wherein either diverse histories, or hearbes, beasts, knots, and such like are stained, or else they are seeled with oke of our owne, or wainescot brought hither out of the east countries, whereby the roomes are not a little commanded, made warme, and much more close than otherwise they would be. As for stooves, we have not hitherto used them greatlie, yet doo they now begin to be made in diverse houses of the gentrie. Like in the houses of knights, gentlemen, &c. it is not geson to behold generallie their great provision of Turkie worke, pewter, brasse, fine linen, and thereto costlie cupbords of plate, worth five or six hundred or a thousand pounds, to be deemed by estimation."

The house of every country-gentleman of property included a neat chapel and a spacious hall; and where the estate and establishment were considerable, the mansion was divided into two parts or sides, one for the state or banquetting-rooms, and the other for the household; but, in general, the latter, except in baronial residences, was the only part to be met with, and, when complete, had the addition of parlours; thus Bacon, in his Essay on Buildings, describing the household side of a mansion, says, "I wish it divided at the first into a hall, and a chappell, with a partition between both of good state and bignesse; and those not to goe all the length, but to have, at the further end, a winter and a summer parler, both faire: and under these roomes a faire and large cellar, sunke under ground: and likewise, some privie kitchens, with butteries and pantries, and the like." It was the custom also to have windows opening from the parlours and passages into the chapel, hall, and kitchen, with the view of overlooking or controlling what might be going on; a trait of vigilant caution which may still be discovered in some of our ancient colleges and manor-houses.

The hall of the country squire was the usual scene of eating and hospitality, at the upper end of which was placed the orsille, or high table, a little elevated above the floor, and here the master of the mansion presided, with an authority, if not a state, which almost equalled that of the potent baron. The table was divided into upper and lower messes, by a large salt-cellar; a custom which not only distinguished the relative dignity of the guests, but extended likewise to the nature of the provision, the wine frequently circulating only above the salt-cellar, and the dishes below it being of a coarser kind than those near the head of the table. So prevalent was this uncourteous distinction, that Shakspeare, in his "Winter's Tale," designates the inferior orders of society by the term "lower messes:"—

> ———"Lower messes,
> Perchance, are to this business purblind."

Decker, too, employing the language of indignation, says, "Plague him, set him beneath the salt; and let him not touch a bit till every one has had his full cut."

In one of those royal progresses which form so striking a feature in the domestic history of the reign of Elizabeth, she contemplated the gay magnificence of Nonsuch, regarded as the triumph of her father's taste, and the master-piece of all the decorative arts. This stately edifice, of which not a vestige now remains, was situated near Ewell, in Surrey, and commanded from its lofty turrets extensive views of the surrounding country. It was built round two courts, an outer and an inner one, both very spacious, and the entrance to each was by a square gate-house, highly ornamented, embattled, and having turrets at the four corners. These gate-houses were of stone, as was the lower story of the palace itself; but the upper one was of wood, "richly adorned and set forth, and garnished with variety of statues, pictures, and other antic forms of excellent art and workmanship, and of no small cost;" all which ornaments, it seems, were made of *rye-dough.* In modern language, the "pictures" would probably be called basso-relievos. From the eastern and western angles of the inner court rose two slender turrets, five stories high, with lanthorns on the top, which were leaded and surrounded with wooden balustrades. These towers of observation, from which the two parts attached to the palace and a wide expanse of champaign country beyond might be surveyed as in a map, were celebrated as the peculiar boast of Nonsuch.

At this time the nobility continued for the most part to inhabit their ancient castles; edifices which, originally adapted by strength of situation and construction merely for defence, were now in many instances, by the alterations of the original buildings, and by the accession of additional ones, become splendid palaces. Thus the castle of Kenilworth, renowned for gorgeous festivities, is said to have cost the Earl of Leicester in buildings 60,000*l.* Other castles, though converted into dwellings of some convenience and magnificence, still retained formidable strength, which was proved in the following century, when so many of them sustained sieges for the king or parliament, and were finally dilapidated.

Besides the regularly fortified castles, there were many mansion-houses of inferior importance, which, though not capable of resisting a regular siege, were strengthened against a tumultuous or hasty invasion. These houses generally formed a square of building, enclosing a court and surrounded by a moat. A drawbridge formed the only access, which was protected by an embattled gate-house. One side of the square was principally occupied by a great hall, and the offices and lodgings were distributed on the other sides. Oxburgh-hall, in Norfolk, and Layer Marney, in Essex, are fine examples of these houses. They were frequently of timber, as Moreton-hall, in Cheshire, and Spekehall, near Liverpool. Leland describes Morley-house, near Manchester, as "builded,—saving the foundation of stone squared, that riseth within a great mote, a six foot above the water, all of timber,—after the common sort of building of the gentlemen for most of Lancashire." Sometimes a strong tower was added at one corner, as a citadel, which might be maintained when the rest of the house was destroyed. This is the case with the curious house of Stoke Say in Shropshire, where the situation near the Welsh border might render such an additional security desirable.

Thus the forms of ancient fortification were continued awhile, rather from habit or ostentation than from any more important motives; but in the new buildings, erected during the reign of Elizabeth and her successor, they were finally laid aside. In some stately houses, though the show of strength was discontinued, the general form remained, however, the same. The circuit of building was entire, and enclosed one or more courts; a gateway formed the entrance, and the great hall was placed at the opposite side of the first court. Such was Audley End, in its original state one of the largest and most sumptuous houses in the kingdom. In other instances the house assumes the half H shape, with the offices placed in the wings, and the circuit is only completed by terraces and low walls; the gate-house remains as a detached lodge, or is entirely omitted. Examples of this form are numerous; as Holland-house at Kensington; Oxnead and Blickling-halls in Norfolk; Beaudesert and Wimbledon-house, built by Sir Thomas Cecil in 1588; remarkable for a great ascent of steps and terraces, disposed in a manner resembling some Italian villas. In others the offices are detached in separate masses, or concealed, or placed in a basement story; and only the body of the house remains, either as a solid mass, or enclosing small courts: this disposition does not differ from the most modern arrangements. Of these houses Longleat in Wiltshire, and Wollaton near Nottingham, are fine examples.

The houses erected during the sixteenth and the early part of the seventeenth century were frequently of magnificent dimensions; picturesque, from the varied lines and projections of the plan and elevation; and rich, by the multiplicity of parts; but they had lost all beauty of detail. The builders, having abandoned the familiar and long-practised Gothic style, were now to serve their apprenticeship in Grecian architecture: "stately Doricke and neat Ionicke worke" were introduced as fashionable novelties—employed first in the porches and frontispieces, and gradually extended over the whole fronts of buildings. Among the architects employed at this period, some foreign names occur. Holbein was much favoured by Henry VIII. and gave various designs for buildings at the old palaces of Whitehall and St. James's. John of Padua had a salary as deviser of his Majesty's buildings, and was employed to build the palace of the Protector Somerset. Jerome de Trevisi is also mentioned; and it is said that the designs for Longleat and a model of Audley End were obtained from Italy. The last circumstance is altogether extraordinary; this was the very best period of Italian architecture, and it seems highly improbable that semi-barbarous designs should proceed from the country of Palladio and Vignola. Thorpe, Smithson, and other Englishmen, were also eminent builders; and probably these persons might have travelled, and thus have gained the imperfect knowledge of Grecian architecture which appears in their works. They were immediately followed by Inigo Jones, who formed his style particularly on the works of Palladio, and became the founder of classic architecture in this country. As if to compensate for the plainness of the exterior, which now prevailed, the interior of the Palatial edifices exhibited the highest luxury of sculpture on the marble which surrounded the fire-places, and on the wood-work of the apartments.

Chimney-pieces were, indeed, very conspicuous; they were miniature frontispieces, consisting, like the porches of the houses, of a mass of columns, arches, niches, and caryatides, piled up to the ceiling. Of these there is one at the old Tabley-hall in Cheshire, singularly rude and grotesque, though dated so late as 1619; containing a hunting-piece and the figures of Lucrece and Cleopatra. Another, in Queen Elizabeth's gallery at Windsor Castle, is very rich, and comparatively pure and elegant in design. The sepulchral monuments of this age are very numerous, but only differ from those of an earlier date in the substitution of the members of Grecian for those of Gothic architecture, or rather in the confused mixture of both.

Towards the end of the reign of Elizabeth the coal trade flourished greatly, and continued to be regarded as an important source, not only of local but of government revenue by succeeding monarchs. At a period shortly after, the prospect of extraordinary gain led various adventurers to speculate in working the mines in the northern counties. An eye witness thus describes the state of things:—"Many thousand people are employed in this trade of coales; many live by working of them in the pits; many live by conveying of them in waggons and wains to the river Tine; many men are employed in conveying the coales in keels from the stathes aboard the ships. One coale merchant employed five hundred or a thousand in his work of coales; yet for all his labour, care, and cost, can scarce live of his trade, nay. many of them hath consumed and spent great estates and dyed beggars. I can remember one of many that raysed his estate by coale trade; many I remember that hath wasted great estates. Some south country gentlemen have, upon great hope of benefit, come into this country to hazard their monies in coale pits. Master Beaumont, a gentleman of great ingenuity and rare parts, adventured into our mines with his thirty thousand pounds, who brought with him many rare engines, not known then in these parts—as the art to bore with iron rods, to try the deepnesse and thicknesse of the coale, rare engines to draw water out of the pits, waggons with one horse to carry down coales from the pits to the stathes, to the river, &c. Within few years he consumed all his money, and rode home upon his light horse."

The subsequent extracts from Harrison's Description of England, prefixed to Hollingshead's Chronicle, edited in the year 1577, contain some very curious and interesting notices concerning the coal trade:—"Of cole-mines we have such plenty in the north and western parts of our island as may suffice for all the realme of Englande. And soe must they doe hereafter indeede, if wood be not better cherished then it is at this present; and to say the truth, notwithstanding that very many of them are carryed into other countryes of the maine, yet theyr greatest trade beginneth to growe from the forge into the kitchin and halle, as may appear already in most cities and townes that lye about the cost, where they have little other fewel excepte it be turfe and hassocke. I marvayle not a little that there is no trade of these into Sussex and Southamptonshire, for want whereof the smiths do work their yron with charre-coal. I think that farre carriage be the only cause, which is but a slender excuse to enforce us to carry them unto the mayne from hence."

"I might," continues our authority, "here take occasion to speak of the great sales yerly made of wood, whereby infinite deale hath been destroyed within these few yeres, but I give over to deale in this behalfe; howbeit, this I dare affirm, that if woodes doe goe so fast to decay in the next hundred years of grace, as they have done and are like to do in this, (sometymes for increase of shepewalkes, and some mayntaynaunce of prodigalitie and pompe, for I have knowne a gentleman that hath borne three-score at once in one paire of galigascons to shew his strength and bravery,) it is to be feared that brome, turfe, gal, heth, brakes, whinnies, ling, dies, hassocks, flaggs, straw, sedge, reede, rushe, and sea-cole, will be good marchandise, even in the citie of London, wherunto some of them alreadie have gotten readie passage and taken up their innes in the greatest merchaunt's parlers."

This quaint writer goes on to contrast the manners of former times with those of his own:—"Now we have many chimnyes, and yet our tenderlings complain of reumes, catarres, and poses; then had we none but reredoses, and our heads did never ake. For as the smoke in those days was supposed to be a sufficient hardning for the timber of the house, so it was reputed a far better medicine to keep the good man and his family from the quacke or pose, wherewith as then very few were acquainted."

The historian proceeds:—"There are old men yet dwelling in the village where I remain, which have noted the multitude of chimnies lately erected, whereas in their yoong dayes there was not above two or three, if so many, in most uplandish townes of the realme, (the religious houses and mannour places of their lordes always excepted, and peradventure some great personages,) but each one made his fire against a reredosse in the halle where he dined and dressed his meate." He then, with something like bitterness, adds:—"When our houses were buylded of willowe then we had oken men, but nowe that our houses are come to be made of oke, our men are not only become willow but a great many altogether of straw, which is a sore alteration."

About fifty years afterwards the apprehensions of Harrison, relative to the decay of wood fuel, appear to have been realized; the grown timber had not only been generally wasted, but there had been an unthrifty neglect in not planting fresh trees. This want of wood, however, not only brought pit-coal into more common use for domestic household purposes, but likewise in a manner compelled the adoption of it for other more important uses, as mentioned by one of our annalists. "Such," says Stow, "hath bene the plenty of wood in England for all uses that within man's memory it was held impossible to have any want of wood; but contrary to former imaginations, such hath bene the great expence of wood to make household furniture, casks, and other vessels, not to be numbered, and of carts, waggons, and coaches, besides the extreame wast of wood in making iron, burning of brick and tile; that, whereas, in the year of our Lord God 1306, King Edward I. by proclamation, prohibyted the burneing of sea-coale in London and the suburbs, to avoid the sulferous smoke and savour of the firing; and in the same proclamation commanded all persons to make their fires of wood, which was performed by all, smiths only excepted; yet at this present, through the great consuming of wood as aforesaid, and the neglect of planting of woods, there is so great scarcity of wood throughoute the whole kingdom that not only the city of London, all haven townes, and in very many parts within the land, the inhabitants in general are constrained to make their fiers of sea-coale or pit-coale, even in the chambers of honourable personages, and through necessitie, which is the mother of all arts, they have of very late years devised the making of iron, the making of all sorts of glass and burning of bricke, with sea-coal or pit-coal. Within thirty years last the nice dames of London would not come into any house or roome where sea-coales were burned, nor willingly eat of the meat that was either sod or roasted with sea-coal fire."

This extract shows how great a revolution was at that time taking place in the application of fuel, not only with reference to the arts, but also for domestic purposes. The abandonment of wood, as an article of firing to which the people had been accustomed from time immemorial, was a matter of stern necessity, not of choice; and amusing is it to observe the severity with which some of the writers of the earlier part of the seventeenth century inveigh, not only against the increase of those avocations which led to the large consumption of wood, but more especially against the introduction of coal, but for the timely and exhaustless supply of which, it is not easy to conceive of the state in which manufacturers, as well as house-keepers, must have been placed. About the period here alluded to the British iron-trade, which has subsequently assumed an importance proportioned to our national skill, and the mineral resources of the island, was beginning to be pursued by men fairly alive to its advantages. To meet this growing spirit for the smelting of the native ores at a time when wood, charred or green, was deemed indispensable, an enormous sacrifice of our forest timber was required; so much so, indeed, that Evelyn, amiable as he was, complained most severely that such should be the case. In his "Sylva" he remarks, that "Nature has thought fit to produce this wasting ore (of iron) more plentifully in woodlands than any other ground, and to enrich our forests to their own destruction;" to which he kingdom, especially in Yorkshire, indicate the situations of ancient bloomaries. These are met with both in the valleys and on the hills; the latter, however, have been supposed to belong to the earlier works, and to a period anterior to the knowledge of bellows. In the sixteenth century the process, according to all accounts, was not many degrees advanced, with the exception of the bellows and a better constructed furnace, beyond the primitive practice.

By the term casting is meant the process of converting fusible metal into any given form, by pouring it, when in a liquid state, into a mould. As the separation of all metals from the ores necessarily exhibits this molten state, and as the flowing of the mass into any receptacle approaches at least the practical illustration of the definition just given, it might be supposed that this method of obtaining metallic articles, so familiar in our times, had obtained from the remotest antiquity; but this was certainly not the fact in reference to iron and other metals.

At what precise period, and in what country, an art carried to such a vast extent, and to so superlative a degree of perfection, first began to be practised, seems almost a futile inquiry. Mr. Mushet not only fixes the date of the discovery of the art of casting in iron in this country about the year 1550, but likewise considers the process to have been an English invention; at all events, it does not appear that the cast-iron trade was known among us before that time. The first description of goods produced by the new process would, of course, be the ordinary cooking utensils in domestic use—pots and pans; these would presently be followed by ranges and ovens, and a variety of implements used in the manufacture of metals in general.

A knowledge of the art of working in iron with the hammer must, however, have preceded all application of the ingenious and now common method, of casting articles in moulds of sand with the metal in its liquid state. This statement will excite little surprise when it is recollected that, in the infancy of the art of iron-making, it is not to be supposed that the metal, before it could be subjected to the hammer, underwent the variety of processes to which it is submitted in our more modern bloomaries, nor even that it was required to be cast at all.

The scythe and the sickle were, at an early time, very much alike. So old is the former, that one learned man tried to derive the word Saxon from the word used by that people for a scythe; and because, he says, their swords were long and bending, like one having the edge the contrary way. But it appears that our scythes and sickles now differ hardly at all from those in use nearly a thousand years ago. They are made in various parts of the country, but more particularly in the neighbourhood of Sheffield, the seat of this manufacture for at least three hundred years. The fierce persecution of the Duke of Alva in the Netherlands compelled many Protestant families to seek refuge in this country; and it was the means of bringing into England this and many other of those useful arts which have flourished ever since.

From an era not now to be ascertained, down to the time of Queen Elizabeth, we had an import trade in knives; and, as the historian of Hallamshire* remarks, "the knyves of Almagne, knyves of France, knyves of Collagne, are among the articles enumerated in the custom-house rate-books of the time of Henry VIII. Queen Elizabeth, in the fifth of her reign, laid some restrictions on this import trade; but more, as it seems, with a view to encourage the London manufacturers than those of the country. London was, at that time, the principal mart of the finer species of cutlery; but, besides London, Salisbury, Woodstock, and Godalming, were rivals with Sheffield in this department of our national manufactures." At what period our native manufacture of these important wares was introduced it is impossible to say. In Stow's "Chronicle" occurs the following passage:—"Richard Matthews, on Fleete Bridge, was the first Englishman who attaigned the perfection of making fine knives and knife hafts; and in the fifth year of Queen Elizabeth, he obtained a prohibition against all strangers and others for bringing any knives into England from beyond the seas, which, until that time, were brought into this land by shippes lading from Flanders and other places.

* Note I.

Albeit at that time, and for many hundred yeeres before, there were made, in divers parts of this kingdome, many coarse and uncomely knives; and at this day, the best and the finest knives in the world are made in London." Although the chronicler, in this passage, directly refers to the early existence and extent of the cutlery trade, inconsiderate copyists have drawn from it a loose statement to the effect that "knives were first made in England in 1563, by Thomas Matthews, on the Fleete Bridge, London." Against this assertion, besides the testimony of Stow, and the common traditions of the Hallamshire cutlers, there has to be set the undoubted fact, that, so early as the year 1417, the cutlers of the metropolis sought and obtained a charter of incorporation from Henry V. It may be added, that they have a hall in Cloak-lane, and admit freemen, on the payment of a livery fine of 10*l.* That knives were made at Sheffield at least a century earlier than the preceding, appears indisputable from the incidental testimony of the poet Chaucer, who, in his "Reve's Tales," states of the miller of Trompington, that, among other accoutrements,

"A Shefeld thwytel bare he in his hose."

The description of knife mentioned by the poet was evidently that used for cutting food, or a *case-knife*, as it was long afterwards called, from being fitted with a sheath. The distinction which Stow, in the passage before quoted, has drawn between "fine" and "coarse uncomely knives," is too vague to enable us to attach an exact meaning to his words.

In the year 1575, if not at an earlier period, Sheffield was certainly celebrated for the fabrication of these wares ; for the Earl of Shrewsbury, under that date, sends to his friend Lord Burleigh "a case of Hallamshire whittells, beinge such fruietes as his pore countrey affordeth *with fame throughout the realme.*" It is probable, indeed, that at this time the manufacture consisted, for the most part, of the coarser and inferior kinds, such as knives which, as Fuller says, were "for common use of the country people," and which excited his surprise when he saw them offered at the low price of one penny.

"Sheffield," as Mr. Hunter justly remarks, "possesses natural advantages of a superior order to those which perhaps any other spot in the island can boast for that peculiar species of manufacture which has fixed itself there. It had acquired an extended reputation for those manufactures as early as the reign of Edward III.; and the princes of the house of Tudor displayed at all times a generous concern for the protection of commerce, and the encouragement of those engaged in it."

It is said that, about the year 1650, clasp or spring knives began to be made with handles of iron, which in a little time they covered with horn or tortoise-shell. In the old Scottish dialect, a clasp-knife was called a jockteleg, a corruption of Jacques de Liege, a famous cutler in the Netherlands, whose knives were the first of this sort known in Scotland.

The *table-fork* did not come into use in England till the reign of James I. as we learn from a remarkable passage in Coryat. The reader will probably smile at the solemn manner in which this important discovery or innovation is related:—"Here I will mention a thing that might have been spoken of before in discourse of the first Italian townes. I observed a custom in all those Italian cities and townes through the which I passed, that is not used in any other country that I saw in my travels; neither do I thinke that any other nation of Christendome doth use it, but only Italy. The Italians, and also most strangers that are commorant in Italy, doe always at their meals use a little forke when they eat their meate; for while with their knife, which they hold in one hand, they cut the meate out of the dish, they fasten the forke, which they hold in the other hand, upon the same dish, so that whatsoever he be that sitting in the same company of any others at meale shall unadvisedly touch the dish of meat with his fingers from which all the table doe cut, he will give occasion of offence unto the company as having transgressed the lawes of good manners, insomuch that for his error he shall be at least browbeaten, if not reprehended in wordes. This form of feeding I understand is generally used in all parts of Italy, their forkes for the most part being made of yronn, steele, and some of silver; but those are used only by gentlemen. The reason of this their curiosity is, because the Italian cannot by any means indure to have his dish touched with fingers, seeing all men's fingers are not alike cleane. Hereupon I myself thought good to imitate the Italian fashion by this forked cutting of meate, not only while I was in Italy, but also in Germany, and often times in England since I came home: being once quipped for that frequently using my forke, by a certain learned gentleman, a familiar friend of mine, Mr. Lawrence Whitaker, who in his merry humour doubted not to call me a table *furcifer*, only for using a forke at feeding, but for no other cause."

Jonson speaks of the utility of forks in that part of his works where *Meercroft* having mentioned his "project of the forks," *Sledge* exclaims:—

> "Forks? what be they?
> *Meer.*—The laudable use of *forks*
> *Brought into custom here*, as they are in Italy,
> To the sparing o' napkins."

In the tranquil times of Elizabeth, a corporation was formed for the transmutation of iron into copper by the method of an alchemist named Medley; of which the learned but credulous Sir Thomas Smith, secretary of state, was a principal promoter, and in which both Leicester and Burleigh embarked some capital. The Master of the Mint ventured to express a doubt of the success of the experiment; but his reason was not a little remarkable,—it was because this profound philosopher had engaged that the weight of copper procured should exceed that *of all the substances* employed in its production; but no one seems even to have felt the force of this objection; and great was the disappointment of all concerned when at length this glittering bubble burst.

About the same time the famous Dr. Dee—let not his splendid titles be forgotten—mathematician, astrologer, and professor of the occult sciences—under the pressure of poverty, entreated Burleigh to procure her Majesty's patronage for his infallible method of discovering hidden treasures. This individual, who stood at the head of his class—of what materials it was composed we need not speak—had been employed by Leicester to fix a *lucky day* for the Queen's coronation. Her Majesty, too, once visited him at Mortlake, took lessons of him in astronomy, and occasionally supplied him with money to defray the expenses of his experiments. This man, however, discovered more knavery than credulity; and as he died poor, was only a little less unfortunate than one of his sagacious fraternity, who, just before he was hanged, replied to the question—"Why could you not tell your own fortune?"—"The stars told me I was to be exalted, but they did not mention in what way!"

It was against the sect of trading projectors common in these days, that Ben Jonson directed a keen and admirable satire:—

"The doctor—the smoky bearded—he
Will close you so much gold in a bolt's head,
And in a trice convey in the stead another,
With sublimed mercury that shall mount in the heat,
And all fly out in fumeo."

It was the custom of these trading projectors to establish themselves wherever they were unknown; to promise to reveal the art of making the philosopher's stone; to build furnaces; to rob their employers, under the excuse of the necessity of preparation; and, when the time was accomplished beyond which they were unable to deceive, to explode their apparatus, or set fire to the house, and escape in the confusion.*

Great credulity was indeed apparent. Even the idea of fixing "an ass's nowl" on the head of *Bottom*, with which the readers of Shakspeare are familiar, is most probably taken from Scot, who gives us a very curious receipt for this singular metamorphosis. "Cut off the head of a horse or an asse (before they be dead, otherwise the vertue or strength thereof will be the lesse effectuall,) and make an earthen vessell of fit capacitie to conteine the same, and let it be filled with the oile and fat thereof; cover it close, and daube it over with lime: let it boile over a soft fier three daies continuallie, that the flesh boiled may run into oile; and annoint the heads of the standers by, and they shall seeme to have horses or asses heads."

But to allude to various manufactures,—in the eleventh century, Dynant in Flanders was celebrated throughout Europe for the manufacture of pots, pans, and other articles of copper, which were long known in commerce under the name of Dynandrie, from the place where they were made;

* Note K.

and, previous to the period when Queen Elizabeth encouraged miners and brass-workers to settle in this country, we imported from Germany, through the ports in the Netherlands, not only swords, knives, sadlers' ironmongery, and even pins, but all our articles of brass and copper, called battery wares, from their having been wrought by the hammer.

At whatever period the knowledge of the composition of brass, or the arts of working it, might first reach this country, we owe not only our flourishing copper trade, but our extensive brass manufactures, to the wise policy of Queen Elizabeth, in granting great privileges to Daniel Houghsetter, Christopher Schutz, and other Germans, whom she had invited into England in order to instruct her subjects in the art of metallurgy. Anderson, in reference to this matter, states that, in 1565, the Queen, after reciting that she had theretofore granted licenses to certain Dutch or Germans to dig for alum and copperas, as well as for gold, silver, copper, and quicksilver, in several counties, granted two exclusive patents to Humphreys and Shute, apparently the persons just mentioned, who had brought into England upwards of twenty foreign workmen, to dig and search for those metals, and also for tin and lead, and to refine the same in England, and within the English pale in Ireland. This is the origin of what was known so well afterwards as the charter for the mines royal. She also, in the same year, granted them "the sole use of the calamy stone, for composition of a mixed metal called latten, and all sorts of battery works, cast works, and wire." Three years afterwards, she incorporated Sir Nicholas Bacon, lord keeper of the great seal, Thomas Duke of Norfolk, and others, jointly with the said Humphreys and Shute, by the name and designation of the governors, assistants, and society of the mineral and battery works. The brass works, at Baptist Mills, about a mile north-east of the city of Bristol, was the first manufactory of that metal established in this country; a large home and export trade is still carried on at that place, as well as at Mangotsfield, in the same neighbourhood.

The art of overlaying, for economy's sake, one metal with another more valuable, is of great antiquity, and was practised both with silver and gold; but the application of the more precious material upon the inferior one appears, so far as we can judge, always to have been analogous to washing or gilding, or by affixing sheets and foils in some less adhesive manner. Articles so gilt or silvered were, from an early period, objects of merchandise in this country, and are sometimes noticed in our statutes. In 1403, Hen. IV. an act was passed to prevent deception in putting off gilt or plated locks, rings, beads, candlesticks, harnesss for girdles, chalices, sword pummels, powder boxes, &c. for solid metal; *all such workmanship upon* copper or latten being prohibited, except ornaments for the church, of which some part was to be left uncovered, to show the copper or brass.

One extremely important application of tin, and which the moderns have carried to great perfection, is in coating other metals. From the practice of tinning vessels of copper to the art of performing a similar operation on plates of iron, the transition may at first appear to many persons to be very trifling indeed. Such, however, is by no means the fact; for with respect to the latter metal, there arose not only the additional difficulty of spreading out the bar, by means of hammering, into laminæ sufficiently thin and smooth; but the formidable task of brightening the surface, in some instances, by the laborious process of filing, as well as the difficulty of always securing an uniform adhesion of a film of tin over the entire surface of the sheet. Tin was for a long time sent into Germany, from whence this country imported plated or tinned iron; and to Germany or Bohemia must in all probability be referred the invention of an art now become of such great utility, and in the practice of which the English workmen have long been acknowledged to surpass those of every other country.

The mode of casting plates of glass is said to have been discovered by a person who was melting some of this metal in a crucible, and accidentally spilt it, while fluid, on the ground. The metal ran under one of the large flagstones with which the place was paved, which obliged the workman to take up the stone in order to recover the glass. He then found it in the form of a plate, such as could not be produced by the ordinary process of blowing. The man, having his attention roused by this fact, was unable to sleep; and seeing at once the superiority of this method for forming mirrors, he made some experiments, and before morning ascertained that the improvement was practicable.

The manufacture of flint-glass was first begun in 1557 at Savoy House in the Strand, and in Crutched Friars. Ninety-eight years after, Sir Robert Mansell obtained a monopoly for making this kind of glass, from his being the first person who used pit-coal instead of wood in his furnaces. But even at this time the art could not have reached any great degree of perfection, as permission was also given by the patent, to import drinking-glasses of fine quality from Venice; and half a century elapsed before England became independent of foreign supplies for such articles.

From the conquest of Alexandria by the Saracens, at the beginning of the seventh century, when the Egyptian papyrus almost ceased to be imported into Europe, to the close of the tenth, about which time the art of making paper from cotton rags appears to have been introduced, there were no materials for writing except parchment—a substance too expensive to be readily spared for merely literary purposes. Warton states, that parchment was so scarce, that none could be procured about 1120, for an illuminated copy of the Bible. It is probable, however, that the want of skins sufficiently beautiful for such a purpose is intended; there must have been parchment for legal instruments;

but, from the cost of this article, an unfortunate practice prevailed of erasing a manuscript, in order to substitute another on the same skin, which probably occasioned the loss of many ancient authors.

Paper-mills are, however, of some antiquity. A quarto volume was published in London in 1588 by Thomas Churchyard, the title of which is, "A Description and Discourse of Paper, and the Benefits it brings, with the setting forth of a Paper-mill built near Dartford." This, there is reason to think, was the first erected. The manufacture of paper was not, however, much encouraged at home, even so late as 1662; and the following observations by Fuller are curious, respecting the paper of his times:—"Paper participates in some sort of the characters of the country which makes it; the *Venetian* being neat, subtile, and court-like; the *French* light, slight, and slender; and the *Dutch* thick, corpulent, and gross, sucking up the ink with the sponginess thereof." He complains that the paper manufacturers were not then sufficiently encouraged, "considering the vast sums of money expended in our land for paper, out of Italy, France, and Germany, which might be lessened were it made in our nation. To such who object that we can never equal the perfection of *Venice-paper*, I return, neither can we match the purity of Venice-glasses; and yet many *green ones* are blown in Sussex, profitable to the makers, and convenient for the users. Our *home-spun* paper might be found beneficial."

The state of the English manufactures was long very low; but multitudes of eminent manufacturers were driven from the Netherlands to England by the Duke of Alva's persecution of the Protestants, where they were graciously received by Elizabeth, and obtained liberty to settle at Norwich, Colchester, Sandwich, Maidstone, and Southampton. These refugees contributed to improve our manufactures of worsted and light woollen goods, and to introduce the manufacture of linens and silks, and probably extended the frame-knitting business. Elizabeth passed an act to relieve the counties of Somerset, Gloucester, and Wilts from the old oppressive statutes, which confined the making of cloth to corporate towns.

The exact period when the cotton manufacture was introduced into England is unknown. Cotton-wool had for centuries been imported in small quantities, to be used as candle-wicks, which appears from an entry in the books of Bolton Abbey, in Yorkshire, in the year 1298. The next mention of cotton-wool appears to be in an old poem, in which the trade of the Genevese with England is thus described:—

> "The Genuois comen in sundry wies
> Into this land by diuers marchandises
> In great Caracks, arrayed withouten lacke
> With cloth of gold, silke, and pepper blacke
> They bring with them, and of crood* great plentee,
> Woll Oyle, Woad ashen, by vessel in the see,
> *Cotton*, Rochalum, and good gold of Genne;
> And then be charged with wolle again I wenne,
> And wollen cloth of ours of colours all."

* Woad.

At the beginning of the sixteenth century the evidences of a regular importation of cotton become more numerous; but though cotton-wool had long been in use, yet, in all probability, it was only for candlewicks, and other minor purposes, not at all for the manufacture of cloth. No mention has yet been found of the cotton manufacture earlier than the year 1641, and there are good reasons for concluding that it could not have existed very long before that period.

It seems highly probable that the art of making cotton cloth was imported from Flanders by the crowd of Protestant artisans and workmen who fled from Antwerp, on the capture and ruin of that great trading city by the Duke of Parma in 1585, and also from other cities of the Spanish Netherlands. Great numbers of refugees sought an asylum in England; some of them settled in Manchester, and it is reasonable to suppose, that the manufacture of cotton would then be commenced in that town, as foreigners commencing a *new* art would be free from the restrictions affecting those who carried on others. The warden and fellows of Manchester College, it is said, had the wisdom to encourage the settlement of the foreign clothiers in that town, by allowing them to cut firing from their extensive woods, as well as to take the timber necessary for the construction of their looms, on paying the small sum of fourpence yearly.

It may be decisively inferred, from the first mention that has been discovered of the cotton manufacture in England, that it had been growing up for a considerable time before that account was written. This notice appears in a little work called "The Treasure of Traffic," published in 1641, and is as follows:—

"The town of Manchester, in Lancashire, must be also herein remembered, and even they for their encouragement commended, who buy the yarn of the Irish in great quantity, and, weaving it, returne the same again into Ireland to sell: neither doth their industry rest here, for they buy cotton-wool in London, that comes first from Cyprus and Smyrna, and at home worke the same, and perfect it into *fustians*, vermillions, dimities, and other such stuffes, and then return it to London, where the same is vented and sold, and not seldom sent into forrain parts, who have means, at far easier termes, to provide themselves of the said first materials."

Thus it appears that, in 1641, the manufacture had become well established at Manchester; and not only did it then supply the home trade with several kinds of cotton goods, but regularly exported them from the metropolis to the distant markets of the Levant; while the importation of cotton-wool and cotton-yarn had also become regular and considerable. Manchester still retained its manufacture of linen, and as linen-yarn was used as the warp for fustians, and nearly all other cotton goods in this country, down to the year 1773, it may be said that the linen manufacture prepared the way for the cotton manufacture, and long continued its auxiliary. It is therefore highly probable that the cotton manufacture was introduced into England towards the close of the sixteenth century, by the Flemish Protestant emigrants.

The spread of the manufacture was afterwards by no means rapid. The same obstacles which impeded its growth in the other countries of Europe impeded it in England. Owing to the rudeness of the spinning machinery, fine yarn could not be spun, and of course fine goods could not be woven. Fustians, dimities, and other strong fabrics, were made; but calicoes and the more delicate cotton goods were not attempted.

At the close of the sixteenth century, the English, who had previously been content to adopt the inventions and plans of others as to this manufacture, entered on that course of mechanical improvement which has since issued in such important results. An engine for knitting or weaving stockings was at this time invented by the Rev. William Lea, of St. John's College, Cambridge, which, though long neglected, yet at length not only enabled our ancestors to discard their former inelegant hose, but our manufactures to excel all of foreign production, and accordingly to meet with a proportionate demand. The invention of the stocking frame led to the exportation of vast quantities of silk hose to Italy; and in 1730, it was remarked by a traveller, that "at Naples, when a tradesman would highly recommend his silk stockings, he protests they are right English."

In the year 1609, Shakspeare planted his celebrated mulberry tree. Previous to this epoch, mulberry trees, though not absolutely unknown in this country, were extremely scarce, and in that year James, with a view to the encouragement of the silk manufacture, imported many hundred thousand of these trees from France, dispersing them all over England, accompanied by circular letters, written to induce the inhabitants to cultivate so useful, and at the same time so ornamental a production of the vegetable world.

Towards the close of the reign of that monarch he gave some encouragement to Mr. Burlamach, a London merchant, and, in consequence, some silk throwsters, silk dyers, and broad weavers, were brought from the continent of Europe, and a beginning was made in the manufacture of raw silk into broad silk fabrics, and which then increased so rapidly, that in the year 1629 the silk throwsters of London formed a body of sufficient importance to be incorporated.

It is desirable that, in certain cases, security should be granted to certain individuals, and which began to be done about this time by letters patent. By this phrase is meant the writ in the king's name and under the great seal, which secures, for a limited time, to the inventor the exclusive right to make and sell the material product of his invention. Unjust preferences have in most states, ancient and modern, occurred to despotic princes as a mode of enriching their favourites, or raising a revenue; and although very oppressive to the rest of their subjects, they were a cheap boon from the sovereign. This blind and tyrannical policy had increased in England to such a height, during several previous reigns, to the time of Elizabeth, that it was considered by the parliament of James I. altogether incompatible with the prosperity of the country. This feeling produced the well-known statute of that monarch for suppressing monopolies, by making void the future grants of all such as do not come under the following proviso: "Provided also, and be it enacted, that any declaration before mentioned shall not extend to any letters patent and grants of privilege, for the term of fourteen years or under, hereafter to be made, of the sole working and making of any manner of new manufacture within this realm, to the true and first inventor or inventors of such manufactures, which others, at the time of making such letters patent and grants, shall not use, so as also they be not contrary to law, nor mischievous to the state, by raising the prices of commodities at home, or hurt of trade, or generally inconvenient."

Strutt derives the use of gloves in England from the continent. For some time, although mentioned as parts of regal and pontifical habits, they appear to have belonged to state dresses rather than to have been worn for comfort or convenience. In the thirteenth century they were adopted by the nobility, who wore them richly embroidered, and reaching to the elbows. The ladies occasionally wore them; but as they concealed their rings, they were far from being generally used. The knight, however, wore his lady's glove in his helmet. Sometimes the contents of a glove materially increased its value, for it was filled with coin.

"Gloves as sweet as damask roses" form part of the stock of Autolycus in the Winter's Tale; and Mopsa tells the Clown, that he promised her "a pair of sweet gloves." The Queen in this, as in most other luxuries of dress, set the fashion; for Howis informs us, that in the fifteenth year of her reign, Edward Vere, Earl of Oxford, presented her with a pair of perfumed gloves, trimmed with four tufts of rose-coloured silk, in which she took such pleasure, that she was always painted with those gloves on her hands; and that their scent was so exquisite, that it was ever afterwards called the Earl of Oxford's perfume.

Before closing the account of this period with a reference to other topics, it is necessary to remark, that agriculture was long in an imperfect state. The sudden transitions so often mentioned from the lowest to the highest price of grain, and the prodigious inequality of its value in different years, sufficiently proves that the produce depended entirely on the seasons, and that art had done nothing to prevent or to lessen the calamities arising from those that are unfavourable. In the reign of James some considerable improvements were, however, made, and many books and pamphlets on husbandry were written. "It deserves to be remarked," says Johnson, "because it is not generally known, that the treatises on husbandry and agriculture, which were published during the reign of King James, are so numerous, that it can scarcely be imagined by whom they were written, or to whom they were sold." Nothing can illustrate more strongly the effects of a pacific system of policy, in encouraging a general taste for reading, as well as an active spirit of national improvement. At all times and in every country the extensive sale of books on agriculture may be regarded as one of the most pleasing symptoms of mental cultivation in the great body of a people. Yet still the nation was dependent on foreigners for its daily bread; a regular importation from the Baltic as well as from France was absolutely necessary, and, on any failure, serious consequences were sensibly felt. It was computed by Sir Walter Raleigh that 2,000,000*l*. went out at one time for corn. It was not until the fifth year of Elizabeth that the exportation of corn was allowed in England; and from that moment agriculture received new life and vigour.

In the reign of Elizabeth, Tusser recommends to the farmer attendance at fairs, both for purchase and sale:—

"At Bartilmewtide, or at Sturbridge faire,
buie that as is needful, thy house to repaire:
Then sel to thy profit, both butter and cheese,
who buieth it sooner, the more he shall leese.

That this custom prevailed until the commencement of the eighteenth century, and to nearly the same extent, is evident from a note on the lines just quoted, by Mr. Hilman. "Sturbridge fair," says he, "stocks the country (namely, Norfolk, Suffolk, and Essex) with clothes, and all other household necessaries, and they (the farmers) again, sell their butter and cheese, and whatever else remains on their hands; nay there the shopkeepers supply themselves with divers sorts of commodities."

In the early part of the reign of James I. Sturbridge fair began to acquire such celebrity, that hackney coaches attended it from London; and it subsequently became so extensive, that for several years not less than sixty coaches have been known to ply at this fair, then esteemed the largest in England.

Still it was no easy thing to accomplish a journey. The Anglo-Saxons called the old Roman roads military ways; the British trackways, which were not paved or gravelled, but covered with verdant turf, the country roads; and they distinguished the highways by one waggon's way, four feet broad, and two waggons' ways, probably eight feet or more; which distinction, according to Mr. Fosbroke, shows the origin of our narrow village roads. Subsequently there were roads made of mortar and stone; of wood and stone; and roads for carriages, distinguished for bridle-ways, or those purposely for horses. Narrow roads were called passes: openness in roads was thought necessary to prevent robbery; and for this purpose all roadside wood and thorns were cut down.

Our ancestors did not travel in carriages, or carry their goods in carts, but rode on horseback, and conveyed their wares or merchandise in pack-saddles or packages on the backs of horses. They likewise conveyed their money in the same way. In the reign of Elizabeth, some travellers were robbed in open day within the hundred of Beyntesh, in the county of Berks, and it is stated that "they were clothiers, and yet travailed not withe the great trope of clothiers; they also carried their money openlye in wallets upon their saddles."

Various and important additions were made to the gardens and orchards of the time. The elder Tradescant, in 1620, entered himself on board of a privateer armed against Morocco, solely with a view of finding an opportunity of stealing apricots into Britain; and it appears that he succeeded in his design. Sir Anthony Ashley, of Winbourne St. Giles, Dorsetshire, first planted cabbages in this country; and a cabbage at his feet appears on his monument: before his time we had them from Holland. Sir Richard Weston first brought clover grass into England from Flanders, in 1645; and the figs planted by Cardinal Pole at Lambeth, so far back as the reign of Henry VIII. are said to be still remaining there. Spelman, who, some affirm, set up the first paper-mill in England, at Dartford, in 1590, was said to have brought from abroad in his portmanteau the first two lime-trees which he planted here, and which are still growing. The Lombardy poplar was introduced into England by the Earl of Rochford, in 1758. The first mulberrytrees in this country are now standing at Sion-house.

Some lines at the close of Peacham's Emblems give an idea of an English fruit garden in 1612.

"The Persian peach, and fruitful quince;
And there the forward almond grew,
With cherries knowne no long time since;
The winter warden, orchard's pride;
The philibert that loves the vale,
And red queen apple, so envide
Of school-boies, passing by the pale."

The filbert is said to have been thus named from Philibert, a king of France. The queen apple was probably thus distinguished in compliment to Elizabeth.

The first *printed* New Testament in our language was that translated by Tindal, assisted by Coverdale, and completed abroad in 1526; but most of the copies were bought up and burned by Bishop Tunstal and Sir Thomas More. A subsequent and revised edition shared the same fate. In 1532 Tindal and his associates finished the whole Bible, except the Apocrypha, and printed it abroad; but while he was afterwards preparing a second edition, he was apprehended, and brought to the stake. On Tindal's death his work was carried on by Coverdale and John Rogers, who translated the Apocrypha, revised Tindal's translation, and added prefaces and notes from Luther's Bible.

The first translation of *the whole* Bible ever *printed* in English is generally called "Coverdale's Bible;" it is a folio volume; and from the appearance of the types, it is now usually considered to have been printed at Zurich, in the printing office of Christopher Froschover. The following extract from the nineteenth Psalm will show the advance of the language since the days of Wickliffe.

"The very heauēs declare the glory off God, ād the very firmamēt sheweth his hādye worke. One daye telleth another, and one night certifieth another. There is nether speach ner lānguage, but their voyces are herde amōge thē. Their soūde is gone out into all londes, and their wordes into the endes of the worlde.

"In thē hath he sett a tabernacle for $y_e$ Sōne, which cōmeth forth as a brydegrome out of his chambre, and reioyseth as a giaunte to rūne his course. It goeth forth frō the one ende of the heauen, and runneth aboute ento the same ende agayne, and their maye no mā hyde himself frō the heate thereof."

Archbishop Parker resolved on a new translation for the public use of the Church, and engaged the bishops and other learned men to take each a portion; the work, when complete, containing some short annotations, was commonly called "the Bishops' Bible." The Archbishop superintended, examined, and finished the whole.

The last English version that remains to be noticed was that which proceeded from the Hampton Court Conference in 1603, when many exceptions being made to the Bishops' Bible, King James gave orders for a new one; not, as the preface expresses it, for a translation altogether new, but to make a good one better; or, of many good ones, one best. Fifty-four learned men were appointed to this important labour; but before it was commenced, some of the persons nominated were either dead or had declined the task; for the list, as given us by Fuller, comprises only forty-seven names. All of them, however, were preeminently distinguished for their piety, and for their profound learning in the original languages of the sacred writings.

This version is unquestionably of extraordinary value. At the period in which it was executed, the English tongue was not equal to such a work; but the translators were enabled to raise it far beyond the elevation it had then attained; so that after the lapse of more than two hundred years, the English Bible is, with very few exceptions, the *standard* of the purity and excellence of our language.

The reign of James I. forms one of the most splendid eras in the literary history of our country. A greater number of celebrated scholars flourished then than at any former or subsequent period; some of whose writings will probably descend to the latest posterity. The genius which the sagacity of Elizabeth had discovered, and her powerful patronage had fostered, now attained a luxuriance of growth, which scarcely need to fear comparison with the most celebrated productions of Greece and Rome. Nor does this remark apply alone to one department of literature, for almost every province in the vast empire of human knowledge began to be cultivated with assiduity and some degree of success. As, from the earliest dawn of the Reformation, a taste for classical learning had revived, the most celebrated works of the ancients were examined with critical research. In these literary labours, the amiable Erasmus led the way; and his footsteps were closely followed by many eminent scholars, both in this country and in various parts of the continent. By their united efforts a flood of light was poured on the writings of the ancients; and the valuable relics of former ages have been transmitted to posterity in greater purity than they could otherwise have assumed. The celebrated Casaubon resided several years at the court of James I. who greatly admired him, and gave him a liberal pension. Aided by the patronage of that monarch, he published valuable editions of the Greek and Roman classics, enriched with laborious criticisms and learned commentaries.

History engaged the attention and employed the talents of many of the most learned men of that age. Among these appeared Sir Walter Raleigh, Buchanan, the learned preceptor of King James, and Lord Bacon, of whom a more particular account must be given.

At the age of sixteen he was distinguished at Cambridge; and very shortly afterwards, struck with the frivolous subtlety of the tenets of Aristotle, he appears to have entered on the course that led to such distinguished eminence. The solid foundation of his scientific character is "the Instauration of the Sciences." It opens with a general and philosophical survey of the subject; whence he proceeds to infer the futility of the ancient philosophical systems, and to point out *induction from sober and severe experiments*, as the only road to truth. Pursue this, he says, and we shall obtain new powers over nature; we shall perform works as much greater than were supposed practicable by natural magic, as the real actions of a Cæsar surpassed the fictitious ones of a hero of romance. Speculative philosophy he likens to the lark, who brings no return from his elevated flights; experimental philosophy to the falcon, who soars as high, and returns the possessor of his prey.

"If," says one of his numerous biographers, "we stand surprised at the happy imagination of such a system, our surprise redoubles upon us when we reflect that he invented and methodized this system, perfected so much, and sketched out so much more of it, amidst the drudgery of business and the civil tumults of a court. Nature seems to have intended him peculiarly for this province, by bestowing on him with a liberal hand all the qualities requisite—a fancy voluble and prompt to discover the similitudes of things—a judgment steady and intent to note their subtlest difference—a love of meditation and inquiry—a patience in doubting—a slowness and diffidence in affirming—a facility of retracting—a careful anxiety to plan and dispose. A mind of such a cast, that it neither affected novelty nor idolized antiquity—that was an enemy to all imposture—must have had a certain congeniality and relation to truth. These characters, which, with a noble confidence, he has applied to himself, are obvious and eminent in his '*Instauration of the Sciences*,' a work designed by him, not as a monument to his own fame, but a perpetual legacy to the common benefit of others."

His inquiry into the mutual influence of thought and language is of great importance, and still remains as an interesting object of research. He touches continually on the phenomena of the intellect, treats separately of its more important powers, exults in their capacity of improvement, but never forgets the limitation of our knowledge, or the fact, that—

> " Wisdom is ofttimes nearer when we stoop
> Than when we soar."

It is ordinarily enough to obtain distinction in one department of science; few, comparatively, have risen to eminence in both scientific and intellectual attainments; but among these Lord Bacon appears covered with honour. In addition to what he actually accomplished, he seems to have taken his station on some lofty height, from whence, with eagle eye, he pierced the surrounding gloom, and caught a glimpse sufficiently clear to direct those who followed him to the regions of experimental philosophy, which have since been traversed with such memorable results.

On moral philosophy his works are truly valuable. His Essays, the most popular of them, may be soon perused; yet, after repeated readings, something unobserved before will ordinarily strike the mind. This, indeed, has been pointed out as a characteristic of all his writings, and one only to be accounted for by the inexhaustible aliment they furnish to our own thoughts, and the sympathetic activity they give to our torpid faculties. The object of his "Georgics of the Mind" is to show the importance of education, and to suggest rules for the development and improvement of the mental character.

Bacon must have been a forensic orator, too, of extraordinary power. Ben Jonson, who was peculiarly qualified to form a competent judgment, says—"There happened in my time one noble speaker, who was full of gravity in his speaking. No man ever spoke more neatly, more pressly, more weightily, or suffered less emptiness, less idleness in what he uttered. No member of his speech but consisted of its own graces. His hearers could not cough, or look aside from him without loss. He commanded when he spoke, and had his judges angry and pleased at his devotion. The fear of every man that heard him was, that he should make an end." No finer description of this art is to be found in any author, ancient or modern.

A distinguished contemporary of Lord Bacon was Sir Edward Coke, well known by his valuable legal Commentaries, particularly those on Magna Charta, and on the works of Littleton. So remarkable were the serenity and fortitude with which he endured reverses, that James I. was accustomed to say of him, "that it was impossible to hurt him, for he always fell on his feet."

It should here be observed, that the philosophical writings of Lord Bacon did not at once produce the important results that might have been anticipated. No new and more enlightened school of philosophy arose as the product of his mighty genius. He had thrown down barriers which had obstructed for ages the progress of knowledge; but few, as yet, were disposed to avail themselves of the opened territory. After his death, however, the records of science began to assume a brighter aspect; and we discover true knowledge emerging from the dungeons of scholastic controversy, and shaking off the shackles of polemical learning.

Physiology was about this time disencumbered of an oppressive mass of error by the genius of Harvey. The honour of the first attempts in anatomy, as in most of the sciences, to cast off the thraldom of the ancients is, however, due to Italy. The great reformer there was Vesalius, whose work on the human system, published at Basle in 1543, began entirely a new era in that department of knowledge.

The despotic sway hitherto maintained in the schools of medicine by the writings of Aristotle and Galen, was now shaken to its foundation, and a new race of anatomists eagerly advanced in the path of discovery. Of the last of the distinguished men who flourished at Padua in the sixteenth century Harvey became a pupil; and the first germ of the discovery which has shed immortal honour on his name and his country arose in the lecture-room of his master. From some scattered hints in his writings, it appears that his doctrine of the circulation of the blood was first advanced in his lectures at the College of Physicians, about the year 1619; and a note-book, in his own hand-writing, is still preserved at the British Museum, in which the principal arguments by which it is substantiated are briefly set down, as if for reference in the lecture-room. Yet, with the characteristic caution and modesty of true genius, he continued for nine years longer to reason and make experiments on what is now considered one of the simplest, as it is undoubtedly the most important, known law of animal nature; and it was not till the year 1628, the fifty-first of his life, that he consented to publish his discovery to the world.

The doctrine thus announced may be briefly stated as follows. When the blood supplied for the various processes carried on in the human frame has undergone a certain change, it requires to be purified by respiration; hence it is urged onwards by fresh blood from behind into the veins;

and returning in them from all parts of the body, enters a cavity of the heart called the *right auricle,* while the purified blood, returning from the lungs by the pulmonary veins, passes into the *left auricle.* When these two *distinct* cavities are sufficiently dilated, they contract, and force the blood which they contain into two other much more muscular cavities, called, respectively, the right and left *ventricle;* all passing backwards into the auricles being prevented by *valves,* which admit of a passage in one direction only. The ventricles then contract in their turn with great force, and at the same instant, and propel their blood—the right, by the pulmonary artery into the lungs; the left, which is much the stronger of the two, into all parts of the body, by the great artery called the *aorta,* and its branches; all return being prevented as before by valves situated at the orifices of those vessels, which are closed most accurately when the ventricles relax, by the backward pressure of the blood, arising from the elasticity of the arteries. Thus the purified blood passes from the lungs by the pulmonary veins through the left auricle into the ventricle of the same side, by which it is distributed into all parts of the body, driving the vitiated blood before it; and the vitiated blood is pushed into and along the veins to the right auricle, and thence is sent into the right ventricle, which propels it by the pulmonary artery through the lungs. In this manner a double circulation is kept up by the sole agency of the heart, through the lungs and through the body; the contractions of the auricles and ventricles taking place alternately. To prevent any backward motion of the blood in the superficial veins, which might happen from their liability to external pressure, they are also provided with simple and very complete valves, which admit of a pressure only towards the heart. They were first remarked by Fabricius ab Aquapendenté, and exhibited in his lectures to Harvey among the rest of his pupils; but their function remained a mystery till it was unravelled by the discovery of the circulation. The first idea of this comprehensive principle suggested itself to him when considering the structure of these valves.

Another noble discovery was that of logarithms; a discovery which, by its abridgment of numerical calculation, has rendered the most important service to science in general, but especially to that of astronomy. To measure the distances of the heavenly bodies, and to pursue other lengthened and complicated inquiries by common arithmetic, had become exceedingly burdensome to the mathematicians and astronomers of Europe; but this discovery by Baron Napier, of Marchiston, in Scotland, rendered the process comparatively easy.

The following is an illustration from the pen of Lord Brougham:—

"Take a set of numbers, going on by equal differences; that is to say, the third being as much greater than the second, as the second is greater than the first; thus, 1, 2, 3, 4, 5, 6, and so on, in which the common difference is 1; then take another set of numbers, such that each is equal to twice or three times the one before it, or any number of times the one before it; thus, 2, 4, 8, 16, 32, 64, 128; write this second set of numbers under the first, or side by side, so that the numbers shall stand opposite to one another, thus—

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2 | 4 | 8 | 16 | 32 | 64 | 128· |

You will find, that if you add together any two of the upper or first set, and go to the number opposite their sum in the lower or second set, you will have in this last set, the number arising from multiplying together the numbers of the lower set corresponding to the numbers added together. Thus, add 2 to 4, you have 6 in the upper set, opposite to which in the lower set is 64, and multiplying the numbers 4 and 16 opposite to 2 and 4, the product is 64. In like manner, if you subtract the upper numbers, and look for the lower numbers opposite to their difference, you obtain the quotient of the lower numbers opposite the number subtracted. Thus, take 4 from 6 and 2 remain, opposite to which you have in the lower line 4; and if you divide 64, the number opposite to 6, by 16, the number opposite to 4, the quotient is 4. The upper set are called the *logarithms* of the lower set, which are called *natural numbers:* and tables may, with a little trouble, be constructed, giving the logarithms of all numbers from 1 to 10,000 and more; so that, instead of multiplying, or dividing one number by another, you have only to add or subtract their logarithms, and then you at once find the product or the quotient in the tables. These are made applicable to numbers far higher than any actually in them, by a very simple process; so that you may at once perceive the prodigious saving of time and labour which is thus made. If you had, for instance, to multiply 7,543,283 by itself, and that product again by the original number, you would have to multiply a number of seven places of figures by an equally large number, and then a number of 14 places of figures by one of seven places, till at last you had a product of 21 places of figures—a very tedious operation; but working by logarithms, you would only have to take three times the logarithm of the original number, and that gives the logarithm of the last product of 21 places of figures, without any further multiplication. So much for the time and trouble saved, which is still greater in questions of division; but by means of logarithms many questions can be worked, and of the most important kind, which no time or labour would otherwise enable us to solve."

While Napier was pursuing a new track in scientific philosophy, Harriott, an English algebraist and astronomer, was no less diligently employed in advancing his favourite sciences. Following up the suggestions of Vieta and Girard,* he arrived at

* Note L.

important results which they had not anticipated, and discovered truths to which they had only approximated. To him two important improvements in algebra are attributed.*

The science of Electricity belongs exclusively to modern times. Pliny speaks indeed of the attracting quality of amber, and later naturalists noticed this property; but the ancients had no conception of the nature or extent of electric attraction, or of the remarkable phenomena to which it gives birth. Gilbert of Colchester, physician to Queen Elizabeth, was the first who made any actual advances to the discovery of this science. To him we owe a great augmentation of the list of electrical bodies, as also of the bodies on which electrics can act; and he also carefully noted several capital circumstances as to the manner of their action, though his theory of electricity was, as might be expected, very imperfect. "Gilbert," says Priestley, "may justly be called the father of modern electricity, though it be true that he left his child in its very infancy."

The kindred science of Magnetism also made some advance. The needle was judged to turn nearly towards the north; but Columbus, in his first voyage, found it to decline from the meridian as he advanced on the Atlantic; and this apparent change of the laws of nature occurred under circumstances which would have appalled a less determined commander. The variation of the

* Note M.

compass was also distinctly noted in the year 1500 by Cabot, a celebrated British navigator. Magnetism made little further progress, till Gilbert explored the subject by a course of patient and skilful investigation. To this eminent philosopher we are indebted for the discovery of the few connecting principles. Every magnet, whether natural or artificial, has its powers concentrated in two opposite points, termed the north and south poles; and the similar poles of separate magnets repel each other, while their dissimilar poles exert a mutual attraction. When a piece of soft iron is approximated to a magnet it becomes itself a magnet, the nearest end assuming an opposite polarity, and therefore being constantly attracted. If a long iron bar be held in a position nearly vertical, its lower extremity is always found to manifest the properties of a north pole; and from this induced power, Gilbert legitimately inferred the magnetism of our globe. He likewise imitated its structure, and hence illustrated the *declination* of the needle as well as its *dip*, or the position which it takes when, after being poised freely on its centre of gravity, it receives the magnetic virtue, a property which had been first noticed by his countryman Robert Norman, in 1576.

A few words must now be given to the Fine Arts. From the earliest times it seems to have been the custom, both with the Court and the Prelacy, to send for foreigners either from Italy or the Low Countries, to execute any important pictorial decoration. No labour or expense was spared to obtain the most beautiful specimens of carved images for the use of the cathedrals and parochial churches; and the windows were filled with the legendary tales of the Romish Church, exquisitely painted, and thus exciting the admiration and inflaming the passions of the superstitious devotees. A host of foreigners was consequently introduced, with whom it was difficult for the homeliness of native skill to maintain a struggle. The workmen and inferior artists employed in the more mechanical part of the works entrusted to painters whose names are well known, appear also to have been foreigners; and the art seems to have been regarded as a great mystery. It may, however, be fairly supposed that the example afforded by the labours of illustrious strangers, and the extreme admiration excited by their works, would have some effect in exciting a spirit of emulation, or at least of imitation, amongst our countrymen; and to this circumstance we are indebted for those few British artists who, though of an inferior description, are all that this country can boast of in days of yore.

The period at which the attention of the British nation was at all turned to the fine arts, was comparatively late. Like the ancient Romans, the disposition of the people seemed little calculated to relish the elegancies of life, until riches and luxury had begun to extend their influence, and soften down the austere and rugged manners of our ancestors. It happened, however, at that particular period of our history when they might have obtained a footing, and when they would probably have fixed those roots which were ready to shoot forth into luxuriance, that an event occurred which prevented such a result.

The Reformation, by banishing the pageantry and show of religion, not only suspended the labours of the artists whose chief employment it was to decorate churches, but rendered these harmless embellishments themselves odious in the eyes of the people. It is to be much regretted that the spirit thus awakened should have proved so irreparably destructive to works of taste. Luther frequently exerted his influence to stem the torrent of destruction, which the enthusiasm of some of his followers had perverted from its intended course; but his efforts were ineffectual.

The more ancient specimens of painting in England seem generally to have been heraldic, except the decorations on illuminated manuscripts, which were carried to a high degree of perfection at as early a period as that art appears to have been practised any where else. Many of these works were rendered particularly valuable from the portraits of remarkable personages, and the historical pictures which they contain.

With the exception of scriptural pieces in church windows, the early practice of painting in England seems to have been almost exclusively confined to portraits: these were disposed either in single heads or family groups crowded together, and most unfancifully arranged; they were chiefly the workmanship of foreign artists, attracted to England by the prospect of gain.

England possessed as yet no native school of art; but from the time of Henry VIII. royal patronage and example had gradually diffused a taste for painting among the nobility. Elizabeth possessed a considerable number of pictures; there still exists at Knowle a collection of portraits believed to have been formed by Lord Buckhurst; and artists from Holland and Flanders frequently visited the country as portrait painters, and found abundant encouragement.

Isaac Oliver is the first British artist on record of whom it is safe to speak with any degree of commendation; and whencesoever his family was derived,—for this is a disputed matter,—he at least, was certainly born on our soil. His province was portrait painting in miniature, many specimens of which are still preserved.

It has been thought that the sculptures which adorn the cathedral of Wells, consisting of subjects from the Scriptures, and some statues larger than life, of our early kings and queens, and exhibiting much simplicity, beauty, and grace, were by native artists. It appears, too, that much of the sculpture of the period when Henry VII. built his beautiful chapel in Westminster Abbey, was executed by them. Yet sculpture seems to have been much neglected; indeed works of art were purposely and wantonly destroyed; but from those that remain, it seems that from the year 1200 even to the time of the monarch last named, we have works of sculpture, not only executed in England, but certainly in many very important instances by Englishmen.

Music was highly fashionable, and practised both by men and women of the first rank. A set of very difficult lessons for the Virginals, composed expressly for the use of Queen Elizabeth, attests her proficiency; and a viol de gamba was seen not only hanging up in every fashionable house, but even in the barbers' shops, to occupy the leisure moments of the guests. Several English composers, as well as performers, attained to high celebrity among their contemporaries; but Italy was then honoured, as it is still, as the great mistress of the art.

THE

# AGE OF SCIENCE.

## THE AGE OF SCIENCE.

A.D. 1644—1730.

" One of the greatest benefits," says Sir H. Davy, " conferred by experimental sciences is, that they have given the true progression to the mind; they have appeared as a work begun, but not perfected. There is no spirit or feeling of imitation in them, which uniformly cramps the best energies of the mind, but one desire for extending them; and *discovery* is the great motive to exertion; it is the highest stimulus to inquiry; and the title of *discoverer* is the most honourable that can be bestowed on a scientific man."

This high distinction has several claimants at the period of our history about to be considered. It was now that the physical properties of the atmosphere began to attract notice, and perhaps the most striking illustration that can be given of the strange manner in which important truths may sometimes be concealed for a long while from observation, even after science has approached almost so near as to touch them, is to be found in the history of the different discoveries relating to this subject. The knowledge of the positive weight, or gravity of air, is as old as the days of Aristotle; and the common pump is also a very ancient invention: its effect depending, as it does entirely, on the pressure of the atmosphere, *might* have suggested, it may be thought, the true philosophy of that subject to some one of its innumerable observers. Yet, although the air was known to be a really heavy body, no one for two thousand years found out the true reason why, on its removal from the barrel of a pump by the elevation of the piston, the water rose into the vacant space. The unlearned multitude attributed the phenomenon to *suction*, or a power of sucking in the pump, and gave it the name of the suction-pump accordingly.

The theory of the philosophers was, however, still more irrational than that of the multitude, only that, professing to rest on one of the great laws of nature, it looked somewhat more solemn and imposing. The water rises in the pump, it was said, on the removal of the air, because *nature abhors a vacuum;* and thus the matter rested for nearly twenty centuries; the alleged abhorrence of nature for a vacuum having never been established by experiment or reasoning, but at the same time being always so gravely asserted as a universal truth, that it never was questioned.

The illustrious Galileo himself, unquestionably one of the greatest men that ever lived, even after advancing to the very confines of all we now know, stopped there, and could find nothing better to offer than the old solution of the difficulty, in a case attended with circumstances which to us would seem to have made the necessity for abandoning it obvious. A pump of more than thirty-two feet in height having chanced to be erected at Florence while Galileo resided in that city, the philosopher finding that the water would not rise as usual to its top, set himself immediately to endeavour to account for the unexpected phenomenon; and after examining the case came to the conclusion, that nature certainly abhorred a vacuum, *but for the first two and thirty feet only*.

It was Torricelli, the pupil of Galileo, who first demonstrated the true cause of the phenomenon, by a most happily imagined experiment. The water rising, as it does, only to a certain height, must, in fact, he remarked, not be drawn, but pushed up into the barrel of the pump; and it can only be so pushed by the pressure of the atmosphere on the exposed portion of it. The thirty-two feet of water in the body of the pump are merely a counter-balance to a column of air of equal basis, reaching to the top of the atmosphere; but if so, it then occurred to him, that another liquid, heavier or lighter than water, will in similar circumstances ascend in proportion to a less or a greater height, a less or greater quantity of it being, of course, required to balance the atmospheric column. Mercury, for example, is about thirteen times and a half as heavy as water; it ought to mount, therefore, only to the height of about twenty-eight inches instead of thirty-two feet. Taking, therefore, a glass tube of about three feet in length, and hermetically sealed, (that is, made air-tight,) at one end, he first filled it completely with mercury, and then closing it with his finger reversed it, and plunged it into a basin of the same liquid metal, when, withdrawing his finger, he had the gratification of seeing the liquid in the tube, now forming one body with that in the basin, descend, until, exactly as he had anticipated, there remained suspended a column of twenty-eight inches only.

Thus ascertaining the comparative density of air and mercury, which he found to be in the proportion of one to nearly fourteen, he discovered, by repeated experiments, that mercury would not naturally rise more than one fourteenth part of thirty-two feet above its level. The conclusion was obvious—that the same cause, whatever it might be, must operate in both cases; and the solution of the phenomenon which immediately occurred to this ingenious philosopher was, that the weight of the column of fluid in each case prevented its higher elevation, and that there was some other force which then held it in equilibrio. What could this be but the weight of the atmospheric air resting on the surface of the fluid? From these previous facts he was led to infer, that the weight of a column of water thirty-two feet high, or of quicksilver fourteen times less, is equal to a column of atmospheric air reaching from the earth's surface to the upper extremity of that fluid: thus not only proving the weight and pressure of air, but furnishing a rule by which its comparative density may be estimated.

Still the Toricellian experiment was for some time insufficient to convince many of the philosophers of that day of the weight of air. They preferred the most absurd and ridiculous explanations of the phenomenon of the sustained column to the simple and obvious cause that had been assigned; but, happily, there were others who could rise above the prejudices of early impressions, and hail the discovery as a most important step in the progress of the physical sciences.

Mersenne received an account of the experiment and deduction from it in 1644, and immediately communicated the news to the philosophers of France, where it was soon repeated in various ways: this gave rise to an ingenious treatise on the subject by Pascal. Having, after some hesitation, adopted Torricelli's idea, he devised several experiments for its confirmation. One was to make a vacuum above the reservoir of quicksilver, in which case he found that it sunk to the common level; and he then engaged M. Perrier, his brother-in-law, to execute a famous experiment, by causing a barometer, constructed according to the directions of Torricelli, to be conveyed to the summit of the Puy de Dome, when it was found that the height of the quicksilver, half way up the mountain, was considerably less than at the foot of it, and that at the top it had fallen some inches. These facts proved incontestably that it was the weight of the atmosphere which counterpoised the mercury in the tube and the water in the pump;

and all further opposition to the doctrine by the supporters of the old hypothesis fell harmlessly to the ground. In these circumstances, therefore, originated the weather-glass and the instrument called the mountain barometer, by which the heights of eminences may be correctly ascertained.*

It should be added, to the honour of Torricelli, that, so far from being elated with his success in having made so curious and important a discovery, he expressed the deepest regret that it had not fallen to the lot of his beloved preceptor, Galileo, to direct the first development of this great physical fact of the gravity of air.

The thermometer, though invented half a century earlier than the barometer, was yet more than another half century in arriving at perfection. Hero, a mechanical philosopher, who flourished at Alexandria about 130 years before Christ, has described a sort of huge weather-glass, in which water was made to rise and fall by the vicissitudes of day and night, or rather the changes of heat and cold. This machine had for ages been overlooked, or merely considered in the light of a curious contrivance; but Sanctorio, a very learned and ingenious Italian physician, who had laboured to improve his art by the application of experimental science, reduced the hydraulic machine of Hero to a more compendious form, and thus constructed, about the close of the sixteenth century, the instrument since

* Note N.

known by the name of the air-thermometer, which he employed with obvious advantage to examine the heat of the human body in fevers.

It may here be remarked, however, that the capital improvement in the thermometer was made in 1724, by Fahrenheit, who took another standard point, from the boiling of water under the mean pressure of the atmosphere. For many years that ingenious artist manufactured thermometers in Amsterdam on correct principles, very neat and small, adapted especially to medical purposes. The multitude of young physicians, who at that period studied in Holland, quickly dispersed them to every part of the globe; and the observations thus obtained gave juster ideas of the comparative temperatures of different climates. It thence appeared that the heat of the torrid zone was not so excessive, nor the cold of the arctic regions so intense as had been commonly represented. The tropical plants could, therefore, enjoy in our hot-houses all the warmth of their native land. The thermometer was first applied to direct the operations of horticulture; it was afterwards extended to regulate the process of brewing, and other arts more immediately depending on practical chemistry; and it is now the general standard of heat.

The invention of the barometer, and the proof thus afforded of the gravity and pressure of the air, led to new efforts, and among them to attempts to remove more fully the atmospheric pressure, and to produce a more perfect vacuum. Hydraulic engines were, in consequence, constructed for raising water to any degree of height, and for increasing the velocity of its motion. No invention of this time, however, contributed more effectually to promote science than that of the air-pump; the honour of which belongs to Otto Guerické, a counsellor of Magdeburgh. He filled a barrel with water, from which he drew part of the fluid by a common sucking-pump; but the weight of the external air soon burst the vessel with a violent explosion, thus proving the weight of air as fully by his failure as he could have done by his complete success. With this awkward and imperfect air-pump he performed several remarkable experiments. One of these is often exhibited in the present day. It consists in exhausting a hollow brass globe, composed of two parts, or hemispheres, closely fitted to each other; and when a portion of the interior air is removed, the pressure of the exterior atmosphere is such as to resist considerable force applied to separate the hemispheres. At length he constructed a rude machine, to which was affixed a glass globe, which, resisting the pressure of the air, enabled him to accomplish his object. He now discovered the elasticity of air, and proceeded in the improvement of his apparatus.

The path thus opened was trodden by many philosophers; and though no description of the Magdeburgh instrument was given to the world, our countryman, the Honourable Robert Boyle, constructed an air-pump on a plan of his own, and may be styled the second inventor of that machine. It was afterwards greatly improved by himself and his friends; but it remained for Newton, and other celebrated mathematicians of his age, to refute the popular theory—that all space is filled with matter either in a solid or fluid state; and to carry forward further inquiries. Boyle has left voluminous proofs of his attachment to scientific pursuits; but the benefits he conferred by his labours in this way were rather indirect than otherwise. He exhibited a variety of experiments in public which kindled the zeal of others of still greater ability. The merit of bringing the celebrated Hooke before the public, and of pointing out to him the road to eminence, is chiefly due to this truly excellent man. Hooke performed, in conjunction with him, by means of the instrument just mentioned, a variety of new and important experiments, illustrative of the mechanical properties of the atmosphere, which afterwards tended considerably to the progress of pneumatic chemistry.

One circumstance promised much for science; for immediately after the Restoration, some gentlemen, who had formed a Philosophical Society at Oxford, which in its infancy owed much to the protection of Oliver Cromwell, adjourned to London, where they held their meetings at Gresham College, and considerably extended the number of their members. The King countenanced and patronized their proceedings, and on the 15th of July, 1662, granted a royal charter, constituting them a body corporate.

under the name of the "Royal Society of London, for promoting National Knowledge." In the year 1665 was published the first number of the Philosophical Transactions, of which work, regarded as the standard of English science, a volume has been published annually since the year 1762.

An important impulse was given to science by the invention of the telescope. Galileo, when on a visit to Venice, heard that a Dutchman, of the name of Jansen, had constructed and presented to Prince Maurice, an instrument through which he saw distant objects magnified and rendered as distinct as if they had been brought nearer to the observer. The idea instantly filled his mind as one of the utmost moment to science; and so thoroughly was he acquainted with the properties of lenses, that he not only discovered the principle of its construction but was able to complete a telescope for his own use. Into one end of a leaden tube he fitted a spectacle glass, plane on one side, and convex on the other; and in the other end he placed another spectacle glass, concave on one side and plane on the other. He then applied his eye to the concave glass, and saw objects "pretty large, and pretty near him." They appeared three times nearer, and nine times larger in surface, than to the naked eye. He soon after made another instrument which represented objects above sixty times larger; and, sparing neither labour nor expense, he finally constructed one so excellent as "to show things almost a thousand times larger, and above thirty times nearer to the naked eye." Galileo was the first astronomer in whose hands such a gift was placed, and to this he owed much of his future reputation.

Still, all that was effected was to exhibit the object under a much larger angle than its ordinary or natural appearance; and even in this result there was one great drawback, for the field of vision was extremely limited, and that in proportion to the increase of its magnifying powers. So strongly has this inconvenience been felt by modern astronomers, that they have frequently expressed their surprise at the numerous and wonderful discoveries Galileo was enabled to make by its means.

The next improvement in the history of the telescope quickly followed its discovery, which was suggested, but not executed, by the great Kepler. It chiefly differs from that of Galileo by being constructed with two convex lenses, instead of a convex and concave; the effect of which is, that objects are inverted, but they are also greatly magnified; they are more distinctly seen, and the field of vision is enlarged.

Kepler was either not aware of the importance of the improvement he had suggested, or his attention was drawn from it to other investigations. Certain it is, that Scheiner, availing himself of the instructions given by Kepler, constructed, after the death of that great philosopher, the first astronomical telescope, so called because of its peculiar adaptation to the survey of the heavenly bodies. But a yet more valuable service was rendered by Kepler, for he first explained the *rationale* of this important instrument, by developing the power of different lenses, and the general laws of parallel, converging, and diverging rays of light, together with the effects produced by changing the position or increasing the number of magnifying glasses.

Hitherto the only species of telescopes which had been invented was the *dioptric*, or that which depended alone on the refrangibility of light. In these, several improvements were made; but at length one more important was given to this instrument, by employing the combined influence of refraction and reflection. The first idea of a *reflecting* telescope is attributed to James Gregory, of Aberdeen, whom Playfair characterises as "a profound and inventive geometer, who wholly devoted himself to the study of optics." In a celebrated treatise, entitled "Optica Promota," this scientific philosopher discussed many questions relative to the force of lenses of various kinds; suggested valuable hints respecting the means of correcting the indistinctness of vision generally complained of in refracting telescopes; and described the reflecting telescope recently invented by himself. He was led to this invention in consequence of the great inconvenience found in the employment of spherical lenses, and the extreme difficulty of freeing them in so great a degree from the prismatic colours as to discern objects distinctly and closely. He determined, therefore, to construct a telescope into which metallic specula, or highly polished mirrors, should be introduced instead of lenses. This contrivance was peculiarly happy, not only as in itself valuable, (since it obviated the two principal objections to refracting telescopes, namely, their great length, and their indistinctness of vision,) but still more as having led to the most important invention of the *reflecting telescope*, by the illustrious Sir Isaac Newton.

It may be considered scarcely credible, yet when the telescope was invented, some individuals carried their devotion to Aristotle to so great a length, that they positively refused to look through that instrument; so averse were they to open their eyes to any truths inconsistent with their favourite creed. And a very few years after, some other followers of the Stagyrite, finding it impossible any longer to call in question the evidence of sense, asserted that it was from a passage in Aristotle—where he attempts to explain why stars become visible in the day-time when viewed from the bottom of a deep well,—that the invention of the telescope was *borrowed*. What an instance do these facts when unveiled give of that fatal weakness, which appears in connexion with the highest interests of man!

"About the time of the invention of the telescope," says Chalmers, "another instrument was formed, which laid open a scene no less wonderful, and rewarded the inquisitive spirit of man.—This was the microscope. The one leads me to see a system in every star—the other leads me to see a world in every atom. The one taught me that this mighty globe, with the whole burden of its people and its countries, is but a grain of sand on the high field of immensity; the other teaches me that every grain of sand may harbour within it the tribes and the families of a busy population. The one told me of the insignificance of the world I tread upon; the other redeems it from its insignificance—for it tells me, that in the leaves of every forest, in the flowers of every garden, and in the waters of every rivulet, there are worlds teeming with life, and numberless as are the glories of the firmament. The one has suggested to me, that beyond and above all that is visible to man there may be fields of creation, which sweep immeasurably along, and carry the impress of the Almighty's hand to the remotest scenes of the universe; the other suggests to me, that within and beneath all that minuteness which the aided eye of man has been able to explore, there may be a région of invisibles; and that, could we draw aside the mysterious curtain that hides it from our senses, we might see a theatre of as many wonders as astronomy has unfolded—a universe within the compass of a point, so small as to elude all the powers of the microscope—but where the wonder-working God finds room for the exercise of all his attributes, where he can raise another mechanism of worlds, and fill and animate them all with the evidence of his glory."

In the case of the microscope, like that of the telescope, the question of origination has been contested; some ascribing the invention to Galileo; some to Jansen and his son; and some to Cornelius Dobrell, a native of Alcmaër. Without attempting to settle the dispute, it will be sufficient to remark, that the true date of the invention is about 1618; and that the instrument was first constructed in the simplest manner. Its effect was to exhibit the object under a greater angle, and thus proportionably to increase its apparent diameter. The first great improvement suggested in this instrument, was that of the *compound* or *double* microscope, which corresponds with the astronomical telescope, since it consists of two lenses—an object and an eye-glass;—the former of which magnifies what is beheld, while the latter brings it nearer to the power of vision.

The facilities afforded to scientific men employed in optical researches, by the invention of these instruments, which have enabled man to approach the nearest to the construction of a new organ of sense, induced almost every distinguished philosopher of that age to direct his attention to this interesting department of human knowledge. Huygens, for instance, entered with great ardour into this study, happily combining a high degree of scientific with practical knowledge. Grimaldi, a distinguished member of the Academy Del Cimento, discovered also a property of light which had escaped the observation of all previous philosophers, to which was primarily given the name of *diffraction*, but which has since been designated the *inflection* of light. This term expresses that motion of rays of light which is perceived when they approach within a small distance of another body, and which, instead of proceeding according to the laws of optics, in a right line, are *deflected*, or caused to bend either towards or from the object, thus producing a kind of imperfect reflection or refraction. About six years after, Hooke, moreover, announced the same discovery as the result of his own observations, and apparently without any consciousness of its having been previously known.

Most interesting and important indeed is that element, the properties of which, together with the laws of vision, now obtained such marked attention. To employ the beautiful language of Sir David Brewster: "If the objects of the material world had been illuminated with white light, all the particles of which possessed the same degree of refrangibility, and were equally acted upon by the bodies on which they fall, all nature would have shone with a leaden hue; and all the combinations of external objects, and all the features of the human countenance, would have exhibited no other variety but that which they possess in a pencil sketch or a China-ink drawing. The rainbow itself would have dwindled into a narrow arch of white light,—the stars would have shone through a grey sky,—and the mantle of a wintry twilight would have replaced the golden vesture of the rising and the setting sun. But He, who has exhibited such matchless skill in the organization of material bodies, and such exquisite taste in the forms upon which they are modelled, has superadded that ethereal beauty which enhances their more permanent qualities, and presents them to us in the ever-varying colours of the spectrum. Without this, the foliage of vegetable life might have filled the eye and fostered the fruit which it veils,—but the youthful green of its spring would have been blended with the dying yellow of its autumn. Without this, the diamond might have displayed to science the beauty of its forms, and yielded to the arts its adamantine virtues; but it would have ceased to shine in the chaplet of beauty, and to sparkle in the diadem of princes. Without this, the human countenance might have expressed all the sympathies of the heart, but the 'purple light of love' would not have risen on the cheek, nor the hectic flush been the herald of its decay."

The experiments and inquiries of Newton on this subject began in 1666, and soon made a vast addition both to the extent and importance of the science. He was at that time little more than twenty-three years old; he had already made some of the greatest and most original discoveries in the pure mathematics; and the same young man, who is admired as the most profound and inventive of geometers, thus appears also, at the same moment, as the most patient, faithful, and sagacious interpreter of nature. Such a combination in early life, and in so high a degree, was hitherto without example.

Other labourers had, however, been employed on the same field of observation and experiment. Descartes had explained the theory, and exerted himself in perfecting the construction of the common refracting telescope; and Huygens had not only executed the magnificent instruments by which he discovered the ring and satellites of Saturn, but had begun those splendid researches respecting the nature of light and the phenomena of double refraction, which have led his successors to such brilliant discoveries. Newton therefore arose when the science of light was ready for some great accession, and at the precise period when he could continue the impulse it had received from his illustrious predecessors.

In hopes of improving the telescope, by giving the glasses a figure different from the spherical, he procured a glass prism, in order to try with it the celebrated phenomena of colours. These trials led to very important results. For, having admitted a beam of light into a dark chamber, through a hole in the window-shutter, and made it fall on the prism, so placed as to cast it on the opposite wall, he was delighted to observe the brilliant colouring of the sun's image, and not less surprised to observe its figure, which, instead of being circular as he expected, was about five times as long as it was broad, so as to have the shape of a parallelogram, rounded at the two ends.

Reflecting on these appearances, he could find nothing to explain the elongation of the image, but the supposition that some of the rays of light, in passing through the prism, were more refracted than others; so that those which were parallel when they fell on the prism, diverged from one another after refraction; the rays that differed in refrangibility differing also in colour. The spectrum, or solar image, would thus consist of a series of circular images; partly covering one another, and partly projecting one beyond another, from the red, or least refrangible rays, in succession, to the orange, yellow, green, blue, indigo, and violet, the most refrangible of all.

Applying the facts he had collected to the rainbow, he gathered thence the most convincing demonstrations of his hypothesis relative to the cause of the prismatic colours. To him belongs the honour of having proved, that the iris is but a magnificent prism produced by natural causes; since, in comparing its colours with those exhibited by the prism, it was found that they are precisely the same, and in the same order. "Newton showed," says Playfair, "the truth of his principles, by calculating the extent of the arch described in the heavens—the breadth of the coloured bow—its distance from the primary—and by explaining the inversion of colours. There is not, perhaps in the whole range of science, any instance of happier application of theory, or one on which the mind rests with fuller confidence."

Akenside has noticed the additional charms which physical science lends even to the beauties of nature, and illustrated it by an example peculiarly happy,—the redoubled delight which he himself experienced, when he first looked at the rainbow, after studying the Newtonian theory of light and colours:

> "Nor ever yet
> The melting rainbow's vermeil-tinctured hues,
> To me have shone so pleasing, as when first
> The hand of Science pointed out the path
> In which the sun-beams, gleaming from the west,
> Fall on the wat'ry cloud, whose darksome veil
> Involves the orient."

The gay colouring with which the Almighty has decked the pale marble of nature, is not the result of any quality inherent in the coloured body, or in the particles by which it may be tinged, but is merely a property of the light in which they happen to be placed. Newton was the first person who untwisted all the shining robe of day, and sustained this great truth by the clearest evidence. He found that all bodies, whatever were their peculiar colours, exhibited these colours only in white light. When they were illuminated by homogeneous *red* light, they appeared *red;* by homogeneous *yellow* light, *yellow*—and so on; their colours being most brisk and vivid under the influence of their own day-light colours. The leaf of a plant, for example, appeared *green* in the white light of day, because it had the property of reflecting that light in greater abundance than any other. When it was placed in homogeneous *red* light, it could no longer appear *green*, because there was no green light to reflect;

but it reflected a portion of red light, because there was some red in the compound green which it had the property of reflecting. Had the leaf originally reflected a pure homogeneous green, unmixed with red, and reflected no white light from its outer surface, it would have appeared quite black in pure homogeneous red light, as this light does not contain a single ray which the leaf was capable of reflecting. Hence the colours of material bodies are owing to the property which they possess of stopping certain rays of white light, while they reflect or transmit to the eye the rest of the rays of which white light is composed.

So far the Newtonian doctrine of colours is capable of rigid demonstration. But its author was not content with carrying it thus far. He sought to determine the manner in which particular rays are stopped, while others are reflected or transmitted; and the result of this profound enquiry was his theory of the colours of natural bodies. It bears the deepest impress of the grasp of his powerful intellect, but it stands on a perishable basis, and must soon be swept away in the progress of science.

It is unnecessary to follow this illustrious philosopher through his subsequent enquiries in optical science; but it must be mentioned that from some of these results he concluded, that every ray of light has two opposite sides, originally endued with the property on which an unusual refraction depends, and other two opposite sides, not endued with that property; and he suggested it as a subject for future enquiry, whether there are not more properties of light by which the sides of the rays differ, and are distinguished from one another. This is the first occasion on which the idea of a *polarity* in the rays of light has been suggested; and in the twenty-ninth query at the end of his Optics, he compares the sides of a ray with the poles of a magnet.

Applying his discoveries, he found that if the object-glass of a telescope be directed to the sun, and an eye-glass be employed through which the eye sees its image or picture, there will be a distinct yellow image, with indistinct images of all the other colours, producing great confusion and indistinctness of vision. He therefore immediately abandoned his attempts to improve the refracting telescope, and took into consideration the principles of reflection; and as he found that rays of all colours were reflected regularly, so that the angle of reflection was equal to the angle of incidence, he considered that, on this principle, optical instruments might be brought to any degree of perfection imaginable, provided a reflecting substance could be found, which could be polished as finely as glass, and reflect as much light as glass transmits; and provided a method of giving it a parabolic figure could be obtained. These difficulties appeared to him however very great and even insuperable.

But, about two years after, he actually executed a telescope with his own hands. It was six inches long; it magnified about forty times, which was more than any six feet refracting telescope could do with distinctness. Yet on account of the badness of the materials and the want of a good polish, it represented objects less distinct than a six feet tube, though he thought it would still be equal to a three or four feet tube directed to common objects. He had seen through it distinctly Jupiter and his four satellites, and also the horns or moon-like phases of Venus, though this last phenomenon required some niceness in adjusting the instrument.

Newton considered this little instrument as in itself contemptible, yet he regarded it as an "epitome of what might be done." Inspired with fresh zeal by his success, he applied himself, variously and fully engaged as he was, to the laborious operation of executing another reflecting telescope, with his own hands. This instrument, which was better than the first, excited some interest at Cambridge, was shown to the King and some of the most eminent philosophers of the time, and is carefully preserved in the library of the Royal Society of London, bearing the following inscription:—"Invented by Sir Isaac Newton, and made with his own hands, 1671." It appears he afterwards repolished and greatly improved a fourteen feet object-glass, executed by a London artist, and he recommended the consideration of such telescopes "to the curious in figuring glasses."

It was in the science of astronomy, however, that he obtained his noblest honours. Yet let it not be supposed that he secured them unaided and alone. In folly or in crime man often takes the start of his species, but the achievements of intellect, though begun by one mind, require ordinarily to be advanced by others, and are the results of combined exertions. So it has been, for example, with astronomy, the origin of which is hidden from us in the most remote ages of antiquity. Man became an observer as soon as he turned his eyes to the heavens; and successive observations, gradually increasing in accuracy, and handed down by tradition from age to age, have been the basis of the information we now possess. But even the embryo of that accuracy of knowledge, and of that exactness of observation, which are the pride of modern astronomy, cannot be traced to a remote period. The methods and instruments of observation, were long rude and imperfect, and the means of calculation were laborious and difficult. If then, we are to look to the earliest ages of man's history for the rise of this science, we are to seek for the origin of all that is valuable in theory as late as the sixteenth century; and for all that is correct and definite in knowledge to the celebrated and immortal names that have embellished the eighteenth of our era.

The visions of fanciful writers have discovered, in the astronomy of the Greeks, whence we derive the little that can be called valuable, that has come down to us from the ancients, the fragments and imperfect remains of a more complete system, existing in some more civilized and remote nation. From this fancied people they conceive, that not only did the Greeks derive what they knew of astronomy, but that it was the common source of that of the Hindoos and Chinese. Delambre, in his works, the histories of the Astronomy of the ancients, and of the Middle Age, has effectually dispersed this splendid vision. He has in them conclusively shown, that the astronomy of Ptolemy is, in fact, that of the Asiatic nations, who, so far from giving any thing to the Greeks, or from having drawn with them from a common spring of knowledge, are in truth their scholars and imitators. Wherever, indeed, we apply the test of real science to these systems of astronomy and methods of calculation, which pretend to so lofty and remote an origin, we find at every step the traces of Ptolemy and Hipparchus; their astronomy is not only the concentration of the discoveries of the Greeks, but the basis of that of the Arabs, the Persians, the Tartars, the Hindoos, and the Chinese, as well as of that known by the Europeans previous to the time of Copernicus.

In all these systems, we find the Earth placed as immovable in the centre of the universe, and of all the planetary motions. By means of improbable hypotheses, all these nations are enabled, in the words of Ptolemy, "to save the appearances." They all are able to predict phenomena, and the position of bodies, within a few degrees of the truth, and appear never to have discovered these hypotheses to be erroneous, or at least, to have suspected that the mistake arose from a fundamental defect in the system itself.

In ages more remote than those of Ptolemy, we are told, that some Grecian philosophers placed fire in the centre of the universe, and made the Earth turn round the Sun in the space of a year, and on its own axis in twenty-four hours. Others, less bold, had ascribed to the Earth only the latter of the two motions, and left to the Sun his annual motion. But we find these ideas in no work on astronomy, nor in the pages of any geometer. Ptolemy hardly deigns to notice them; he intimates indeed, that, to ascribe to the Earth a motion of rotation, would facilitate the explanation of some phenomena; but all the rest appeared to him too absurd to merit a serious refutation.

The founder of modern astronomy was Copernicus, a native of Thorn in Prussia, who had previously made many astronomical observations, and continued them in peaceful seclusion when appointed to a canonry in the chapter of Frauenberg. During his residence at Rome his talents had been so well appreciated, that the bishop of Fossombrona, who presided over the council for reforming the calendar, solicited the aid of Copernicus in this desirable undertaking. At first he entered warmly into the views of the council, and charged himself with the determination of the length of the year and of the month, and of the other motions of the Sun and Moon that seemed to be required, but he found the task too irksome, and probably felt that it would interfere with those interesting discoveries which had already begun to dawn on his mind.

On him the idea had long operated that simplicity and harmony should characterise the arrangements of the planetary system, and in the complication and disorder which reigned in the hypotheses of Ptolemy, he saw insuperable objections to its being regarded as a representation of nature. In the opinions of the Egyptian sages, in those of Pythagoras and others, he recognised his own earliest conviction that *the earth was not the centre of the universe,* but he appears to have considered it as still possible that our globe might perform some function in the system more important than that of the other planets; and his attention was much occupied with the speculation of Martianus Capella, who placed the Sun between Mars and the Moon, and made Mercury and Venus revolve round him as a centre; and with the system of Apollonius Pergæus, who made all the planets revolve round the Sun, while the Sun and Moon were carried round the Earth in the centre of the universe. The examination, however, of these hypotheses gradually dispelled the difficulties with which the subject was beset, and after the labours of more than thirty years, he was permitted to see the true system of the heavens. The Sun he considered as immovable in the centre of the system, while the Earth revolved between the orbits of Venus and Mars, and produced by its rotation about its axis all the diurnal phenomena of the celestial sphere. The precession of the equinoxes was thus referred to a slight motion of the Earth's axis, and the stations and retrogradations of the planets were the necessary consequence of their own motions combined with that of the Earth about the Sun. These remarkable views were supported by numerous astronomical observations; and in 1530 Copernicus brought to a close his immortal work on the Revolutions of the Heavenly Bodies.

Hearing of the labours of this distinguished astronomer, George Rheticus, professor of mathematics at Wirtemberg, resigned his chair, and repaired to Frauenberg, to make himself master of such important discoveries. This zealous disciple prevailed on his master to permit the publication of his system; and they seem to have arranged a plan for giving it to the world, without alarming the vigilance of the Church, or startling the prejudices of individuals. Under the disguise of a student of mathematics, Rheticus published in 1540 an account of the manuscript volume of Copernicus, which was received without any disapprobation, and he was afterwards encouraged to reprint it with the name of the author. The success of these publications, and the flattering manner in which the new astronomy was received by several able writers, induced Copernicus to place his manuscript in the hands of Rheticus. It was accordingly printed at the expense of Cardinal Schenberg in 1543. Its author, however, did not live to give it a perusal. A complete copy was handed to him in his last moments, and he saw and touched it a few hours before his death. This great work was dedicated to the Pope, in order, as Copernicus himself says, that the authority of the head of the Church might silence the calumnies of individuals, who had attacked his views with arguments drawn from religion. Thus introduced, the Copernican system met with no ecclesiastical opposition, and gradually advanced, notwithstanding the ignorance and prejudices of the age.

The system imagined by Copernicus, is one of extreme beauty and simplicity. By his introduction of circular orbits, supposed by him at first to be concentric to the Sun, he suppressed at one blow all the epicycles with which Ptolemy and his followers had been compelled to load the path of their planets; the phenomena of stations and retrograde motions, become simple corollaries of the different radii of the orbits, and different rates of motion of the planets. All the parts of the system are in close connexion with each other, the mutual relations are determinate, and all the distances are commensurable. On the other hand, in the ancient system, all is incoherent and vague; each of the planets might be considered as nearer or farther, indifferently, provided the order of distances were not inverted, by bringing closest to the earth a planet of the longest zodiacal revolution.

If, however, in its general features, the system of Copernicus be thus brilliant and imposing, in its detail it was far less complete. The author lays down as an axiom, that all the motions are circular and uniform, while observation makes us acquainted with none that are not constantly varying. To account for this, Copernicus was finally compelled to give to each of his circular orbits a different centre; the sun is enclosed within all the orbits, but does not occupy the centre of any; it has no other apparent duty, but to distribute light, and appears unconnected with any of the motions. In fine, in order to reconcile the appearances with the theory, he was compelled to recur again to new epicycles, after having suppressed those of Ptolemy.

An important step was however made by him, without which a farther progress was impracticable. But if the reformation had stopped there, practical astronomy would have gained little by the change. The founder of modern astronomy was not in possession of a sufficient series of good and authentic observations; he had not the taste or fitness for long calculations. To have done all, would have required more years than fall to the lot of man, and three whole lives were employed before the task begun by Copernicus, was completed.

Among the astronomers to whom much is due, and who provided the materials of the Newtonian philosophy, the name of Tycho Brahe merits a conspicuous place. The great eclipse of the sun which happened on the 26th August, 1560, while he was at the university of Copenhagen, attracted his notice; and when he found that all its phenomena had been accurately predicted, he was seized with an irresistible passion to acquire the knowledge of a science so infallible in its results. Destined for the profession of the law, his friends discouraged the pursuit which now engrossed his thoughts, and such were the reproaches, and even persecutions to which he was exposed, that he quitted his country with the design of travelling through Germany. During his stay at Augsburg he inspired the burgomaster of the city, Peter Hainzell, with a love of astronomy. This public-spirited citizen erected an excellent observatory at his own expense; and here Tycho began that distinguished career which has placed him in the first rank of practical astronomers.

On his return to Copenhagen in 1570 he was received with every mark of respect. The king invited him to court, and persons of all ranks harassed him with their attentions. At Herritzvold, near his native place, the house of his maternal uncle afforded him a retreat from the gaieties of the capital, and he was there offered every accommodation for the prosecution of his astronomical studies. Here, however, the passion of love and the pursuits of alchemy distracted his thoughts; but though the peasant girl of whom he was enamoured was of easier attainment than the philosopher's stone, the marriage produced an open quarrel with his relations, which it required the interference of the king to allay.

In the tranquillity of domestic happiness Tycho resumed his study of the heavens, and in 1572 he enjoyed the singular good fortune of observing, through all its variations, the new star in Cassiopeia, which appeared with such extraordinary splendour as to be visible in the day-time, and which gradually disappeared in the following year.

Dissatisfied with his residence in Denmark, Tycho resolved to settle in some distant country, and having gone as far as Venice in search of a suitable residence, he at last fixed upon Bâsle, in Switzerland. The king of Denmark, however, had learned his intention from the Prince of Hesse, and when Tycho returned to Copenhagen to remove his family and his instruments, his sovereign announced to him his resolution to detain him in his kingdom. He presented him with the canonry of Rosohild, with an income of 2000 crowns per annum. To this he added a pension of 1000 crowns; and he promised to give him the island of Huen, with a complete observatory erected under his own eye. This generous offer was instantly accepted. The celebrated observatory of Uraniburg was established at the expense of about 20,000*l.*; and in this magnificent retreat Tycho continued for twenty-one years to enrich astronomy with the most valuable observations. Admiring disciples crowded to this sanctuary of the sciences to acquire the knowledge of the heavens; kings and princes too felt themselves honoured by becoming the guests of the great astronomer of the age.

When James I. went to Copenhagen, in 1590, to conclude his marriage with the Princess Anne of Denmark, he spent eight days under the roof of Tycho, at Uraniburg. As a token of his gratitude, he composed a set of Latin verses in honour of the astronomer, and left him a magnificent present at his departure. He gave him also his royal license for the publication of his works in England, and accompanied it with the following complimentary letter.

"Nor am I acquainted with these things on the relation of others, or from a mere perusal of your works, but I have seen them with my own eyes, and heard them with my own ears, in your residence at Uraniburg, during the various learned and agreeable conversations which I there held with you, which even now affect my mind to such a degree, that it is difficult to decide whether I recollect them with greater pleasure or admiration."

One of the principal discoveries of Tycho was that of the inequality of the Moon's motion, called the variation. He detected also the annual equations which affect the place of her apogee * and nodes, and he determined the greatest and the least inclinations of the lunar orbit. His observations on the planets were numerous and precise, and have formed the data of the present generalizations in astronomy. Though thus skilful in the observation of phenomena, his mind was but little suited to investigate their cause, and it was probably owing to this defect that he rejected the system of Copernicus. The vanity of giving his own name to another system was not likely to actuate a mind such as his, and it is more probable that he was led

* Note O.

to adopt the immobility of the earth, and to make the sun, with all his attendant planets, circulate round it, from the great difficulty which still presented itself by comparing the apparent diameter of the stars with the annual parallax of the earth's orbit. The death of Frederick, in 1588, proved a severe calamity to Tycho, and to the science which he cultivated. During the first years of the minority of Christian IV. the regency continued the royal patronage to the observatory of Uraniburg; and in 1592 the young king paid a visit of some days to Tycho, and left him a gold chain in token of his favour. The astronomer, however, had made himself enemies at court, and the envy of his high reputation added fresh malignity to the irritation of personal feelings. Under the ministry of Walchendorf, a name for ever odious to science, Tycho's pension was stopped;—he was in 1597 deprived of the canonry of Roschild, and was thus forced, with his wife and children, to seek an asylum in a foreign land. His friend, Henry Rantzau, of Wansbeck, under whose roof he found a hospitable shelter, was fortunately acquainted with the emperor, Rodolph II., who to his love of science added a passion for alchemy and astrology. The reputation of Tycho having already reached the imperial ear, the recommendation of Rantzau was scarcely necessary to ensure him his warmest friendship. Invited by the emperor, he repaired in 1597 to Prague, where he met with the kindest reception. A pension of 3000 crowns was immediately settled upon him, and a commodious observatory erected for his use in the vicinity of that city. Here the exiled astronomer renewed with delight his interrupted labours, and the gratitude which he cherished for the royal favour increased the satisfaction which he felt in having so unexpectedly found a resting-place for approaching age. These prospects of better days were enhanced by the good fortune of receiving two such men as Kepler and Longomontanus for his pupils; but the fallacy of human anticipation was here, as in so many other cases, strikingly displayed. Tycho was not aware of the inroads which both his labours and his disappointments had made upon his constitution. Though surrounded with affectionate friends and admiring disciples, he was still an exile in a foreign land. Though his country had been base in its ingratitude, it was yet the land which he loved,—the scene of his earliest affections,—the theatre of his scientific glory. These feelings continually preyed upon his mind, and his unsettled spirit was ever hovering among his native mountains. In this condition he was attacked with a disease of the most painful kind, and though the paroxysms of its agonies had lengthened intermissions, yet he saw that death was approaching. He implored his pupils to persevere in their scientific labours. He conversed with Kepler on some of the profoundest points of astronomy, and with these secular occupations he mingled frequent acts of piety and devotion. In this happy condition he expired without pain at the age of fifty-five, the unquestionable victim of the councils of Christian IV.

Notwithstanding the accession which astronomy had received from the labours of Copernicus and Tycho, no progress was yet made in developing the general laws of the system, and scarcely an idea had been formed of the power by which the planets were retained in their orbits. The labours of assiduous observers had supplied the materials for this purpose, and Kepler arose to lay the foundations of physical astronomy.

John Kepler was born at Wiel, in Wirtemberg, in 1571. He was educated for the church, and discharged even some of the clerical functions; but his devotion to science withdrew him from the study of theology. Having received mathematical instruction from the celebrated Mæstlinus, he had made such progress in the science, that he was invited, in 1594, to fill the mathematical chair of Gratz, in Styria. Endowed with a fertile imagination, his mind was ever intent upon subtle and ingenious speculations. In the year 1596 he published his peculiar views in a work on the Harmonies and Analogies of Nature. In this singular production, he attempts to solve what he calls the great cosmographical mystery of the admirable proportion of the planetary orbs; and by means of the six regular geometrical solids,—the cube, the sphere, the tetrahedron, the octohedron, the dodecahedron, and the icosahedron,—he endeavours to assign a reason why there are six planets, and why the dimensions of their orbits, and the time of their periodical revolutions, were such as Copernicus had found them. If a cube, for example, were inserted in a sphere, of which Saturn's orbit was one of the great circles, it would, he supposed, touch by its six planes the lesser spheres of Jupiter; and in like manner, he proposes to determine, by the aid of the other geometrical solids, the magnitude of the spheres of the other planets. A copy of this work was presented by its author to Tycho Brahe, who had been too long versed in the severe realities of observation to attach any value to such wild theories. He advised his young friend, "first to lay a solid foundation for his views by actual observation, and then, by ascending from these, to strive to reach the causes of things;" and there is reason to think that by the aid of the whole Baconian philosophy, thus compressed by anticipation into a single sentence, Kepler abandoned for a while his visionary inquiries.

Before his time astronomers paid but little attention to physical causes. This was the case even with Copernicus himself. They were content with imagining an hypothesis that might serve as the basis of their calculations. Kepler, on the other hand, was unwilling to admit any thing without a reason; and having detected an error of eight minutes in the best predictions of the positions of a planet, he set himself to investigate a theory that should be more consistent with the phenomena.

He commenced by inquiring why the number of planets was limited to six, and upon what principle the ratios of their respective distances from the sun, in the system of Copernicus, were founded. In the course of this inquiry, he detected a series to which the six planets conformed, with the exception of a single interval, where he inferred a planet was wanting. This gap has been filled by the modern discoveries; and besides, another planet has been discovered, which takes exactly the eighth place in the series of Kepler. Of this series, thus found consistent in all its parts, we yet want the physical reason.

He next sought the relations between the distances and the periodic times of the planets, and after seventeen years of labour and research, discovered the famous law, which still goes by his name, viz. that the squares of the periodic times are proportioned to the cubes of the distances. He failed in giving a mathematical demonstration of this law, which depends on a principle he did not understand; but he showed, from its coincidence with the phenomena, that it was true of the earth and the five other planets then known. This relation has been verified in the case of the five planets since discovered, and has been shown to be equally true of the satellites of Jupiter and Saturn.

The second law of the planetary motions discovered by him is, that their orbits are not circles, as had been always supposed before, but ellipses. The motions in them were therefore essentially unequal, and he thus refuted the ancient axiom, retained even by Copernicus, that ascribed to these bodies uniform circular motions. This law was at first deduced from observation alone, but he finally succeeded in demonstrating its necessity; and this demonstration, reproduced by Newton in a more rigorous form, is now universally received. By the aid of this principle, the direct calculation of elliptic motions becomes possible, but is still attended with great difficulty. These difficulties were removed by an artifice of Kepler's, who comprised the whole calculation in the determination of the elliptic from uniform circular motion, by means of three elegant and simple formulæ, sufficient for all the purposes of practical astronomy.

By these brilliant discoveries, the sun was at last brought to occupy the place Copernicus had wished to assign it, but whence, in consequence of an erroneous hypothesis in respect to the motions, he had himself been compelled to remove it. The sun cannot occupy the common centre of circular orbits, but it does a focus common to all the elliptical paths of the planets. To this point, as a centre, all the motions must be referred; from it, all the distances must be counted. The planes of these ellipses cut each other in lines passing through the centre of the sun, and all the lines of their nodes pass through the same centre.

It was in attempting to reduce all the motions to physical causes, that Kepler was led to the discovery of these fundamental laws, of which no former astronomer or mathematician had even suspected the existence. When he found that the sun really occupied the common focus and centre of motion of the system, he became aware that it must be the principal source and director of their motions. He ascribed to it a mass capable of attracting and moving all the planets. He even ventured to declare that the sun must revolve upon its own axis, and that in a space of time less than three months. He finally saw that *Universal Gravitation* must be a law of nature, and thus wanted but one step of reaching the discovery of Newton. From some inadvertence, difficult at the present moment to conceive, he inferred that this attraction must decrease in the simple ratio of the distance; and committed this error, even although he had established completely that the intensity of light diminished in the ratio of the surfaces over which it is distributed, that is to say, as the squares of the distances.

Bouillaud, a French writer on astronomy, in a work published in 1643, pointed out the mistake of Kepler, but instead of availing himself of this fortunate discovery to improve the theory, he used it as an argument against the laws of Kepler, with which, on the contrary, it is absolutely and completely consistent. Thus, for a second time, did the true law of attraction elude the grasp of astronomers; and it was not received nor appreciated until it was demonstrated by Newton.

While Kepler was thus correcting and completing the system of Copernicus, rendering it fit to form the basis of the future calculations of astronomers, and engaged in the labours of which the whole value was long unappreciated, it was, almost at the same moment, receiving elucidation in another direction, to estimate the importance and consequences of which required little more than the use of the faculty of sight. The telescope, as has been seen, was pointed by Galileo to the heavens. He speedily detected phases of the planet Venus, precisely similar to those of the moon. Copernicus, it is said, had announced that such phases were the necessary result of his system; adding, that they could not be observed, in consequence of the small apparent diameter of the planet, and the brilliancy of its light. Galileo's inference was the converse of this: from the phases he deduced that Venus revolves round the sun. On turning his instrument to Jupiter, he found that large planet to be attended by four satellites or moons, which performed around it revolutions much more rapid than those of our own moon. He here found a confirmation of the opinion, that this last named body might accompany the earth, in an annual revolution around the sun. On the disc of the sun itself, he perceived spots by whose motion he determined the rotation of that great sphere on its axis. He even saw the ring of Saturn, but his telescope had not sufficient power to exhibit it separate from the planet, and the discovery of its true character was left for Huygens. The telescope, thus fertile in the hands of the first who directed it to the heavens, has continued from that time to be the most powerful instrument of discovery.

Before the end of the sixteenth century mechanical science never went beyond the problems which treat of the equilibrium of bodies, and had been able to render these accurately, only in the cases which can be easily reduced to the lever. But Galileo caused a great revolution in the physical sciences. Among his many discoveries, one arose from attentively observing the vibrations of the lamps suspended in the cathedral of Pisa; he found in consequence, that *the vibrations of a pendulum, whether moving in a greater or less area, are performed in equal times.* A most important step was thus taken towards the accurate measurement of time. The obligation which the theory of motion has to Descartes, consists in his having pointed out the nature of centrifugal force, and ascribed that force to the true cause—the motion of bodies, or their tendency to uniform and rectilineal motion. The laws which regulate the collision of bodies remained unknown till some years later, when they were laid down by three members of the Royal Society, Dr. Wallis, Sir Christopher Wren, and Mr. Huygens.

The last mentioned mathematician first explained the true relation between the length of a pendulum and the time of its least vibrations, and gave a rule by which the time of the rectilineal descent, through a line equal in length to the pendulum, might from thence be deduced. He next applied the pendulum to regulate the motion of a clock, and gave an account of what he constructed, and the principles on which he proceeded. Hooke lays claim to the honour of this and other conclusions, but there is no doubt that Huygens has the precedence. An invention, in which Hooke has certainly the priority to any one, is the application of a spiral spring to regulate the balance of a watch. It greatly contributed to solve the problem of finding the longitude at sea, to which Galileo, Huygens, and himself, appear all to have had an eye.

Furnished with the telescope and the clock, the facilities for observation were prodigiously increased. The former was used not only in facilitating the simple inspection of the heavenly bodies, but was applied to graduated instruments, in order to direct them with greater precision to their objects, and render them capable of measuring angles with greater minuteness. We are indebted for this application of them to Picard. Before this, the observations of the motion of the sun had been extremely difficult and rude, and the determination of his place, in respect to the fixed stars, invisible as they are during his continuance above the horizon, susceptible of little accuracy. The shadow of a gnomon furnished to the ancients the best of their methods of determining the angle of his apparent circular path with the equator; the observation of the solstices, the sole mode of ascertaining the length of the solar year. The motion of the sun in longitude was investigated by means of an instrument that is now reduced to a mere illustration of the doctrine of the imaginary celestial sphere. Ptolemy had proposed the introduction of the quadrant, instead of the simple gnomon, for the former of these purposes, an instrument equally applicable to observations of the stars; but to compare their position with the sun, no better method than that of the armillary sphere was found until the clock was provided for the use of astronomers. Tycho Brahe was the last who employed the armillary sphere. This instrument, as its name imports, was a skeleton globe formed of rings: these represented the several great circles of the sphere, and the apparatus was like our globes, suspended from a meridian moving in a horizontal circle. This instrument being rectified for the latitude of the place, and the meridian circle made to correspond with the plane of the true meridian, the axis of motion would be parallel to that of the earth, and point to the poles of the heavens. The position of the sun in the celestial sphere could be determined daily, by making the shadow of the upper half of the ecliptic fall upon the lower. The point opposite to the sun would then mark out his position in that circle, and might be made to follow his diurnal course, by a motion of the sphere on its axis, that would keep the shadow constantly applied to the lower part of the ecliptic. The day of the equinox would be pointed out by a triple coincidence, for the shadows of the equinoctial colure and the equator, would also coincide with their respective places. If on such a day the moon should be in her first quarter, and visible before the setting of the sun, an intermediate point of comparison would be furnished; the sphere might be made to follow the motion of the moon when the sun ceased to be visible, and thus to pursue the course of the sun below the horizon. The stars were next observed by means of sights affixed to rings turning on the poles of the ecliptic, whose direction would give the position of the stars on the celestial sphere, and in relation to the sun; and on the setting of the moon, one of the stars might be used to continue the regular motion of the instrument. In this way the places of the stars, in reference to the equinoctial points and the sun's apparent path, were ascertained. These positions, estimated in a northern and southern, or an eastern and western direction, were called, in terms borrowed from geography, latitude and longitude. But these names have on earth reference to the terrestrial equator, while in the celestial sphere they refer to the sun's path or the ecliptic. We cite this as an instance of the uses that might be made of this instrument, and it will be evident that the wonder is merely that with it observations as accurate as those of Tycho, which were correct to a minute of a degree, could have been made.

The introduction of an accurate measure of time changed at once the plan of observation, and the method of determining the places of the heavenly bodies. The intervals of their passages over the meridian, reduced to portions of a great circle, give the angular distance at the pole of the equator, or what is called the difference in right ascension; while the meridian altitude, in places whose latitude is known, gives the distance north or south of the equator, to which the name of declination is given. Pairs of observations of the time of the passage of the sun over the meridian, and of his declination, taken at equal intervals on each side of the day, of the equinox, give the inclination of his apparent path, the position of the equinoctial point in the celestial sphere, and the instant of the equinox. All these determinations were much facilitated, when the telescope was applied to the instruments used by observers.

It has been stated that this is due to Picard. Morin had previously shown, that with the telescope the stars might be observed in open day; but in order to determine their positions, it was necessary to find the means of ascertaining the position of the optical axis of the instrument, or at least of fixed points in the field of view. This was effected by placing wires crossing each other in the focus, which are thus visible as distinctly as the object itself. Huygens added to these, plates of various breadths, which, being moveable, could be changed until one were found that exactly covered the disc of a planet, or filled up any other small angular sphere; he thus gave the first idea of the micrometer.* One important step remained still to be made; namely, that of applying the telescope as a

* Note P.

sight, to instruments intended for the measure of angles, and this Picard at last accomplished. His use of these instruments was, however, rather applied to geodesy,* than to pure astronomy. With them he measured a degree of the meridian between Paris and Amiens, and thus provided Newton with an indispensable element, in the calculation by which he showed that the attractive force of the earth extended to the lunar orbit.

Picard, after he had overcome the difficulties that attended the adaptation of the telescope to circular instruments, was prepared to lead the way in the observations which have embellished the present century; but all his efforts were insufficient, when counteracted by the miserable parsimony of the government of France. He was compelled to wait ten years for a mural quadrant, although he demanded it in the most earnest manner, and did not receive it until too late for him to use it, not having lived even to see it set up in the meridian. While waiting for it, he placed a simple telescope, revolving on a horizontal axis, in the meridian, and thus first used the transit instrument, so valuable in its subsequent applications.

Olaus Roëmer, a Dane, the pupil and friend of Picard, improved upon his idea; he united the advantages of the transit and instrument for measuring angles, giving to the latter the form of a complete circle, instead of that of a mere quadrant.

* Note Q.

This most happy idea remained neglected and unimproved, however, from his day until our own, when, in the hands of Reichenbach, it has furnished the principle of the most perfect instruments that have yet been constructed—those in the observatories of Altona and Konigsberg. The great observatory of Copenhagen, where Roëmer was placed as astronomer, was, with all its instruments and papers, destroyed by fire; in the same manner, also, was his private observatory in his own house; and no record is left of all his valuable observations, except the "Journal of Three Days," of which he had luckily multiplied and distributed copies. Thus again the improvement of scientific astronomy was retarded, and Flamstead was left to reap the honours that would otherwise have accrued to Roëmer.

When simple sights were employed with instruments for measuring angles, it was possible to divide their limbs to a degree of accuracy greater than that with which these sights could be directed to the object. On the application of the telescope, the reverse became true. Hence it was necessary that means should be found to subdivide the smallest divisions of the limb, until they corresponded in minuteness to the precision with which the telescope could be directed. This was attained by the invention of Vernier, who planned an addition for the purpose, that still goes by his name.

Newton is deservedly ranked, by the just pride of his countrymen, as the greatest of philosophers and mathematicians. He was also the most fortunate. An universe to explain, and the materials in readiness for the explanàtion, can occur but once in the history of mankind. Galileo had ascribed the fall of heavy bodies to the earth's attraction, and Kepler had conceived an attraction of the same kind to extend from the sun to all the bodies of the solar system; he had, however, as we have seen, mistaken the law of the decrease, and the phenomena were consequently at variance with his theory. It was reserved for Newton to set this question at rest. Having retired for a short time from Cambridge, on account of the plague of 1665, he was sitting alone in his garden, and began to speculate on the power of gravity. This power, he reflected, is not sensibly diminished at the greatest elevation from the earth, as on the summits of the loftiest edifices, or the highest mountains; it must, therefore, extend farther than is generally supposed. Why not as high as the moon? and, if so, her motion must be affected by it,—will this account for her revolution and orbit? If to the moon, why not to the planets, and the whole solar system? and, if so, will this explain their motions round the sun? Following up this train of thought, by laborious mathematical calculations, he found, on comparing the relative distances of the several planets from the sun, that if any power, like that of gravity, retained them in their courses, it must decrease in the duplicate ratio of the increase of their distances. But being impressed with the idea which then generally prevailed, that the orbits of the planets were concentric circles, he found that his calculations did not exactly correspond with what he then supposed to be the truth, and discouraged by this difficulty, he for some time suspended his inquiries.

An accident, however, of a very interesting nature induced him to resume his former inquiries, and enabled him to bring them to a close. In June, 1682, when he was attending a meeting of the Royal Society of London, the measurement of a degree of the meridian, executed by M. Picard in 1679, became the subject of conversation. Newton took a memorandum of the result obtained by the French astronomer, and having deduced from it the diameter of the earth, he immediately resumed his calculation of 1665, and began to repeat it with these new data. In the progress of the calculation, he saw that the result which he had formerly expected was likely to be produced, and he was thrown into such a state of nervous irritability that he was unable to carry on the calculation. In this state of mind he entrusted it to one of his friends, and he had the high satisfaction of finding his former views amply realised. The force of gravity which regulated the fall of bodies at the earth's surface, when diminished as the square of the moon's distance from the earth, was found to be almost exactly equal to the centrifugal force of the moon, as deduced from her observed distance and velocity.

The influence of such a result upon such a mind may be more easily conceived than described. The whole material universe was spread out before him;—the sun, with all his attending planets;—the planets, with all their satellites;—the comets wheeling in every direction in their eccentric orbits;—and the systems of the fixed stars stretching to the remotest limits of space. All the varied and complicated movements of the heavens, in short, must have been at once presented to his mind, as the necessary result of that law which he had established in reference to the earth and the moon. Before this time, all investigation into the law of the decrease of the gravitating force had been on the hypothesis of circular orbits, except the incomplete one of Kepler. These great discoveries, the basis on which rest the mechanism of the heavens, were, at the instance of Halley, demonstrated or arranged in "the Principia," or "Mathematical Principles of Natural Philosophy," a work which is memorable not only in the annals of one science or of one country, but which will form an epoch in the history of the world, and will ever be regarded as one of the brightest pages in the records of human reason.

The grand and comprehensive view exhibited in this work of the mechanism of the natural world, is its distinguishing excellency, which has been thus happily characterised by Playfair:—"It is seen in the new application of mechanical reasoning, by transferring it from earth to heaven—from small portions of matter to the mechanism of the universe;

in the reduction of questions concerning force and motion, to geometrical problems, and thus rendering them no longer subjects of speculation, but capable of proof; and in the mensuration of mechanical action by its nascent effects, applying the same principles and general laws to the calculation of the greatest, as well as the least moving force."

Euclid and Archimedes, by the aid of the "method of exhaustion," a process of indirect demonstration, by which a great variety of difficult questions were solved; and by their investigation of quantities infinitely small, prepared the way for that department of mathematical science, to which the moderns have given the names of "Differential Calculus," "Infinitesimal Analysis," or "Fluxions."

"Few things," Professor Playfair remarks, "more ingenious than this method have been devised; and nothing could be more conclusive than the demonstrations resulting from it; but it laboured under two very considerable defects; viz. the long and difficult process by which those demonstrations were obtained, and its *indirect* form, giving no insight into the principle on which the investigation was founded."

After the lapse of more than two thousand years, the "method of exhaustions" was displaced by that of "indivisibles," invented by Cavalleri; by means of which the same objects were attained with greater ease and accuracy *analytically*, which the ancient geometers had discovered by *synthetical* reasonings.

The route, before circuitous, was now by a method of analysis of his own invention *direct;* and in consequence of this most happy and important discovery, many propositions were demonstrated with the utmost facility, though they had baffled all preceding geometricians; and not a few new theorems were invented of singular beauty and elegance.

Following the track thus marked out, the great mathematicians of the sixteenth and seventeenth centuries examined more closely the doctrine of infinites, yet there was still wanting some more exact calculus adapted to these researches.

Newton, while an under-graduate at Cambridge, quickly discovered a law which led to the invention of his celebrated "binomial theorem," and eventually to the method of "fluxions."

The new flood of light thus poured on a science, which leads to truth and certainty, by means of absolute and infallible demonstrations, though not appreciated by some, and objected to by others, was gladly accepted by the principal mathematicians of the time, not excepting the venerable Huygens, then in extreme old age.

But though the mighty genius of Newton was chiefly applied to the mechanical operations of nature, he was not regardless of its internal phenomena. "To him," says a modern historian, "chemistry is *indebted for the first correct views* respecting the nature of combination; a subject which had little engaged the attention of the more sensible experimentalists of the preceding periods, and which was formerly attributed to the occult qualities of the Aristotelians, and afterwards to the mechanical forms of the particles of bodies." From this science, as well as from all the other branches of philosophy, this profound investigator of nature gathered proofs of the great law of attraction; for, to the same principle which puts in motion the vast machine of the universe, the chemical affinities and electric attractions are also to be attributed. Salt of tartar, for instance, becomes moist by exposure to air, because that salt attracts the humidity of the atmosphere. Muriatic acid unites with salt of tartar by virtue of their respective attractions; but when oil of vitriol is poured on this compound, the former acid is displaced by the superior attraction of the latter. Silver dissolved in aquafortis, is separated from that menstruum by the superior attraction of quicksilver; in like manner copper separates quicksilver; and iron, copper. Referring to these and other similar instances, he says, "Does not this argue, that the acid particles of the aquafortis are attracted more strongly by iron than by copper, by copper than by quicksilver, and by quicksilver than by silver?" Such are the simple but clear, and in most instances, correct suggestions relating to the subject of attraction, which chemistry owes to the great luminary of mechanical philosophy.

"When we look back," says an eloquent divine of the present day, "on the days of Newton, we annex a kind of mysterious greatness to him, who, by the pure force of his understanding, rose to such a gigantic elevation above the level of ordinary men; and the kings and warriors of other days sink into insignificance around him; and he at this moment stands forth to the public eye in a prouder array of glory than circles the memory of all the men of former generations; and while all the vulgar grandeur of other days is now mouldering in forgetfulness, the achievements of our great astronomer are still fresh in the veneration of his countrymen, and they carry him forward in the stream of time with a reputation ever gathering, and the triumphs of a distinction that will never die.

"In that march of intellect which led him onwards, through the rich and magnificent field of his discoveries, he pondered every step; and while he advanced with a firm and assured movement wherever the light of evidence carried him, he never suffered any glare of imagination or of prejudice to seduce him from his path. Sure I am, that in the prosecution of his wonderful career, he found himself on a way beset with temptation on every side of him. But he expatiated on a lofty region, where, in all the giddiness of success, he might have met with much to solicit his fancy, and tempt him to some devious speculation. Had he been like the majority of other men, he would have broken free from the fetters of a sober and chastised understanding, and, giving wing to his imagination, had done what philosophers have done after him, been carried away by some meteor of their own forming, or found their amusement in some of their own intellectual pictures, or palmed some loose and confident plausibilities of their own upon the world. But Newton stood true to his principle, that he would take up with nothing which wanted evidence, and he kept by his demonstrations, and his measurements, and his proofs; and if it be true that 'he who ruleth his own spirit is greater than he who taketh a city,' there was won, in the solitude of his chamber, many a repeated victory over himself, which should give a brighter lustre to his name than all the conquests he has made on the field of discovery, or than all the splendour of his positive achievements."

The proof of the revolution of the earth, in an annual orbit, around the sun, was at first sought in the annual parallax of the fixed stars; but this was soon discovered to be so small, as, were it even within the reach of the instruments employed, to be cloaked by irregularities of a great amount, and arising from other causes. Picard, in the course of his astronomical and geodetic researches, had discovered an annual variation in the position of the polar star. The same fact was afterwards noticed by other astronomers, particularly by Flamsteed, who watched it for nine years, in the hope of demonstrating the motion of the earth by means of it, considered as an annual parallax. This, in truth, was the first idea that would present itself to an astronomer; but when these anomalies were reduced to the test of calculation, it was found that they were very different from what an annual parallax would produce.

Picard had determined, that in the case of the polar star, the annual change amounted to 40 sec.; the inferences of Flamsteed were less correct. In 1725, Molyneux commenced observations upon the star γ *Draconis;* Bradley luckily visited him while engaged in this inquiry, and on the former being called off from it by a public appointment, continued the observations. By carefully watching eight different stars, he found that each described a small ellipsis around a fixed point in the heavens, the greater axis of each of which was of the same magnitude, while the lesser axis varied. The fact of the motion, and that under a very peculiar law, entirely different from annual parallax, as well as in a contrary direction, was therefore evident. Having discovered the motion, he next set himself to investigate the physical cause. In this pursuit he was successful.

It is not sufficient to satisfy our curiosity, that we know the magnitude of the earth itself, or even its weight, which has been ascertained; but astronomers did not rest until they found the relation between that magnitude and the distances of the other bodies of our system. These distances are within the reach of calculation; for whenever they are not so great as infinitely to exceed the diameter of the earth, the apparent position of the heavenly body, whose distance is sought, will be different, as seen from the surface or from the centre of the earth. This difference is called parallax. The moon is so near to us, that the determination of her parallax is attended with but little difficulty; but it is not so with the other planets. If, however, it were possible to obtain the horizontal parallax of any one of them, those of the sun, and of all the others, become the results of a simple calculation. Mars, which is observed annually in opposition to the sun, is, under ordinary circumstances, the most convenient for this purpose. The smallness of the quantity is, however, such as almost to escape observation. Hence, the magnitude of the solar system was not known, until it became possible to make use of another and extremely rare celestial phenomenon. This is the transit of Venus over the disc of the sun.

Venus being the nearest of the planets, her parallax is the greatest; but, from the circumstance of her constantly accompanying the sun, the methods applicable to the moon and Mars, are not adapted to the case of this planet. But when she passes directly between the earth and sun, she may be seen, by the aid of the telescope, passing over the disc of the latter. The ingress and egress will be affected by parallax, precisely as in the case of a solar eclipse. Observations, either of the beginning or end at two places, or of both beginning and end at a single place, will furnish data for the calculation; but greater certainty may be obtained by the comparison of a great number of observations.

Kepler first pointed out, that such a phenomenon must occasionally occur, although, from the inclination of the orbit of Venus, it must be extremely rare; and Horrox, an English mathematician, was the first who predicted such a transit with certainty; he also had the great good fortune to observe it.

It was, at the time, considered by astronomers as no more than a curious phenomenon, more interesting from its infrequency; but Kepler evidently saw that it might be attended with important consequences, although he does not enumerate them. Halley was the first who pointed out, in express terms, their value in determining the dimensions of our system. The attention of the learned of Europe was in consequence strongly excited, and preparations were made, in various parts of that continent, as well as at St. Helena, at the Cape of Good Hope, and at Tobolsk in Siberia, at Calcutta, at Madras, and at Tranquebar, to have it carefully observed. Many unexpected causes, however, interfered, and a very considerable discrepancy was found in the results calculated from the various observations; some of the best prepared and most practised observers lost the sight altogether, in consequence of the weather; and, upon the whole, the determination was generally considered as inconclusive. Short, however, who gives, in the *Transactions of the Royal Society* for 1763, a calculation of the sun's parallax, from all the observations, observing that four of them differed far from the limits within which all the rest were included, proposed to omit them. On leaving them out of view, he obtained a parallax for the sun of 8 deg. 69 min., almost identical with what is now received. All these four, that are rejected, can bé made to confirm this conclusion, if it be admitted that the counting of the seconds was correct, but that the wrong minute was written down; and in one of them, the observer himself, on recollection of the circumstances, made this corrèction before the calculation of Short.

This partial failure of the transit of 1761, it may here be stated, caused a still greater excitement in relation to that of 1769. Several of the governments of Europe vied with each other in their exertions to send competent observers, furnished with the best instruments, to various parts of the world. In Europe, only the immersion would be visible, and at a late hour; except, in high latitudes, where the emersion might be visible after sunrise of the next morning, and within the polar circle, where the sun did not set. Such a position as the last, the most advantageous of all, was occupied at Wardhuys, in Lapland, by Helle, under direction of the Danish government. The British government despatched the celebrated Cook to Otaheite, to observe in the opposite hemisphere. The value of these two sets of hemispheres, one in a high northern, the other in the southern hemisphere, was first pointed out by Hornsby, the professor of astronomy at Oxford. It escaped the notice of Lalande, who had busied himself in, and wished to assume the direction of the whole proceeding, as well as the compilation of the results. Disgusted with his pretensions, both the British and Danish governments kept their intentions secret; and Lalande had the mortification to find, that the best selected stations were chosen and occupied advantageously, without his knowledge.

The circumstances for the observation of this transit were in America much more favourable than in any part of the continent of Europe, except in the higher latitudes. Under the influence of the distinguished men who founded the American Philosophical Society, these auspicious circumstances were improved to the utmost. Three committees of that body were formed, who observed separately, at Norriton, in Philadelphia, and at Cape Henlopen. Of the first committee, were Dr. Smith, Provost of the University of Pennsylvania, and the celebrated Rittenhouse; of the second, Professor Ewing, and Dr. H. Williamson; of the third, Mr. Owen Biddle. The state of the weather, and the attention and skill of the observers, place their observations in the very highest rank; they, in consequence, received the most marked commendations from the British Astronomer Royal, who was in active correspondence with the society on this interesting subject.

Maskelyne, the Astronomer Royal, also calculated the parallax of the sun, as did De Sejour, in France. Although both these astronomers agreed upon 8.88 sec., that quantity is less near the truth than the determination of the American philosophers, the solar parallax being now admitted to lie between 8.5 sec. and 8.6 sec.

The close of the seventeenth century saw the erection and endowment of the two great observatories of Paris and Greenwich. During the reign of Charles II., the naval and commercial interests of the kingdom received more attention from the government than they had previously done; the monarch particularly encouraging every improvement in nautical science that tended to benefit the maritime affairs of the nation. That great desideratum, the determination of the longitude at sea, occupied much attention at this time, and many schemes were contrived for its accomplishment. Amongst others was that of a Frenchman, named St. Pierre, who proposed employing the distance of the moon from the fixed stars in the solution of this important problem. The subject was referred to the opinion of men of science, when a reward of 20,000*l.* was offered for its easy and satisfactory solution.

On the examination of the foreigner's claims, it was found that the knowledge possessed of the elements of the lunar motions, as well as of the positions of the fixed stars, was too scanty to enable him to predict the place of the moon with reference to the other heavenly bodies; and therefore, until a correct knowledge on these important points was obtained, the method was not practicable. On this being communicated to the king, and on its being intimated that the way to supply the deficiency was by the establishment of a national observatory, he at once determined on its adoption. Mr. Flamsteed was consequently appointed the first Astronomer

Royal, and was directed particularly to apply himself to rectifying the tables of the lunar motions, and the places of the fixed stars, with a view of perfecting the art of navigation.

The spot recommended by Sir Christopher Wren for the site of this edifice was that of Greenwich Castle, because it was elevated and commanding. It had been the birth-place of Henry VIII., Mary, and Elizabeth, and here the youthful Edward VI. had breathed his last; but as the castle was no longer a favourite resort of royalty, it was freely granted for the purpose. During the erection of the observatory, Flamsteed performed the duties of his office at Pelham House, now forming the central building of the Royal Naval Asylum, and on its completion, he removed his instruments to it, and pursued there his important observations during a period of forty-five years.

The results of his long and useful labours began to be printed under his own direction, during his life-time, and were afterwards completed under that of his friends and former assistants. Mr. Sharpe performed a considerable part of the necessary computations, and laid down the positions of the stars on the maps; and Sir James Thornhill, (the painter of the dome of St. Paul's, and the hall of Greenwich Hospital,) volunteered his services in drawing the figures of the constellations. The whole was published in 1725, in three volumes, folio, under the title of Historia Celestis; a noble monument of his talent and industry. This catalogue contains three thousand fixed stars. He also published a celestial Atlas, an important and valuable work.

To the assiduous observations and the indefatigable activity of Halley, the natural history of the atmosphere, of the ocean, and of magnetism, are all under the greatest obligations. For the purpose of inquiring into these subjects, this ardent and indefatigable observer relinquished the quiet of academical retirement, and having gone to St. Helena, not only made an addition to the catalogue of the stars of 360 from the *southern* hemisphere—adding, says Bossuet, "a new continent to the vast regions of astronomy"—but returned with great acquisitions both of nautical and meteorological knowledge. His observations on evaporation were the foundation of two valuable papers on the origin of fountains; in which, for the first time, the sufficiency of the vapour taken up into the atmosphere to maintain the perennial flow of springs and rivers was fully established. The difficulty found in conceiving how a precarious and accidental supply like that of the rains can sufficiently provide for a great and regular expenditure like that of the rivers, had given rise to various opinions as to the origin of fountains, which had hitherto divided the scientific world. A long residence on the summit of an insulated rock, in the midst of a vast ocean, visited twice every year by the vertical sun, would have afforded to an observer less quick-sighted than Halley, an opportunity of seeing the work of evaporation carried on with such rapidity and copiousness as to be a subject of exact measurement. From this extreme case, he proved that in the Mediterranean, the humidity daily raised up by evaporation is three times as great as that which is discharged by all the rivers that flow into it. The origin of fountains was no longer questioned, and of the multitude of opinions on that subject, which had hitherto perplexed philosophers, all but one entirely disappeared.

Beside the voyage to St. Helena, Halley made two others, the British government having entrusted to a Doctor of Laws the command of a ship of war, in which he traversed the Atlantic and Pacific oceans in various directions, and returned with a collection of facts and observations for the improvement of geography, meteorology, and navigation, far beyond that which any individual traveller or voyager had hitherto brought together.

The variation of the compass was long before this time known to occur, but its laws had never yet been ascertained. These Halley now determined, and the general facts which he established have led to most of the improvements and discoveries which have since been made, respecting the polarity of the needle. Halley also derived from his observations a very complete history of the winds which blow in the tropical regions—the trade-winds and the monsoons—together with many interesting facts concerning the phenomena of the tides. Much more was accomplished by this distinguished man; few of the individuals of any period have higher claims on the gratitude of succeeding ages, and it should not be forgotten that as the friend of Newton, he often stimulated with good effect, the tardy purposes of that great philosopher.

Halley's researches on the lunar theory are very valuable. He first started the idea of finding the longitude at sea by means of the moon's place, which is now universally adopted. The principle of this problem may be easily perceived. An observer at sea can readily find the time of day by means of the sun or a star, and can thereby correct a watch; and if he can at the same moment in which he finds his own time, also discover *that* at Greenwich, the difference between the two, turned into degrees, minutes, and seconds, will be his longitude east or west of Greenwich. If therefore he carries with him a nautical almanac, in which the times of various astronomical phenomena are registered, as they will take place at Greenwich, or rather as they will be seen by an observer placed at the centre of the earth with a Greenwich clock, he can notice any one of these phenomena, and reduce it also to the centre. He will then know the corresponding moments of time, for his own position and that of Greenwich. The moon traverses the whole of its orbit in little more than twenty-seven days, and therefore moves rapidly in reference to the fixed stars, its motion being nearly a whole sign of the zodiac in forty-eight hours. If we observe the distance between the moon and a star, and find it to be ten degrees, the longitude of the place in which the observation is made can be seen as aforesaid, if the almanac will tell what time it was at Greenwich when the moon was at that same distance from the star. In the time of Halley, though it was known that the moon moved nearly in an ellipse, yet the elements of that ellipse, and the various irregularities to which it is subject, were very imperfectly ascertained. It had, however, been found even from the time of the Chaldeans, that some of these irregularities have a *period*, as it is called, of little more than eighteen years, that is, they begin again in the same order after every eighteen years; the periods and quantities of several other errors had also been discovered with something like accuracy. To make good lunar tables, that is, tables from which the place of the moon might be correctly calculated beforehand, became the object of Halley's ambition. He therefore observed the more diligently during the whole of one of the periods of eighteen years, and produced tables which were of great service to astronomers. Of these men of science he has sometimes been called "the Prince," but it may be safely said that no man, either before or since, has done more, by various efforts, to improve the theoretical part of navigation, by the diligent observation alike of heavenly and earthly phenomena.

Halley succeeded Flamsteed as Astronomer Royal, and as the instruments of the latter were claimed by the widow as private property, some delay in his proceedings occurred. At length a sum of money was granted for what was necessary; an iron-framed mural quadrant was erected by Mr. Graham, the celebrated clock-maker of that time, in 1725, and a transit instrument of rather singular construction was also fitted up; these are still preserved at the observatory as astronomical curiosities. Although Halley had arrived at the advanced age of sixty-three when he entered on his office, yet for the period of eighteen years he watched the heavens with the closest attention, hardly ever missing an important observation, and without any assistant, performed all the duties of the establishment.

The third Astronomer Royal was James Bradley, one of the most remarkable men who have combined both astronomical theory and practice. His two great discoveries are the aberration of the fixed stars, and the nutation, or oscillatory motion of the earth's axis. To these discoveries we owe, it has been observed by Delambre, the accuracy of modern astronomy.

Dr. John Keill was the first person who publicly taught natural philosophy by experiments. He began courses in this way at Oxford about 1704 or 1705, and thus introduced the law of the Newtonian philosophy. He was succeeded in these efforts by Desaguliers.

The circumstances of another individual engaged at this time in the diffusion of knowledge, were so remarkable, that a more particular account of them must now be given. Nicholas Saunderson, born at the village of Thurston, in Yorkshire, in 1682, was only a year old, when he was deprived, by small-pox, not only of his sight, but of his eyes themselves, which were destroyed by disease. Yet it was probably to this apparent misfortune that he chiefly owed both a good education, and the leisure he enjoyed from his earliest years, for the culture of his mind and the acquisition of knowledge. He was sent when very young to the free school at Penniston, in the neighbourhood of his native place; and here, notwithstanding the vast disadvantage under which apparently he contended with his school-fellows, he soon distinguished himself by his proficiency. It is to be regretted that we have no account of the mode of teaching that was adopted by his master in so singular a case, or the manner in which the poor boy contrived to pursue his studies in the absence of that organ to which usually the mind is chiefly indebted for knowledge. At all events, it is certain that the progress he made in this part of his education was such as is not often equalled, even by those to whom nature has given all the ordinary means of study; for he acquired so great a familiarity with the Greek language, as to be in the habit of having the works written in it read to him, and following the meaning of the author as if the composition had been in English; while he showed his perfect mastery over the Latin, on many occasions in the course of his life, by both dictating and speaking it with the utmost fluency and command of expression.

When brought home from school, young Saunderson was taught arithmetic by his father, and soon evinced as remarkable an aptitude for this new study as he had done for that of the ancient languages. A gentleman residing in the neighbourhood gave him his first lessons in geometry; and he received additional instruction from other individuals, to whose notice he was introduced by his unfortunate situation and rare talents. But he soon surpassed all his masters, and left the most learned of them without any thing more to teach him. He then pursued his studies for some time by himself, needing no other assistance than a good author and some one to read to him. It was in this way he made himself acquainted with the works of the old Greek mathematicians, Euclid, Archimedes, and Diophantus, which were read to him in the original.

But he was still without a profession, or any apparent resource by which he might support himself through life, although he had already reached his twenty-fifth year. His own wish was to go to the university; but the circumstances of his father, who held a place in the excise, did not enable him to gratify his ambition. At last, however, it was resolved that he should proceed to Cambridge, not in the character of a student, but to open classes for teaching mathematics and natural philosophy. Accordingly, in the year 1707, he made his appearance in that university: under the protection of a friend, one of the fellows of Christ's College, that society, with great liberality, immediately allotted him a chamber, admitted him to the use of their library, and gave him every other accommodation they could for the prosecution of his studies. It is to be recorded, likewise, to the honour of the eccentric Mr. Whiston, who then held the Lucasian Professorship of Mathematics in the university, (an office in which he had succeeded Sir Isaac Newton, having been appointed at the express recommendation of that great man), that on Saunderson opening classes to teach the same branches of science on which he had been in the habit of reading lectures, he not only showed no jealousy of one whom a less generous mind might not unnaturally have regarded as a rival and intruder, but exerted himself, in every possible way, to promote his success. Saunderson commenced his prelections with Newton's Optics. The Newtonian philosophy was as yet only beginning to attract attention among the learned at Cambridge. Whiston himself informs us, in that curious production called his Memoirs, that his own attention had been first strongly excited to the Principia by a paper written by Dr. Gregory, (nephew of the celebrated James Gregory, already mentioned), when professor at Edinburgh, "wherein," says he, "he had given the most prodigious commendations to that work, as not only right in all things, but in a manner the effect of a plainly divine genius; and had already caused several of his scholars to keep acts, as we call them, upon several branches of the Newtonian philosophy; while we at Cambridge, poor wretches, were ignominiously studying the fictitious hypothesis of the Cartesian, which Sir Isaac Newton had also himself done formerly, as I have heard him say."

The subject itself which Saunderson chose, independently of the manner in which he treated it, was well calculated to attract notice, few things seeming at first view more extraordinary than that a man who had been blind almost from his birth, should be able to explain the phenomena and expound the doctrines of light. The disadvantage under which Saunderson laboured here, however, was merely that he did not know experimentally the peculiar nature of the sensations communicated by the organ of vision. There was nothing in this to prevent him from apprehending perfectly the laws of light: that it moves in straight lines,—that it falls on surfaces, and is reflected from them at equal angles,—that it is refracted, or has its course changed, on passing from one medium into another of different density,—that rays of different colours are so refracted in different degrees; and the consequences to which these primary laws necessarily lead. He was not, it is true, able to see the rays, or, rather, to experience the sensation which they produce by falling on the eye, but knowing their direction, he could conceive of them, or represent them, by other lines, palpable to the sense of touch, which he did possess. This was the means he generally took to make himself acquainted with any geometrical figure. He had a board, with a great number of holes in it, at small and regular distances from each other; and on this he easily formed any diagram he wished to have before him, by merely fixing a few pins in the proper places, and extending a piece of twine over them to represent the lines. In this manner, we are told, he formed his figures more readily than another could with a pen and ink. On the same board he performed his calculations by means of a very ingenious method of notation which he had contrived. The holes were separated into sets of nine, each set forming a square, having a hole at each corner, another at the middle point of each side, and one in the centre. It is obvious that in such a figure, one pin placed at the centre might be made to stand in any one of eight different positions with reference to another pin placed on the boundary line of the square; and each of these positions might represent, either to the eye or the touch, a particular number, thus affording signs for eight of the digits. Saunderson used to employ a pin with a larger head for the central hole; so that even when it stood alone, it formed a symbol easily distinguishable from any other. Lastly, by using two large headed pins in one of the positions, instead of one with a large and another with a small head as usual, he formed a tenth mark, and so obtained representations for the nine digits and the cypher—all the elementary characters required in the common system of notation. Here then were evidently the means of performing any operation in arithmetic.

In a description of this contrivance, which we have from the pen of Mr. Colson, Saunderson's successor at Cambridge, we are assured that its inventor, in making use of it, "could place and displace his pins with incredible nimbleness and facility, much to the pleasure and surprise of all the beholders. He could even break off in the middle of a calculation, and resume it when he pleased, and could presently know the condition of it by only drawing his fingers gently over the table." But Saunderson was also wont to perform many long operations, both in arithmetic and algebra, solely by his powerful and admirably disciplined memory. Indeed his mind, after having once obtained possession of even a very complicated geometrical figure, would, without the aid of any palpable symbols, easily retain a perfect conception of all its parts, and reason on it, or follow any demonstration of which it might be the subject, as accurately as if he had it all the while under his eye. It occasionally cost him some effort, it was remarked, to imprint on his mind, in the first instance, a figure unusually intricate; but when this was once done, all his difficulties were over. He seems to have made use of sensible representations chiefly in explaining the theorems of science to his pupils. In the print prefixed to his Algebra, he is represented discoursing on the geographical and astronomical circles of the globe, by the assistance of an armillary sphere constructed of wood. His explanations were always remarkable for their simplicity and clearness, qualities which they derived, however, not from any tedious or unnecessary minuteness by which they were characterised, but from the skill and judgment with which he gave prominence to the really important points of his subject, and directed the attention of his hearers to the particulars most concerned in its elucidation.

His ability and success as a teacher continued and augmented that crowded attendance of pupils, which, in the first instance, he had owed perhaps principally to the mere curiosity of the public. Every succeeding university examination afforded additional evidence of the benefit derived from his prelections. His merits, consequently, were not long in being appreciated both at Cambridge and amongst scientific men in general. He obtained the acquaintance of Sir Isaac Newton, his veneration for whom was repaid by that illustrious philosopher with so much regard, that when Whiston was expelled from his chair in 1711, Sir Isaac exerted himself with all his influence to obtain the vacant situation for Saunderson. On this occasion, too, the heads of colleges applied to the crown in his behalf, to issue a mandate for conferring on him the degree of Master of Arts, as a necessary preliminary to his election ; and their request being complied with, he was appointed to the professorship. From this time Saunderson gave himself up almost entirely to his pupils. He was created Doctor of Laws in 1728, on a visit of George II. to the university, on which occasion he delivered a Latin oration of distinguished eloquence. He died in 1739, in the fifty-seventh year of his age, leaving a son and a daughter. His constant labours as a teacher had left him but little time to prepare any thing for the press. But an able and well known Treatise on Algebra, which he had employed his latter years in compiling, appeared in two volumes quarto, the year after his death. Excepting a work on Fluxions, and a Latin Commentary on Sir Isaac Newton's Principia, which were printed together several years after, no other papers of this eminent mathematician have yet been given to the world.

It is flattering to our patriotism as Englishmen to reflect, that although signals may be traced to the remotest antiquity, the discovery of the modern telegraph is unquestionably an English one; for that which was adopted by the French in 1793, was evidently suggested to them by the "masts and yards," proposed to the Royal Society, in 1684, by the celebrated Dr. Hooke. The telegraph, as its name implies, is a scheme of figurative characters, for the immediate conveyance of intelligence from one distant station to another; and it has probably been had recourse to, wherever towers, masts, or camps existed. The urgency of simultaneous co-operation in naval actions, has always rendered a code of signals imperiously necessary; and though, from the comparative inefficacy of the early efforts, estimated in regard to the present admirable system, they may appear insignificant, it is nevertheless interesting to trace them.

From the remotest ages, and amidst the most barbarous nations, fire by night, and smoke by day, the most obvious and general means of alarm have been employed, as the announcement of hostile approaches. When the Chinese mandarins travel, signals are made by these means from one day's station to another, in order that proper arrangements may be made for their accommodation. But the "pyrsiæ," or fire-beacons, of the Greeks and Romans, were of a more organized character, and, according to Polybius, were even capable of expressing the letters of the alphabet. The ancients, too, were wont to send letters into besieged cities and camps by fastening them to arrows and javelins. But Lazzari, in a rare work published at Venice, relates a more curious method. He says, that in 1640, Thomas, Prince of Savoy, occupied Turin, and was investing a French garrison, who held out in the citadel; while lying thus, a division, which had marched to their relief, inclosed their despatches in a bomb-shell, and threw them over the heads of the enemy, into the fortress.

Nor must the gallant and successful exploit of our own countryman, Captain John Smith, early in the seventeenth century, be forgotten. This extraordinary character, who sought the world around for honourable adventures, after a thousand remarkable incidents, joined the Austrian army in Hungary, where the discomfiture which resulted from his stratagem took place. The event is best recounted in the words of his biographer:—

"After the losse of Caniza, the Turkes, with twentie thousand, besieged the strong towne of Olumpagh so straightly, as they were cut off from all intelligence and hope of succour, till John Smith, the English gentleman, acquainted Baron Kisell, Generall of the Archduke's Artillery, he had taught the Governour his worthy friend, such a rule, that he would undertake to make him know any thing he intended, and have his answer, would they bring him but to some place where he might make the flame of a torch seene to the towne. Kisell inflamed with this strange invention: Smith made it so plaine, that forthwith hee gave him guides, who in the darke night brought him to a mountaine, where he showed three torches equi-distant from other, which plainly appearing to the towne, the Governour presently apprehended, and answered againe with three other fires in like manner, each knowing the other's being and intent. Smith, though distant seven miles, signified to him these words: On Thursday, at night, I will charge on the east, at the allarum, salley you. Ebersbaught answered he would, and thus it was done. First he writ his message, you see, as briefe as could be, then divided the alphabet in two parts, thus:—

"A b c d e f g h i k l
"1 1 1 1 1 1 1 1 1 1 1
"m n o p q r s t v w x y z
"2 2 2 2 2 2 2 2 2 2 2 2 2

"The first part, from A to l, is signified by showing and hiding one linke, so oft as there is letters from A to that letter you meane; the other part, from m to z, is mentioned by two lights in like manner. The end of a word is signified by showing of three lights, ever staying your light at that letter you meane, till the other may write it in a paper, and answer by his signall, which is one light, it is done; beginning to count the letters by the lights, every time from A to m; by this meanes also the other returned his answer, whereby each did understand other. The guides all this time having well viewed the campe, returned to Kisell, who, doubting of his power, being but ten thousand, was animated by the guides, how the Turkes were so divided by the river in two parts, they could not easily second each other. To which Smith added this conclusion; that two or three thousand pieces of match fastened to divers small lines of an hundred fathome in length, being armed with powder, might all be fired and stretched at an instant before the allarum, upon the plaine of Hysnaburg, supported by two staves, at each lines end, and in that manner would seem like so many musketteers; which was put in practice, and being discovered by the Turkes, they prepared to encounter these false fires, thinking there had been some great armie, whilest Kisell, with his ten thousand, entered the Turkes quarter, who ranne up and downe as men amazed. It was not long ere Ebersbaught was pell-mell with them in their trenches, in which distracted confusion, a third part of the Turkes, that besieged that side towards Knousbruck, were slaine, many of the rest drowned, but all fled. The other part of the armie was so busied to resist the false fires, that Kisell, before the morning, put two thousand good souldiers in the towne, and with small losse was retired; the garrison was well relieved with that they found in the Turkes quarter, which caused the Turkes to raise their siege, and return to Caniza; and Kisell with much honour was received at Kerment, and occasioned the author a good reward and preferment, to be captaine of two hundred and fiftie horsemen, under the conduct of Colonell Voldo, Earle of Meldritch."

About sixty years after this feat, the Marquis of Worcester, in his curious tract, entitled *the Century of Inventions*, mentions that he had discovered a method by which, at a window, as far as the eye can discern black from white, a man might hold discourse with his correspondent, by night as well as by day, "though as dark as pitch is black." But as this nobleman gives no idea of the means by which the design was to be accomplished, Dr. Hooke's proposal only is tangible. The siege of Vienna by the Turks had roused his attention to the subject, and there can exist no reasonable doubt, but that his very complete suggestion is the parent of the modern telegraph. Amontons and Guyat followed this illustrious leader, but their methods too closely resembled Hooke's to be entirely original; and it almost appears an act of retribution, that this highly-gifted, but choleric, mechanic, should have been refused that justice which he so often denied to others.

It was about this period in which electricity may be said first to have taken a scientific form. The power of amber to attract small bodies, after it has been rubbed, was known to Thales, and is certainly mentioned by Theophrastus. The observations of Gilbert, a physician of Colchester, at the end of the sixteenth century, though at the distance of two thousand years, made the first addition to the superficial and transient remarks of the Greek naturalist, and offered a pretty full enumeration of the bodies which can be rendered electrical by friction. Gilbert was a man above his age. He undoubtedly considered the earth as endowed with magnetic poles, and this is now acknowledged as a truth. He also perfectly and most accurately distinguished between magnetic and electrical attraction. But though others noticed, Dr. Wall was the first who distinctly observed the crackling noise and faint light which electricity sometimes produced. By a singularly fortunate anticipation, he remarks of the light and crackling, that they seemed in some degree to represent thunder and lightning.

Electrical effects were for a time, however, referred to no general principle, and they were explained by different inquirers in very different manners, and attributed either to mere mechanical causes, or to some occult specific qualities of the different bodies exhibiting them. This, at first view, appears wonderful; for in the beginning of the eighteenth century the methods of philosophical research attained their highest degree of perfection; and the public mind, generally speaking, seems to have been in that happy state, in which the imagination and activity of youth are, as it were, chastened by the correctness and sagacity of manhood. But the reason seems to be, that the objects of the philosophy of the Newtonian school absorbed for at least half a century all the attention of scientific men. The grand laws of the system of the universe came on the understanding with that kind of effect which the new sensations of vision produce on the blind receiving sight. The mathematical theory of philosophy and astronomy, the laws of light, and the motions of the heavenly bodies, were the universal topics of discussion and admiration.

It is not a little remarkable, that the first fact communicated by Newton to the Royal Society, was an electrical experiment, and that the truth of his statement was doubted by some of the members of that illustrious body. The secretary was ordered to write to him to relate its failure. They were satisfied by the answer; which however proved that the young philosopher was offended by their doubts of his accuracy. Happily they did not persist in a mistake, or a disgust on the part of Newton might at this time have been a formidable obstacle to the progress of science.

Otto Guerické erected the first electrical machine, which was a globe of sulphur whirled on an axis, and rubbed against the hand. Hauksbee, in 1709, substituted globes and cylinders of glass for the globe of sulphur, and has described a great number of the luminous phenomena of electricity.

After his experiments, by which the knowledge of this mysterious substance was considerably advanced, Wheeler and Grey, who had discovered that one body could communicate electricity to another without rubbing, being willing to try to what distance the electrical virtue might be thus conveyed, employed, for the purpose of forming the communication, a hempen rope, which they extended to a considerable length, supporting it from the sides by threads, which, in order to prevent the dissipation of the electricity, they thought it proper to make as slender as possible. They used silk threads with that view, and found the experiment to succeed. Thinking it would succeed still better, if the supports were made still more slender, they tried very fine metallic wire, and were surprised to find, that the hempen rope, thus supported, conveyed no electricity at all. It was, therefore, as being *silk*, and not as being *small*, that the threads had served to retain the electricity. This accident led to the great distinction of substances conducting and non-conducting electricity.

Mr. Grey discovered the insulating apparatus, and was the first person who rendered metals, water, and the human body electrical by communication with excited instruments. He was a great benefactor to the science; but his facts are infinitely more valuable than his theories; and he afforded an instance of the truth of that capital dogma of Aristotle, that, " those who know only one thing find it easy to account for every thing."

Stimulated by the early discoveries of Mr. Grey, M. du Fay, intendant of the French King's gardens at Paris, entered on the same plan of investigation, repeated the different experiments made in England, and added to them various new ones, connected with brilliant and important results.

Du Fay was the first person who distinguished the two electricities under the names of *resinous* and *vitreous*, and he ascertained the very considerable principle, that "bodies similarly electrified repel each other; but that bodies dissimilarly electrified attract each other." His writings display a truly philosophical spirit. He has attempted, in all cases, to generalize on the phenomena, and patience and accuracy seem to have equally regulated his practical researches and his speculative views.

While natural philosophy thus made progress, the name of "Rosicrucian" was for some time appropriated by professors of the occult sciences. Anthony Wood mentions attending, at Oxford, the lectures of Peter Sthael, a German, "a noted chemist and Rosicrucian," who had been brought thither by the honourable Robert Boyle, in 1659; and the system must have been at least fresh in remembrance when Pope founded on it the machinery of the Rape of the Lock.

The present was an era, however, which has been justly described by Linnæus as the dawn of the golden age of natural history. In the period that preceded it, the thick darkness that settled on almost every subject worthy to occupy the human faculties, still continued to overshadow this most interesting science. Scarcely any effort was made to elucidate even the most familiar phenomena; and when it was attempted, the want of observation and philosophical discernment was supplied by the extravagances of credulity and the fictions of the imagination. Since what had been seen and ascertained was, therefore, trifling in amount compared with what had been heard and conjectured, it is not surprising that the few works of the time devoted to natural history, should so abound with the fictitious and absurd as to be only useful for pointing out the illusions by which mankind have been enthralled.

In producing a far better state of things, John Ray, to whom have been given the appellations of "Father of Natural History," "Aristotle of England," and the "Linnæus of his time," was fully employed. He is mentioned shortly after entering the university of Cambridge, in terms of high commendation, not only for his knowledge of Latin and Greek, but also for his skill in Natural History. Availing himself to the utmost of his advantages, and extending his inquiries into some departments of learning then very little cultivated, Ray soon acquired a high reputation, both for his scholarship and philosophical attainments. At a time when all scientific works, and frequently even the private correspondence of friends, were written in Latin, a facility in the use of that language was not a rare attainment; but a nicer perception of peculiarities in idiom, and a higher tone of classical elegance, are observable in Ray's Latin compositions, than in the writings of most of his contemporaries.

Ray's ardent desire of knowledge, and the pleasure he derived from pursuits so congenial to his taste and disposition, led him sooner or later to investigate almost every department of natural history. But botany, a subject which has attracted so many minds to the study of nature, was the object of his earliest predilection, and it continued during the greater part of his life to engross the larger share of his attention. Hitherto but little had been done for this science, either in Britain or on the continent. When Ray gave it his attention, it was nearly in the same state in which Turner found it a century before. Almost the only works that treated of plants were styled "Herbals," of which the last-mentioned individual might well say, that they were "all full of unlearned cacographees, and falsely naming of herbs." Their use in medicine was the only consideration that recommended plants to attention; and while all the works relating to the subject were, to quote from the title-page of one of them, "compyled, composed, and auctorysed by divers and many noble Doctours and expert Maysters in Medycynes," the object at which they aimed may be gathered from the title of the "Grate Herball," which professed to give "Parfyt Knowledge and understanding of all Herbes, and their gracyous virtues which God hath ordeyned for our prosperous welfare and helth, for they hele and cure all manner of dyseases and sicknesses that fall or misfortune to all manner of creatures of God created." Modern botanists value plants for their variety and beauty, and also as supplying a link in the chain of natural affinities; but those of former times thought merely with the apothecary, who finding one unknown to him, said, "It has a fine poisonous smell, and must be good for something!" As yet no attempt had been made to form a system of arrangement, and the particular localities of species were very little regarded. Ray's first work on the subject was published in 1660: it was nothing more than a mere catalogue of plants about Cambridge, with the addition of the place of their growth. The names are simply placed in alphabetical order; and no generic characters or descriptions of species are given.

The favourable manner in which this publication was received, and the impulse it gave to the study of botany, notwithstanding its uninviting nature and local reference, urged its author to prepare a similar work applicable to the whole of England. For the accomplishment of this object, but little aid could be derived from books. The only enumeration of British plants that had been attempted was by William Howe, in his Phytologia Britannica, published in 1650. But that work was too meagre and inaccurate to be of much service; and another by Merret, which professed to give the history of every kingdom of nature, was equally undeserving commendation. Ray was therefore obliged to rely on his own industry, and the contributions of his numerous friends. He travelled through the greater part of England and Wales, zealously examining the indigenous plants; nor did he neglect the opportunity thus afforded of inspecting whatever was new or interesting either in nature or art. Local and general history, traditions, antiquities, provincial language and manners, occasionally shared his attention with the more direct objects of his research. He kept a journal of his proceedings, and inserted in it the localities of the rarer plants. This curious production was published after his death by Dr. Derham, under the title of "Itineraries." In 1661 he made a journey into Scotland, accompanied by Mr. Willughby and another scientific friend, to examine the natural productions of that country, which were even less known than those of England. He does not appear to have derived much satisfaction from his northern tour; indeed he was disappointed in one of his principal objects, as he failed in discovering any new plants.

Ray and Willughby also travelled on the continent for three years, from 1663 to 1666; and to the end of Willughby's life in 1672, their time was principally occupied in extensive observations.

From a conversation with Ray a short time before his death, Derham has described the objects which the two friends had in their agreeable but laborious pursuits. "These two gentlemen, finding the history of nature very imperfect, had agreed between themselves, before their travels beyond sea, to reduce the several tribes of things to a method; and to give accurate descriptions of the several species, from a strict view of them." It cannot be doubted that Ray entered on his task, however perplexing it might be, with the enthusiastic energy of a man really in love with his subject, and who had thus given his own idea of the proper character of a naturalist:—"Let it not suffice us to be book-learned, to read what others have written, and to take upon trust more falsehood than truth; but let us ourselves examine things as we have opportunity, and converse with nature as well as books. Let us endeavour to promote and increase this knowledge, and make new discoveries; not so much distrusting our own parts, or despairing of our own abilities, as to think that our industry can add nothing to the invention of our ancestors, or correct any of their mistakes. Let us not think that the bounds of science are fixed like Hercules' pillars, and inscribed with a *ne plus ultra*. Let us not think we have done when we have learnt what they have delivered to us. The treasures of nature are inexhaustible. There is employment enough for the vastest parts, the most indefatigable industries, the happiest opportunities, the most prolix and undisturbed vacancies." "Willughby," says Derham, "prosecuted his design with as great application as if he had been to get his bread thereby. All which I mention," adds this amiable writer, "not only out of the great respect I bear to Mr. Willughby's memory, but for an example to persons of great estate and quality, that they may be excited to answer the ends for which God gives them estates, leisure, parts and gifts, and a good genius; which was not to exercise themselves in vain or sinful follies, but to be employed for the glory, and in the service of the Infinite Creator, and in doing good offices in the world." Intimately associated in life, he and Ray deserve to be held in remembrance while we are reaping the full advantage of their labours, in the days when natural history was, for the most part, a tissue of puerile conceits and extravagant fables.

For several years after, Ray's literary occupations consisted in the preparation for the press, of Willughby's Book on Birds, the completion of some of his own works on botany, and various contributions to the Royal Society. The latter related chiefly to the natural history of the higher animals, but they likewise communicated valuable information regarding insects, spiders, and the myriapodæ. The physiology of vegetation also formed a subject of communication; and on one occasion, at the request of the indefatigable secretary, Mr. Oldenburgh, who was one of Ray's regular correspondents, the latter furnished one of the philosophical discourses annually read to the Society, which was received with great approbation. The subject was the nature of seeds, and the specific differences of plants. Willughby's observations on birds were written in Latin; and the work was accordingly completed in that language, and published in the year 1675. Nothing was omitted by the editor to render it as complete as possible. The descriptions are frequently of considerable length, and will often be found more correct and satisfactory than many of those contained in the numerous and costly works which have since been devoted to his favourite tribe of animals. Ray afterwards prepared an English translation, to which he made large additions, and gave it to the public in 1678. In this edition, the plates were likewise improved and increased in number; but their execution was by no means satisfactory to Ray, as the engravers were but little experienced in representing such objects, and his distance from London prevented him from giving efficient directions.

His earliest attempt to arrange plants in methodical order was, to a considerable extent, conformable to that of Cæsalpinus, published in 1583,—the first to avail himself of Gesner's judicious suggestion to arrange vegetables by means of their fructification. Ray had, however, perceived the propriety of seeking for distinctive characters in the other parts of a plant, in consequence of which he has made nearer approach to a natural arrangement than any preceding systematist.

He afterwards improved his method; though his system thus amended, like the former, is in a considerable degree founded on the fruit; but the other parts are adopted without hesitation whenever they afford strongly marked characters of distinction. One of its principal merits consists in assigning a distinct class to the palms, which had scarcely been recognised in any previous system. The arrangement of the other trees, according to the nature of the fructification, which was the most defective part of the first method, is also deserving of high commendation; but the chief glory of Ray's second method arises from its taking the lead in distributing plants according to the number of their cotyledons. Of this, however, he has been in a great measure deprived; but it ought only to have adorned the brows and graced the memory of him by whom it was obtained.

The first work, in which he made a practical application of the system he had formed, and long before he had rendered it so complete as it afterwards appeared, was his general "Historia Plantarum," of which the first volume, forming a thick folio, was published in 1686. He undertook this work at the request of several of his learned friends, particularly two gentlemen of rank named Hatton, to whom the first volume is dedicated. The second volume appeared about a year afterwards, and a supplementary one was added in 1704. In this arduous undertaking he received considerable assistance from many of his scientific friends, especially Mr. Skippon, Sir Hans Sloane, Dr. Tancred Robinson, and Mr. Dale; but it demanded, on his part, the most persevering and indefatigable industry.

It is truly characterised by Linnæus, as *opus immensi laboris.* It embodies all that is valuable in preceding writers, and forms a complete epitome of the botanical lore of the age. It likewise gives the substance of many works, such as the Hortus Malabaricus, which are inaccessible, from their rarity, to the generality of readers. To its value as a compilation, are added all the practical knowledge, original observation, and critical discernment of its author. The descriptions are frequently of great length, and in general remarkably accurate. To these are added the place of growth, time of flowering, qualities, and uses.

Ray's volume on "the Wisdom of God, manifested in the works of Creation," has been universally admired. Such was its popularity, that it soon passed through many editions, and was translated into several languages. It has suggested the plan, and furnished a great part of the valuable materials of most of the works that have since been written on the same topic.

The success of this volume led him to prepare another of a somewhat similar nature, entitled, "Physico-Theological Discourses, concerning the primitive Chaos, and Creation of the World;" which was published in 1692, and dedicated to Archbishop Tillotson. Although little known in the present day, this work excited considerable attention at the time it appeared, and soon went through several editions. It is a striking proof of the extent and variety of knowledge which its author possessed;

and, independent of its theoretical views, contains such an assemblage of facts relating to the structure of the earth, and the changes it has undergone, that it has not yet altogether lost its utility.

Among his various occupations, he thus describes one, in which he was engaged towards the close of life; "For my part I am now almost three-score and fifteen years of age, so that it is time for me to give over those studies and inquiries;"—alluding to a history of insects, which he had commenced and had been recommending Dr. Derham to pursue. "'Tis true of late years I have diverted myself by searching out the various species of insects to be found hereabouts; but I have confined myself chiefly to two or three sorts, viz. papilios, diurnal and nocturnal, beetles, bees, and spiders. Of the first of these I have found about three hundred kinds, and there are remaining many more still undiscovered by me, and all within the compass of a few miles. I have now given over my inquisition, by reason of my disability to prosecute, and my approaching end, which I pray God fit me for. You that have more time before you, may profitably bestow some of your spare hours upon such inquiries, and may probably make useful discoveries, at least may reap a great deal of pleasure and satisfaction in finding out and bringing to light some of the works of God, not before taken notice of." Such was the last study that employed his active mind, and the result appeared in a history of insects published after his death. This classification possesses considerable merit. It is true the praise of assuming the metamorphoses of these animals as the basis of a natural arrangement, is due to Swammerdam, but in many other respects Ray improved on the method of his illustrious contemporary.

Memorable as this period was for the advancement of science, considerable progress was made in literature.

Charles I. participated the feelings of his predecessors. An attached adherent has thus described his various accomplishments. "With any artist, good mechanic, traveller, or scholar, he would discourse freely; and as he commonly improved by them, so he often gave light to them in their own art or knowledge. For there were few gentlemen in the world that knew more of useful or necessary learning than this prince did, and yet his proportion of books was but small, having, like Francis I. of France, learned more by the ear than by study."

At the period of Charles's accession, a lively curiosity after new and various knowledge had begun to take place of that exclusive devotion to the ancients, which had prevailed from the time of the revival of letters; so that few men aimed at distinction by emulating the cumbrous erudition of the founders of modern scholarship, and that general information began to be more prized than what is technically called learning.

We find it affirmed, that few works of merit appeared in any country of Europe which were not speedily clothed in an English dress. Books of voyages and travels were printed in considerable numbers, and read with great avidity. Beside all the separate relations published by voyagers, two large and important collections had appeared: that by Hackluyt, a person of great knowledge and diligence in his own line of pursuit, who had been appointed lecturer in geography at Oxford, and was the first to introduce maps, globes, and spheres into the common schools; and "Purchas his Pilgrimage," otherwise called "Hackluytus Posthumus," a voluminous compilation by a chaplain of Archbishop Abbot's, designed to comprise whatever had been related concerning the religions of all nations, from the earliest times.

That learned and accurate traveller, George Sandys, had communicated to the public much information both on the classical antiquities and the modern state of Italy, Greece, Turkey in Europe, Palestine, and Egypt. Knowles had published a valued history of the Turks, which has been continued by several persons; and there had been many valuable contributions to natural history. Camden had completed his annals of Elizabeth, and made considerable progress in those of her successor, before his hand was arrested by death. Speed had compiled a meritorious chronicle; and Samuel Daniel, estimable both as a man and a writer, had published a history of England remarkable for judgment and good sense, for purity of style, and for the novelty of commencing with the Norman conquest, instead of the Deluge, or the landing of

Brute the Trojan; the usual starting-posts of the chroniclers. The Life of Henry VII. by Lord Bacon had also afforded an excellent model in this kind of writing.

Antiquities, general and national, civil and ecclesiastical, were diligently and ably cultivated by Spelman, the restorer of Anglo-Saxon literature, by Selden and Usher, so distinguished in European literature, and by Sir Robert Cotton, who was likewise occupied in the laborious work of collecting his noble library of manuscripts. Some curious circumstances occurred while he was thus engaged. It is said for instance, that being one day at his tailor's, he discovered that the man was holding in his hand, ready to cut up for measures, an original Magna Charta, with all its appendages of seals and signatures. This circumstance is mentioned by Colomiês who long resided in this country; and an original Magna Charta is preserved in the Cottonian library, exhibiting marks of dilapidation.

Oliver Cromwell was anxious for the prosperous condition of letters and learning. Most firmly did he oppose the mistaken fanatics who aimed at the destruction of the universities, and under his protectorate, science and polite literature greatly advanced. He also founded a college at Durham, for the convenience of students in the north, with a provost, four professors, and a certain number of fellows and tutors. He settled a pension on the justly-honoured Usher. He applied to Cudworth for his recommendation of proper persons to be employed in political and civil affairs. He made a proposal to Dr. Casaubon to write a history of the civil war. He issued his orders, that the paper employed by Dr. Walton in printing his Polyglot Bible, should be allowed to be imported duty free. His appointments and pensions to Milton, Marvel, and others, are equally creditable.

At Aleppo, it is probable Dr. Pococke, who was born at Oxford, first acquired a taste for Oriental literature. On his return home he was appointed to the newly-founded Arabic professorship in the university of his native city. Entrusted afterwards with a diplomatic mission to Constantinople, he prosecuted his philological studies with peculiar advantages, and enriched his library with many valuable eastern manuscripts.

Milton terms Selden "the chief of learned men reputed in this land;" and Whitelock states, "that his mind was as great as his learning, being very generous and hospitable." Clarendon, who could not regard him with any political partiality, though he had been on terms of intimacy with him in early life, says, "He was of so stupendous learning in all kinds and in all languages, (as may appear in his excellent and transcendent writings), that a man would have thought he had been entirely conversant among books, and had never spent an hour but in reading and writing; yet his humanity, courtesy, and affability were such, that he would have been thought to have been bred in the best courts, but that his good nature, charity, and delight in doing good, and in communicating all he knew, exceeded that breeding." The name of Lightfoot must also be mentioned with special honour.

Rival schools of verse were about this time contending for the mastery. They are thus aptly characterized by a contemporary :—" You have others that labour only to ostentation, and are ever more busy about the colours and surface of a work than in the matter and foundation; for that is hid, the other is seen. Others, that in composition are nothing but what is rough and broken; and if it would come gently, they trouble it of purpose. They would not have it run without rules, as if that style were more strong and manly that strikes the ear with a kind of unevenness. These men err not by chance, but knowingly and willingly; they are like men that affect a fashion by themselves, have some singularity in a ruff, cloke, or hatband; or their beards specially cut to provoke beholders, and set a mark upon themselves. . . . Others there are that have no composition at all; but a kind of tuning and riming fall in what they write. It runs and slides, and only makes a sound. Women's parts they are called, as you have women's taylors.

> 'They write a verse as smooth, as soft as cream,
> In which there is no torrent, nor scarce stream.'

You may sound these wits, and find the depth of them with your middle finger. They are cream-bowl, or but puddle deep."

The attachment of Waller to poetry was so early evinced, that he might almost be said to have "lisped in numbers." The first volume of his poems was published in his eighteenth year. He was unquestionably the most elegant and harmonious versifier of his age; and contributed greatly, both by poetry and prose, to refine the English language.

Among the few poets of his time appears Milton, whose genius had angelic wings, and fed on manna. Abruptly leaving the university, with which he was dissatisfied, he employed some years at his father's house, in enriching his mind with stores of learning, and in cultivating the graces of poetry. Among the fruits of this season of leisure were Comus, Il Penseroso, L'Allegro, and Lycidas. Thence he proceeded to Paris, at that time the favourite seat of literature, and still further improved his taste by a visit to Italy. But the political changes which then arose accelerated his return. The acknowledged excellence of his political tracts, added to his high reputation for learning, procured him the appointment of Latin secretary to the parliament, an office which he held during Cromwell's protectorate, until the loss of sight obliged him to relinquish its duties. After the restoration he spent his days in retirement, engaged in composing those admirable poems which have given immortality to his name.

Some great production in the highest region of poetry had been in his contemplation from nearly the commencement of his literary life. The idea accompanied him to Italy, where, with a more defined object, it acquired a more certain shape from the example of Tasso, and the conversation of Tasso's friend, the accomplished Marquess of Villa. From this moment it seems to have been immovably fastened on his mind; and though for a season oppressed and overwhelmed by the duties of controversy, its root was full of life, and pregnant with vigorous vegetation. At the end of 1655, and the beginning of the following year, the mighty work is said to have been seriously undertaken; and it is curious to reflect on the steadiness of its growth under a complication of adverse circumstances, and to see it, like a pine on the rocks of Norway, ascending to its majestic elevation beneath the inclemency of a dreary sky, and assailed in the same moment by the fury of the ocean at its feet, and the power of the tempest above its head.

Gifted with a mind pre-eminently sublime, and richly stored with all the various branches of learning and science, with an ear attuned to harmony, and a taste chastised by cultivation, he at length completed a poem, which has challenged the admiration of each succeeding age, and stands among the noblest memorials of human genius. He has spoken of "a work not to be raised from the heat of youth, or the vapour of wine—nor to be obtained by the invocation of Memory and her syren daughters; but by devout prayer to that eternal Spirit, who can enrich with all utterance and knowledge, and who sends out his seraphim with the hallowed fire of his altar to touch and purify the lips of whom he pleases:"—words which more appropriately describe his own poem than any other within the range of English literature.

When it is considered that Milton was not only blind, but far advanced in years; that he was the object of factious hostility and popular neglect; that, deprived of part of his small fortune, he was only saved from actual poverty by the contraction of his wants; that he was encompassed by dangers as well as darkness; that though snatched, as it were, by miracle from the vengeance of the law, he was still fearful of the assassin's dagger; that he was unprovided with any assistance in his literary labours, but that of a girl, or of an occasional friend to read to him, and to hold the pen as he dictated,—our astonishment will be increased at the boldness of mind which could conceive, and at the inexhaustible energy which could complete a poem, so vast in its plan, and so magnificent in its execution. To Milton we are also indebted for other poems, and for prose works of transcendent excellence, which are happily awakening increasing attention in the public mind. In that distinguished man were combined all the rarer qualities which dignify our nature; and of him it constitutes the noblest panegyric, that his works are not less the just expression of his character, than the monuments of his genius.

Contemporary with Milton, though his junior, and belonging to a period of which he became the great luminary and master-spirit, was Dryden. His prose, not less admirable than his verse, presents him before us in the character of the father of English criticism. His Essay on Dramatic Poetry is the first regular and judicious treatise in our language on the art of writing. Before his time, those who wished to arrive at just principles of taste, or a rational code of criticism, had no guides, except they were acquainted with the works of the ancients, and the modern languages of Italy and France. His claims should, therefore, not be forgotten, though valuable discourses have been delivered to the public since his time, and though his prose works may now be read more for the charm of their pure idiomatic English than for the novelty or instruction of their contents.

Pope, when only twelve years old, became acquainted with Spenser, Waller, and Dryden. The latter he held in the highest admiration; he studied his works with great attention and pleasure, adopted them as a model of rhythm, and copied the structure of his favourite periods. So far, however, was *this from a grovelling imitation, that it enabled him* to raise English rhyme to the most perfect melody of which it is capable. To quote Johnson's elaborate criticism—"It is surely superfluous to answer the question that has once been asked, whether Pope was a poet, otherwise than by asking, in return, if Pope be not a poet where is poetry to be found? To circumscribe poetry by a definition will only show the narrowness of the definer, though a definition which shall exclude Pope will not easily be made. Let us look around upon the present time, and back upon the past; let us inquire to whom the voice of mankind has decreed the wreath of poetry; let their productions be examined, and their claims be stated, and the pretensions of Pope will be no more disputed."

The writings of Hobbes are alike marked by vigour and acuteness of mind, and by the latent venom of infidelity. He was born at Malmesbury in 1588. Introduced to public favour by a correct and valuable translation of Thucydides, he formed an intimacy with Descartes and Galileo, in the course of a continental tour with the Earl of Devonshire, an event which induced him to apply his mental energies to mathematical and philosophical studies. In 1650 he published his essay on "Human Nature," which has generally been considered the ablest of his literary productions. This was followed by his work, entitled, "Leviathan," in which his erroneous principles were more fully developed, and for this he was summoned before the Parliament, and severely censured. The reproof thus administered, will be admitted by all rightly regulated minds to have been fully merited. Why did not the perspicacious philosopher of Malmesbury perceive that—

> "What none can prove a forgery, *may* be true,
> What none but bad men wish exploded, *must*?"

Byron could thus write—"Indisputably, the firm believers in the gospel have a great advantage over all others,—for this simple reason, that if true, they will have their reward hereafter, and if there be no hereafter, they can be but with the infidel in his eternal sleep, having had the assistance of an exalted hope, through life, without subsequent disappointment, since (at the worst for them) 'out of nothing, nothing can arise,' not even sorrow." Most unwarrantable, therefore, are the efforts of scepticism; they admit of no excuse, they deserve the severest condemnation.

Another individual, of a very different order, was John Locke, who, as soon as he entered his college, devoted himself to philosophic studies. He afterwards practised in medicine with considerable success, but relinquished his engagements in behalf of the science which he preferred to all others. Among his various works, which rank with the noblest efforts of vigorous and enlightened minds, is his Essay on the Human Understanding, which however is far more generally known by its title than by its valuable contents.

In his Prefatory Epistle its origin is thus stated: "Five or six friends, meeting at my chamber, and discoursing on a subject very remote from this, found themselves quickly at a stand by the difficulties that rose on every side. After we had awhile puzzled ourselves, without coming any nearer a resolution of those doubts which perplexed us, it came into my thoughts that we took a wrong course; and that, before we set ourselves upon inquiries of that nature, it was necessary to examine our own abilities, and see what objects our understandings were and were not fitted to deal with. This I proposed to the company, who all readily assented; and thereupon it was agreed that this should be our first inquiry. Some hasty and undigested thoughts, on a subject I had never before considered, which I set down against our first meeting, gave the first entrance into this discourse; which, having been thus begun by chance, was continued by entreaty, written by incoherent parcels, and after long intervals of neglect, resumed again as my humour or occasions permitted; and at last, in a retirement where an attendance on my health gave leisure, it was brought into that order thou now seest it."

The work thus introduced is indeed of no ordinary worth. Its author towers far above all his predecessors and contemporaries in this department of literature, and was the instrument of effecting a mighty revolution in the opinions of mankind on moral and metaphysical subjects, the effects of which are still apparent, and will probably continue to be felt through all succeeding ages. Locke may justly be considered as the founder of a new and more enlightened school of intellectual philosophy, which, having originated in Britain, has gradually diffused itself over the greater part of the civilized world. Considering the period in which he wrote, and the slender advances then made in moral science, he must be acknowledged to have achieved a work of great magnitude, and to have taken a high station among those to whom mankind are specially indebted.

The Earl of Clarendon is chiefly known to posterity by his "History of the Rebellion;" the principal value of which consists in the accurate knowledge possessed by the noble author of all the characters he delineates, and of all the memorable facts he records. The strictest impartiality was scarcely to be expected in such circumstances; but allowing for these, this elaborate history may be considered as characterised by a high degree of fidelity of narrative, as well as of elegance of composition. His characters are sketched with great spirit, and exhibit striking, though in some instances, distorted portraits of the originals. Gilbert Burnet, Bishop of Salisbury, made also some valuable additions to the literature of his age. His "History of his own Times," the matured fruit of age and experience, though not free from predilections and prejudices, contains unquestionably the most faithful and impartial record of a peculiarly eventful era of English history.

John Bunyan, too, urges a strong and irresistible claim on our grateful remembrance. "The characteristic peculiarity of the Pilgrim's Progress," is, says a modern critic, "that it is the only work of its kind which possesses a strong human interest. The allegory of Bunyan has been read by thousands with tears. This wonderful performance, while it obtains admiration from the most fastidious critics, is loved by those who are too simple to admire it. In the wildest parts of Scotland the Pilgrim's Progress is the delight of the peasantry. Every reader knows the strait and narrow path as well as he knows a road in which he has gone backward and forward a hundred times. This is the highest miracle of genius, that things which are not should be as though they were; that the imaginations of one mind should become the perpetual recollections of another; and this miracle the tinker has wrought."

The eulogium of Cowper points to a far higher aim:—

> "O thou, whom, borne on Fancy's eager wing
> Back to the season of life's happy spring,
> I pleas'd remember, and, while mem'ry yet
> Holds fast her office here, can ne'er forget;
> Ingenious dreamer! in whose well-told tale
> Sweet fiction and sweet truth alike prevail;
> Whose hum'rous vein, strong sense, and simple style
> May teach the gayest, make the gravest smile;
> Witty, and well employ'd, and, like thy Lord,
> Speaking in parables his slighted word;
> I name thee not, lest so despis'd a name
> Should move a sneer at thy deserved fame;
> Yet ev'n in transitory life's late day,
> That mingles all my brown with sober grey,
> Revere the man, whose PILGRIM marks the road,
> And guides the PROGRESS of the soul to God."

The distinction attained by Joseph Addison was well deserved. As an undergraduate he acquired the reputation of an elegant Latin poet; his first English poem, addressed to Dryden, was worthy of his early fame; a criticism on the Georgics of

Virgil, appended to a translation of one of them, has been pronounced by high authority "the finest example that has ever appeared, either in our own or any other language;" but his Essays in the Spectator, the Tatler, and similar works, lie at the basis of the honours more recently awarded him. His object aided by some of his contemporaries, among whom was Sir Richard Steele, was to "teach, not with didactic severity, but in a sprightly and agreeable manner, the minuter decencies and inferior duties of life; to regulate the practice of daily conversation; to correct those species of human depravity which are rather ridiculous than criminal; to furnish correct rules for criticism; and to direct the attention of the gay and trifling to sources of rational enjoyment, and means of intellectual improvement."

"Before the Tatler and Spectator," continues Johnson, "if the writers for the theatre are excepted, England had no masters of common life. No writers had yet undertaken to reform the savageness of neglect, or the impertinence of civility; to show when to speak, or be silent; how to refuse, or how to comply. We had many books to teach us our more important duties, and to settle opinions in philosophy and politics; but an *arbiter elegantiarum*, a judge of propriety, was yet wanting, who should survey the track of daily conversation, and free it from thorns and prickles, which tease the passer, though they do not wound him. The Tatler and Spectator adjusted, like Casa, the unsettled practice of daily intercourse by propriety and politeness; and like La Bruyere, exhibited the characters and manners of the age."

In the number and variety of his works, however, De Foe stands unrivalled by any writer in the English language; his prototype, William Prynne, perhaps, only excepted. Such was the versatility of his talents, that he wrote on almost every subject within the range of human speculation. Whether it were politics or morals, trade or religion, history or fiction, he seems to be equally at home, and to wield his pen with a power and facility that point him out as no ordinary man. Even the worst of his pieces, in spite of their uninviting style or forbidding subject, display marks of talent and genius that distinguish him from the herd of commonplace writers. The number of his works, when we consider his other engagements, evince extraordinary rapidity of composition. As an illustration of his readiness, we are told that he wrote two twelve-penny pamphlets in one day; and those productions had not then attained the ample margin and loose printing of modern times.

The most remarkable of all the works of De Foe, Robinson Crusoe, was published in 1719. It met with a very favourable reception, and immediately became so popular, that Taylor, who purchased the manuscript after every other bookseller had refused it, is said to have gained by the transaction a thousand pounds. Seldom, indeed, has any immediate decision of the public respecting a literary performance been so fully ratified by posterity. At the distance of more than a century it has lost very little, if any, of its original attraction. There is an air of reality and truth about it which belongs to no other work of fiction; we cannot indeed persuade ourselves that it is the creation of fancy, nor divest ourselves of the conviction which every circumstance conspires to rivet on the mind, that we are perusing real adventures, and conversing with actual personages. Hence, whilst it carries captive the affections of children, it fixes the admiration of mature years; it is the book of all countries, and of every age and class; it delights the illiterate, and amuses as well as instructs persons of the most cultivated minds; and it speaks in the resistless language of nature to all hearts.

The rude materials of this remarkable work are found in the adventures of Alexander Selkirk, who was discovered on the desert island of Juan Fernandez, clothed in goats' skins, and looking more wild than the first owners of them. The habitation he had raised was reached with difficulty, his discoverers climbing up and down many rocks, till they came at last to a pleasant spot of ground, full of grass and of trees, where stood his two huts; while his numerous tame goats showed his solitary retreat. These two huts, the one for dressing his victuals, the other to sleep in; his contrivance to obtain fire by rubbing two pieces of pimento wood together; his distress for want of bread and salt, till he came to relish his meat without either; his wearing out his shoes, till he grew so accustomed to be without them that he could not for a long time afterwards, on his return home, use them without inconvenience; his bedstead of his own contriving, and his bed of goat-skins; when his gunpowder failed, his teaching himself by continual exercise to run as swiftly as the goats; his falling from a precipice in catching hold of a goat, stunned and bruised, till, coming to his senses, he found the goat dead under him; his taming kids to divert himself by dancing with them and his cats; his converting a nail into a needle; his sewing his goat-skins with little thongs of the same; and when his knife was worn to the back, contriving to make blades out of some iron hoops; his solacing himself by psalms and prayers, and his indifference to return to a world from whence his feelings were so entirely weaned; became incidents in the hand of De Foe, from which he wrought a fabric altogether inimitable in his own or any following age.

The "Review of the State of the English Nation," by the same author, was originally published once a week; it at last appeared every Tuesday, Thursday, and Saturday, occupying four quarto pages. To the political news and disquisitions was regularly appended a short chronicle of domestic incidents; and the whole was written by De Foe himself.

One of his leading objects was, however, to correct the vices of the times. Throughout the work he carries on an unsparing warfare against folly and vice, in all their forms and disguises. In forcible terms, he inveighs against the fashionable practice of immoderate drinking, the idle propensity to swearing, the little regard that was paid to the marriage vow, and the loose conversation and habits of men in general. In well-pointed satire, he chastises the licentiousness of the stage; and condemns, in strong language, the barbarous practice of duelling. He has also some just remarks on the rage for gambling speculations, which, at this period, had risen to a great height. On all these subjects he brings forth his capacious stores of wit and humour to the assistance of grave reasoning, adducing examples occasionally of the flagitious courses he condemns, but with sufficient delicacy to show that his aim was the reformation rather than the exposure of the offender. No man paid a greater regard to those decencies of expression which have so much influence in regulating the intercourse of life; and although few individuals had greater provocation, from the coarse and illiberal writers of the day, yet he rarely suffered his temper to be disturbed, or departed from courtesy of language towards even his bitterest opponents. He tells us he knew no such thing as personal prejudice against any man; but if he harboured the feeling, he would never make it the tool of public satire, and for that reason has always omitted reflections where there might have been the least cause to suspect private provocation. The work was continued till the completion of the ninth volume, when a tax induced the author to bring it to a termination. It has usually been regarded as the parent and in some respects the model of the Spectator; but it has not enjoyed the good fortune of that celebrated work; for while the Spectator has been frequently reprinted, a perfect copy of the Review is not known to exist. There are only the first six volumes in the British Museum.

At this time general education was a thing wholly unknown, and the suggestion of it would have been treated with ridicule. Even in the middle classes, which form the connecting link in society, a well-educated man, unless he belonged to one of the learned professions, was a sort of phenomenon, that served only for the gaze of the multitude; nor is it to be wondered at, when it is considered that the cultivation of a taste for literature and mental improvement was thought by many in the upper classes to be beneath the dignity of a gentleman. That general knowledge which afterwards circulated in common talk, was at this time rarely to be found. Men not professing learning were not ashamed of ignorance; and in the female world any acquaintance with books was distinguished only to be censured.

It is, however, a fact well-deserving remembrance, that during that part of the reign of Charles II. when the nation was under strong apprehensions of a popish government, and religious persons were the victims of persecution, it being expected that printed Bibles would become rare, or locked up in an unknown tongue, many people, struck with the alarm, employed themselves in copying the Bible in *short hand*, that they might not be destitute of its consolations in the hour of calamity. De Foe in early life thus wrote out the whole Pentateuch.

But honourable as this is, it is not to the credit of those who carried away the learning and politeness of the age that many of them were lax in their morals, and therefore but ill qualified to become public censors. Those who affected the reputation of wits, and became desirous of associating with men of genius, were initiated at the tavern, where they often sat up late, and revelled in riot and debauchery. It was by these censors of literature, to whom "a tavern chair was the throne of human felicity," that the fate of a publication was often decided; which occasioned Dennis to say, "Who that has common sense can forbear laughing, when he sees a parcel of fellows who call themselves wits, sit in combination round a coffee-table, as sharpers do round a hazard-table, to trick honest gentlemen into an approbation of their works, and bubble them of their understanding?" The society of such men was but little calculated to improve or exalt the female character. Indeed their wives were considered but little better than a higher sort of domestics, whose chief province was to administer to the gratification of their senses. Deserting their families, they consumed their evenings at the theatre and the tavern, where the charms of conversation were too often drowned in intemperance.

Female intellect was therefore at this time, as in former days, greatly neglected, and the men themselves were but little in advance of the other sex. Pedantry had been too long substituted for learning, and a false taste had given a reputation to wit, at the expense of more solid attainments. From the days of Henry VIII. to those of Elizabeth it was not unusual to bestow a learned education on ladies in high life; and the taste that existed for theological studies had a tendency to sharpen the appetite for mental improvement. But after the death of that princess, their education became more neglected; and though there continued some exceptions to the general rule, yet, for the most part, an affectation of learning took place of the reality, and exterior accomplishments became more acceptable at court than the sterling qualities which confer true nobility on their possessor. Education must have been in a degraded state when a writer made one of his "gentlemen of wit and sense" thus speak: "What an unfashionable fellow art thou, that in this age art given to understand Latin!" "'Tis true," is the reply, "I am a bold fellow to pretend to it, when it is accounted pedantry for a gentleman to spell, and when the race of gentlemen is more degraded than that of horses. If they go on as they began, the gentlemen of the next age will scarce have learning enough to claim the benefit of clergy for manslaughter."

Improvement was, however, now taking place, so far at least as respected youths of family and fortune, exempted by their station from the observance of the routine of professional instruction. Peacham stigmatises the class of schoolmasters as often ignorant and incompetent, and generally chargeable with a high degree of ill-manners, and even barbarity towards their pupils. "Ingenious youths," he well observes, "cannot brook such contempt as to be called by opprobrious names, and which is more ungentlemanly, nay barbarous and inhuman, pulled by the ears, lashed over the face, beaten about the head with the great end of the rod, smitten upon the hips, for every slight offence, with the ferula,—not offered to their father's scullions at home." Domestic tutors, however, he represents as still worse; ignorant and mean-spirited persons, engaged by sordid parents at a pitiful salary, and encouraged to expect their reward from some family living to be bestowed as the meed of their servility and false indulgence.

Comparing the summary he gives of different branches of study, not with our present affluence of knowledge, but with the penury and rudeness of the preceding ages, we shall be struck with the increase of useful and ornamental learning which it implies. Some of the most accomplished individuals for a century preceding were better classics than the "Complete Gentleman," as described by Peacham; and all were skilled in theology—a branch of study totally omitted by this writer. But Henry VIII. is said to have been destined to the church, and somewhat of an ecclesiastical education might well be judged fitting for his successors; and few, it is probable, of their nobility could have emulated them in these scholastic acquirements. On the other hand, geography, with the elements of astronomy, geometry, and mechanics; the study of antiquities, comprising mythology and knowledge of medals, and the theory and practice of the arts of design; were parts of learning now almost for the first time enumerated amongst the becoming accomplishments of an English gentleman.

It is pleasing, too, to find De Foe strongly urging the importance of female education. "We reproach the sex every day," says he, "with folly and impertinence, while I am confident, had they the advantages of education equal to us, they would be guilty of less than ourselves." He complains that the females of his time were taught merely the mechanical parts of knowledge, such as reading, writing, and sewing, instead of being exalted into rational companions; and he argues, that men in the same class of society would cut a poor figure if their education were to be equally neglected. "The soul," he observes, "was placed in the body like a rough diamond, and must be polished, or the lustre of it will never appear. And it is manifest, that as the rational soul distinguishes us from brutes, so education carries on the distinction, and makes some less brutish than others. Why, then, should women be denied the benefit of instruction? If knowledge and understanding had been useless additions to the sex, God would never have given them capacities; for he made nothing needless. Besides, I would ask such, what they can see in ignorance that they should think it a necessary ornament in a woman? or what has woman done to forfeit the privilege of being taught? Does she plague us with her pride and impertinence? Why do we not let her learn, that she may have more wit? Shall we upbraid woman with folly, when it is only the error of this inhuman custom that hinders her being made wiser? The capacities of women are supposed to be greater, and their senses quicker than those of the men;" and that they are capable of emulating them, he tells us, "might be proved by some examples in his own day."

With so high an opinion of the female character, it is no wonder that he exclaims, "I cannot think that God ever made them so delicate, so glorious creatures, and furnished them with such charms, so agreeable and so delightful to mankind, with souls capable of the same enjoyments as men, and all to be only stewards of our houses, cooks, and slaves."

Instances were certainly not wanting of the eminence to which women might be raised. Lucy Harrington, afterwards Countess of Bedford, enjoyed the reputation of a medalist and a Latin scholar, and was celebrated by Sir William Temple, long after her death, for the singular skill and taste which she had exercised in laying out the gardens of Moor Park. Lady North, born at Sidney, was both herself a writer, and distinguished as a patroness of the learned; a merit shared by other ladies of rank and fortune.

Another remarkable instance of female literary talent appears in the case of Mrs. Lucy Hutchinson, the wife of Colonel Hutchinson, to whom was confided, during the civil war, the military government of Nottingham Castle. This excellent lady drew up for the instruction of her son, before he entered on public life, a memoir of her late husband; a work characterised alike by piety, tenderness, moderation of sentiment, and, allowing for the time in which it was written, exquisite beauty of composition. This valuable manuscript, which contains one of the most faithful records of those eventful times, after having lain hidden amidst the archives of the family for more than one hundred and fifty years, was recently presented to the world by one of her descendants, who has thus contributed in no ordinary degree to our literary stores.

Many years elapsed after the publication of the "English Mercurie," before newspapers appeared in single sheets as they do now. The first, called "The Public Intelligencer," was published by Sir Roger L' Estrange, on the 31st of August, 1661. Periodical pamphlets, which had become fashionable in the reign of Charles I., were more rare in that of James II. The first Gazette in England was published at Oxford on the 7th of November, 1665, the court being then held there. On the removal of the court to London, the title was altered to "The London Gazette." "The Orange Intelligencer" was the third newspaper published, and the first after the Revolution in 1688; it continued to be the only daily one in England for some years; but in 1690 there appear to have been nine London newspapers published weekly. In 1709 the number of these was increased to eighteen; but still there seems to have been but one daily paper, which was then called " The London Courant." In the reign of George I. the number was three daily, six weekly, and ten, published three times in a week.

The origin of literary journals was the happy project of Denis De Sallo, a counsellor of the Parliament of Paris. In 1665 appeared his "Journal des Sçavans." He published this essay in the name of the Sieur de Hedouville, his footman! Was this a mere stroke of humour, or designed to insinuate that the freedom of criticism could only be allowed to his lackey? The work, however, met with so favourable a reception, that Sallo had the satisfaction of seeing it circulated throughout Europe in the following year, and his journal, at the same time, translated into various languages.

Edward Cave, the projector of the Gentleman's Magazine, the first publication of the species, and since

" The fruitful parent of a thousand more,"

was born in 1691. To this undertaking he owed the affluence in which he passed the last twenty years of his life, and the large fortune which he left behind him. When he formed the project he was so far from expecting the success he enjoyed, and others had so little confidence in its value, that though he had for several years talked of its plan among booksellers and printers, none of them thought it worth the trial. Five years afterwards his work had an advertisement, which, from the influence of association, will strike many as singular :—

"At EDIAL, near Lichfield, in Staffordshire, Young Gentlemen are boarded and taught the Latin and Greek languages, by SAMUEL JOHNSON."

A fact respecting the business of printing in London may here be stated, which at the present day seems not a little curious. It appears that in 1666 the entire number of working printers, who had served a regular apprenticeship, then resident in and about the metropolis, was no more than one hundred and forty. In addition to these there were some "foreigners," as they were called, that is, workmen who had not obtained their freedom by serving a regular apprenticeship; but they are spoken of as not very numerous.

On a bill being brought into parliament in the latter part of the reign of King William, for laying a tax on periodical publications, a statement of objections to it was published, one of which is thus expressed: "For that the said newspapers have been always a whole sheet and a half, and sold for one halfpenny to the poorer sort of people, who are purchasers of it by reason of its cheapness, to divert themselves, and also to allure herewith their young children, and entice them to reading; and should a duty of three halfpence be laid upon these mean newspapers (which, by reason of the coarseness of the paper, the generality of gentlemen are above conversing with), it would utterly extinguish and suppress the same." An Act imposing the stamp-duty, which is here deprecated, was afterwards passed in the reign of Queen Anne, and one of its effects appears to have been the discontinuance of the "Spectator."

In the account already given of the "Age of Learning," allusion was made to the improvement which had taken place in language; and on this point Montgomery remarks with his usual felicity :—

"From the reign of Elizabeth to the protectorate of Cromwell, inclusively, there rose in phalanx, and continued in succession, minds of all orders, and hands for all work, in poetry, philosophy, history, and theology, which have bequeathed to posterity such treasures of what may be called genuine English literature, that whatever may be the transmigrations of taste, the revolutions of style, and the fashions in popular reading, these will ever be the sterling standards. The translation of the Scriptures, settled by authority, and which, for reasons that need not be discussed here, can never be materially changed, consequently can never become obsolete,—has secured perpetuity to the youth of the English tongue; and whatever may befal the works of writers in it from other causes, they are not likely to be antiquated in the degree that has been foretold by one, whose own imperishable strains would for centuries have delayed the fulfilment of his disheartening prophecy, even if it were to be fulfilled :—

'Our sons their fathers' failing language see,
And such as Chaucer *is* shall Dryden *be*.'

POPE.

"Now it is clear, that unless the language be improved or deteriorated, far beyond any thing that can be anticipated from the slight variations which have taken place within the last two hundred years, compared with the two hundred years preceding, Dryden *cannot become* what Chaucer *is;* especially since there seems to be a necessity laid upon all generations of Englishmen to understand, as the fathers of their mother-tongue, the great authors of the age of Elizabeth, James I., and Charles I.; from Spenser (though much of his poetry is wilfully obscured by affected phraseology,) and Shakspeare (the idolatry to whose name will surely never permit its divinity to die,) to Milton, whose style cannot fall into decay, while there is talent or sensibility among his countrymen to appreciate his writings. It may be confidently inferred that the English language will remain subject to as little mutation as the Italian has been, since works of enduring excellence were first produced in it;—the prose of Boccaccio, and the verse of Dante, so far as dialect is concerned, are as well understood by the common people of their country at this day, as the writings of Chaucer and Gower are by the learned in ours.

" Had *no* works of transcendant originality been produced within the last hundred and fifty years, it may be imagined that such fluctuations might have occurred, as would have rendered our language as different from what it *was* when Milton flourished, as *it then* was from what it had been in the days of Chaucer, with this reverse, that, during the latter, it must have degenerated as much as it had been refined during the earlier interval. But the standard of our tongue having been fixed at an era when it was rich in native idioms, full of pristine vigour, and pliable almost as sound articulate can be to sense, —and that standard having been fixed in poetry, the most permanent and perfect of all forms of literature—as well as in the version of the Scriptures, which are necessarily the most popular species of reading,—no very considerable changes can be effected, except Britain were again exposed to invasion as it was wont to be of old; and the modern Saxons or Norwegians were thus to subvert both our government and our language, and either utterly extinguish the latter, or assimilate it with their own."

"In the eighteenth century," says Schlegel, "the English were the first people of Europe in literature as in every thing else. The whole of the modern French philosophy was produced by that of Bacon, Locke, and other Englishmen; at least it borrowed all its first principles from them. In France, however, it soon assumed an appearance quite different from what it ever had in England. In Germany, on the other hand, the mighty regeneration of literature, in the middle of this century, received its first impetus and ruling direction principally from the poetry and criticism of the English."

Some progress appears now to have been made in the fine arts. A collection of antiques and other objects of curiosity, bequeathed to Charles I. by Prince Henry, appears first to have directed his attention towards painting and sculpture; the taste was afterwards fostered in him by the Duke of Buckingham, and his merits, as a connoisseur, and a patron of art and artists, were unquestionably great.

Rubens, the celebrated Flemish painter, came to England about the year 1630, charged with an important commission from the King of Spain. Hostilities having meanwhile commenced with that country, he could not be received by Charles and his ministers as an accredited envoy; yet, as a private individual, he was treated with the highest distinction by the whole English court. He received from the king the honour of knighthood, and the Duke of Buckingham purchased a large collection of his paintings and other curiosities, to the amount of ten thousand pounds.

Sir Anthony Vandyke, a native of Antwerp, and a pupil of Rubens, finding that his talents were not duly appreciated on the continent, came to reside in England, where he amassed great wealth by the exercise of his professional talents. During his short but splendid career he gathered around him all the literature of his age, and was caressed and flattered by men of the highest rank in society.

Masonry was now employed for the public edifices of London, but the mansions of the nobility were then merely of brick, and the houses of the citizens of timber; in the reign of Charles I., however, stone houses were erected in London; and the Earl of Arundel was almost the first who introduced the practice of building in that material.

Inigo Jones, the most celebrated of English architects, was born in 1572, of obscure parents, and was apprenticed to a joiner. In this humble sphere he practised drawing and designing for his amusement. Some of his early productions having been shown to the Earl of Pembroke, that liberal patron of the arts determined to send him to Rome. Here, in the admiring contemplation of its specimens of ancient architecture, his breast was fired with ambition to rival the most perfect models of antiquity. For some years he resided in Denmark, and was patronised by Christian IV., the reigning sovereign. Thence he was taken to Scotland by James I., and he followed in the train of that prince on his coming to the possession of the English crown. A second visit to Italy improved his taste, and elevated his genius. After his return, he planned and executed several of those edifices which still adorn the British capital, and have excited the admiration of the intelligent from all parts of the world. To the commanding influence of this celebrated man, the introduction into this kingdom of the Roman and Grecian style of building, in place of the Gothic, which had hitherto prevailed, is chiefly to be attributed.

The civil dissensions of the reign of Charles, however, cut short many fair designs for the advancement and embellishment of social life, and deprived many eminent scholars and distinguished artists of a valuable friend and munificent patron. Still a powerful impulse had been given both to taste and learning; and notwithstanding the temporary check which they sustained, no ground was absolutely or permanently lost. Manners had been refined and civilized, and a race of men had been formed, who carried into civil war itself habits and principles which greatly restrained its license, and almost totally deprived it of the ferocity which in all other ages and countries had formed its leading characteristic.

Architecture was in abeyance in this country from the troublous times of Charles I., till the restoration of the monarchy, in the person of his son, whose French taste would have completely Gallicized the edifices, as well as the manners and morals of the nation, had not the resplendent genius of Sir Christopher Wren averted, or rather modified the infliction.

He is worthy of remembrance from his philosophical researches, and his revival of the fine arts. In 1657 he was elected professor of astronomy in Gresham College, and in 1661 was appointed to the Savilian professorship of astronomy at Oxford. Having directed his studies to architectural science, he was associated with Sir John Denham in the office of surveyor of his Majesty's works, at a time in which the finest opportunity was afforded for the development of his talents. A great part of the metropolis had been laid in ruins by the dreadful conflagration of 1666; and to him was chiefly confided the important work of raising it from its ashes. Having traversed the continent of Europe to inspect the most superb monuments of antiquity, he returned to superintend the rebuilding of the city of London. In accomplishing this object, Sir Christopher Wren had more opportunity of displaying his skill in architecture than any individual before or since. Besides the restoration of a considerable number of smaller churches, he had the honour of erecting the Cathedral of St. Paul, which, next to that of St. Peter at Rome, is the most magnificent edifice in the modern world.

The lofty steeples which frequently crowned the towers of the Gothic cathedrals continued to be raised over churches, where the Roman style had superseded that which before prevailed, and appear to have been considered an essential characteristic and ornament of an ecclesiastical edifice. Sir Christopher Wren, who almost invariably employed the Italian or Roman style in the churches he built, raised his towers from the ground in front, and placed on them steeples of a pyramidal form and vast height, which he decorated in a manner corresponding to the architecture of the body of the church, as much as their tapering forms would permit. The most remarkable of these towers is that of St. Bride's Church, in Fleet-street.

Buildings were not wanting to present a contrast to such edifices. The Mansion-House, in which the Lord Mayor for the time being resides, is a huge pile, and has been said to look "as if it were built by a ship-carpenter." It is stated that the celebrated amateur architect, Lord Burlington, to whose taste London is indebted for some fine private mansions, sent the corporation an original design by Palladio. "Who is this Palladio? Is he a *freeman?*" said a civic cognoscento. He was answered in the negative. A discussion arose; it lasted some time, and was then abruptly terminated by some one saying, "Palladio was a papist;" and the result was the erection of the present edifice by the *city architect.*

It is said that Sir Kenelm Digby brought some of the marble bases, columns, and altars, from the ruins of the temple of Apollo at Delos; and at a later period, the travels of Messrs. Wheeler and Spon, in Greece, made the artists of England acquainted with the nature of the buildings yet remaining in that country; but neither these relics of Grecian sculpture, nor the general descriptions of the edifices, seem to have had any influence on taste at the time; but afterwards, when the admeasurements of the ancient buildings of Athens were published, a revolution took place. The subsequent publication of the remains of Grecian architecture in Sicily, Italy, and Asia Minor, seems to have confirmed that preference; and down to the present day, the greater part of the English buildings are formed on Grecian models, with slight modifications.

An improvement in the exterior was accompanied by attention to the interior of buildings. Foreign artists, of considerable eminence, were now employed to paint walls, staircases, and ceilings, with figures and arabesques; and collections of pictures began to be formed. Fine carving and gilding was bestowed on various articles of furniture; and with such profusion were the richest materials brought into use, that state beds of gold and silver tissue, embroidered velvet, or silk damask fringed with gold, silk carpets from Persia, toilets covered with ornamental pieces of dressing plate, tables of massive silver richly embossed with figures, and enormous cabinets elaborately carved in ebony, became the familiar ornaments of the principal mansions.

The Marquis de Ferté-Imbaud, who was sent to England in 1641, as ambassador from the court of France, counted, in the river between London and Rochester, eight hundred and fifty vessels, "half," he says, "ships of war, and half merchantmen. The Sovereign of the Sea, the largest ship in the navy, being of 112 guns, he and his attendants went on board, and were astonished at the magnificence of this 'floating palace.' It was covered with paintings, carving, gilding, and bas-reliefs; all was wonderfully neat, and the cabins exceedingly spacious and elegant."

In sculpture, during the time of Charles, we meet with the names of Christmas and Stone, Englishmen. The principal works after this period were by foreigners; and we find that Cibber, Scheemacker, Roubiliac, and others of their school, had all the employment in art. Such was its state in England till the middle of the last century, when, under the auspices of George III., sculpture and the sister arts rose into notice, and were practised by native artists, with honour to themselves and to their country.

The Earl of Arundel, the earliest and greatest of English collectors, was, however, eagerly prosecuting his inquiries after the remains of ancient art both in Europe and Asia ; and the splendid Buckingham, whether from genuine taste for these objects, or from that passion for every kind of magnificence which sometimes assumes its semblance, trod zealously in his footsteps. Sir Thomas Roe, when at Constantinople, acted as a kind of factor to both these noblemen, for the discovery and purchase of marbles, coins, and other curiosities. It appears that an extremely skilful and enterprising agent had been sent out by the Earl of Arundel, specially to explore the continent and islands of Greece, and the shores of Syria and Lesser Asia; the fruits of whose labours were no less than two hundred pieces of sculpture. The researches of Sir Thomas Roe, on behalf of the Duke of Buckingham, were extended by means of consuls, Greek priests, and other agents, from Smyrna to Prusa, Troy, and Pergamos; to Sinope on the Euxine; and zealously prosecuted along the coasts of Thessaly, and at Delphi, Delos, Corinth, Thebes, Athens, Sparta, and many other Grecian cities and islands ; and a splendid collection seems to have been the result of these efforts, although great difficulties arose from the scruples of the Turks and the avidity of the Venetians, and all attempts to gain permission to make excavations were encumbered by the usual jealousies of barbarians, who always imagine hidden treasures to be the real object of such researches.

Until the year 1670 the native engravers limited themselves to maps, cuts, and small portraits for books, all of which are greatly below mediocrity. John Payne is the first English engraver that merits attention. His chief works are frontispieces and other book cuts, and portraits ; he also executed a variety of other subjects, as landscapes, animals, flowers, fruit, and birds ; but several of his portraits are very fine, and by far the best of his works. Of others honourable mention may also be made.

The mode of engraving called mezzotinto, is said to have been suggested to Prince Rupert, by observing a soldier one morning rubbing off from the barrel of his musket, the rust which it had contracted from being exposed to the night dew. He perceived, on examining the gun, that the dew had made on its surface a number of very minute holes, so as to form the resemblance of a dark engraving, parts of which had been already rubbed away by the soldier. He immediately saw it would be practicable to find a method of covering a plate of copper in the same manner with little holes, which being inlaid, and laid on paper, would undoubtedly produce a blank impression, while by scraping away in different degrees such parts of the surface as might be required, the paper would be left white wherever there were no holes. Pursuing the thought, he at last, after various experiments, invented a species of steel roller, covered with points, or salient teeth, which, being pressed against the copper-plate, indented it in the manner he wished; and then the roughness thus occasioned had only to be scraped down, when necessary, in order to produce any gradation of shade that might be desired. Some writers state, however, that this mode was the invention of Lieut.-Colonel de Siegen, that he thus engraved the portrait of the Landgravine of Hesse, in 1643, and that of him the art was learnt by the Prince, by whom it was much improved.

But however successfully native genius and energy have brought this art to a degree of excellence never surpassed, we are much indebted to foreign aids for the foundation of our graphic fame. As it was truly observed during the last long war with France, that many of our best ships were taken from our maritime rivals, so may it be as truly affirmed that the industry and talent of Great Britain have profited by the progress of foreign engravers, and with honourable rivalry have not only made the labours of foreign hands their own, but have improved on the inventions of their competitors.

Charles I., during the life of his father, was a scholar of Coperario, (Cooper,) and, it is said, had acquired considerable facility on the viol di gamba. He had much affection for music, and especially for that of the Church; hence he encouraged the art and its professors, who, though not men of great genius, were the best of which the nation could boast at this time. After this period, music for a time declined; but before the Restoration of Charles II. instrumental music, and particularly stringed, began to make its way in England.

Of Henry Purcell it has been affirmed, that during a short life, and in an age almost barbarous for every species of music but that of the church, he manifested more original genius than any musician, under similar circumstances, in any part of Europe. His powers embraced every kind of composition with equal facility. In the theatre he knew how to produce the utmost effect of which an orchestra was then capable; in the church, fugue, imitation, or plain counterpoint, or the expressive style of accompanying the voice with instruments, whereof he was the founder; in the chamber, sonatas for instruments, odes, songs, ballads, cantatas, and catches, were equally easy to him. He became the wonder of the nation, and till the arrival of Handel was almost the only composer whose works commanded attention.

After the death of Purcell there were many eminent composers, and among them Dr. Henry Aldrich, appointed Dean of Christ Church in 1689, who was not only profoundly skilled in the theory and practice of harmony, but who also distinguished himself as a scholar, a theologian, a profound critic, and an able architect, and who possessed exquisite taste in arts, science, and literature in general. He has been succeeded by Croft, Boyce, Battishill, and a host of others.

The names of several authors are familiar to every reader on agriculture, or on rural economy at large. The Sylva and Terra of one of them, Evelyn, still retain a merited reputation. In fact, the improvement which took place in the management of land in this country from the reign of James II. down to the middle of the last century, was not very great; and hence the writers on husbandry between the period of the Revolution and the accession of George III. are not, generally speaking, superior to those who published nearly a hundred years before them. The chief exception to this remark appears in Jethro Tull, a gentleman of Berkshire, who introduced the practice of drilling wheat and other crops about the year 1701, and who, thirty years afterwards, put forth a book on horse-shoeing husbandry.

The most extensive of the continental planters was Louis XIV., who removed an entire forest, the Bois de Boulogne, from Versailles to its present site, a distance of more than seven miles. But these were efforts of power rather than of science, for the trees were much torn and mutilated by the operation. The great transplanting machine which was made use of in these extraordinary experiments remained at Versailles till, probably, about the time of the French revolution. Le Notre was the artist employed in these operations—the same who laid out the gardens of Versailles, and planted St. James's and Greenwich Parks.

Evelyn informs us that the example of the French was soon followed in this country; and that he himself had "frequently removed elms as big as his waist." The methods at first used for the transporting of trees, if not very scientific, were extremely ingenious. The object was to raise them with a large ball of earth, and move them along in a vertical position. Sometimes they called in the aid of frost, by cutting a trench and moving the earth round the tree, before the autumnal rains. When the frost set in, the bulb was consolidated, and could be cut in one mass along with the tree; but in the case of large trees, the weight of these bulbs was very great; and they could be raised only by powerful cranes, which were also necessary to move the tree to and from the platform on which it was transported. The platform was made low, and with small wheels, which further augmented the force necessary for its removal, and thus the transportation of even a moderate tree for a short distance required a great deal of animal power. Many trees were, however, moved about Blenheim, and some of the other seats of the nobility.

About sixty years after the time of Evelyn, the transplanting machine was invented by Brown, the celebrated landscape gardener; and the removal of large trees became much more easy. The machine consisted of two very high wheels, an axle and a pole; and when the trees were large, a truck wheel was used at the end of the pole. The tree was considerably lopped, the earth loosened from the roots, the pole set erect and lashed to the stem; and then, a purchase being made fast to the upper part of the pole, the whole was pulled at once, and drawn horizontally along. Still though this machine, and the mode of using it, were great improvements on the methods recommended by Evelyn, yet the trees were subjected to much mutilation, and they did not recover their beauty and vigour till some time had elapsed.

The weeping willow is a native of the Levant, but it thrives well in England, if the situation be not too cold, and near the water. It rises to a considerable height, and no tree can be more graceful on the brink of a lake or stream. It is said that Pope, the poet, planted the first in England. Having received a present of figs from Turkey, he observed a twig of the basket in which they were packed putting forth a shoot; this he planted in his garden, and it soon became a fine tree, from which all the weeping willows in England have sprung. This parent tree was, however, cut down a few years ago.

The discovery of mahogany was accidental, and its introduction into notice was slow. The earliest mention of it is that it was used in the repair of some of Sir Walter Raleigh's ships, at Trinidad, in 1597. Its finely variegated tints were admired; but in that age the dream of El Dorado caused the neglect of what was really valuable. The first that was brought to England was about the beginning of the last century, a few planks having been sent to Dr. Gibbons, of London, by a brother, who was a West India captain. The doctor was erecting a house in King street, Covent Garden, and gave the planks to the workmen, who rejected them as being too hard. His cabinet-maker, named Wollaston, was however employed to make a candle-box of the wood, and as he was sawing it, he also complained of the mahogany ; but when the article was finished, it outshone in beauty all the doctor's other furniture, and became an object of great-curiosity. The wood was then taken into favour. Dr. Gibbons had a bureau made of it, and the Duchess of Buckingham another. The despised mahogany now became a prominent article of luxury, and at the same time raised the fortunes of the cabinet-maker, by whom it had been at first so little regarded.

In the reign of Charles I. Parkinson published his great work, "Paradisi in Sole Paradisus Terrestris, or a Garden of all sorts of pleasant Flowers, with a kitchen Garden of all manner of Herbs and Roots, and an Orchard of all sorts of fruit-bearing Trees." He describes fifty-eight sorts of apples, sixty-four pears, sixty-one plums, twenty-one peaches, five nectarines, six apricots, thirty-six cherries, three figs, and twenty-three vines, with sorts of most of the smaller hardy fruits still cultivated. Thirty-five years after the appearance of Parkinson's work, the celebrated Evelyn did for the trees of the forest what his predecessor had done for those of the orchard.

Charles II. paid some attention to the luxury of fruit, one of his very few harmless propensities. Le Notre was his landscape gardener, and Rose his private gardener. He also had studied in France, and was so skilled in the management of hot-houses, now first introduced, as to be able to produce ripe cherries and strawberries at an installation dinner holden at Windsor on the 23d of April, 1667.

The first oranges, it is stated, were imported into England by Sir Walter Raleigh; and it is added that Sir Francis Carew, who married the niece of Sir Walter, planted their seeds, and that they produced the orange-trees at Beddington, in Surrey, of which Bishop Gibson, in his additions to Camden's Britannia, speaks as having been there for a hundred years previous to 1695. As these trees always produced fruit, they could not, as Professor Martyn justly observes, have been raised from seeds; but they may have been brought from Portugal, or from Italy, (the places where orange-trees have usually been obtained,) as early as the close of the sixteenth century.

The fine cider orchards of Herefordshire began to be planted in the reign of Charles I. The adaptation of these apples to the soil was quickly discovered, and they spread over the face of the whole country. At the time when cider was first manufactured in England, it was believed that it would almost wholly supersede the use of foreign wines.

The Ashmolean Museum was the first public institution in England for the reception of rarities in art and nature; and in the infancy of the study of natural history in this country it possessed what was then considered a valuable and superior collection. It owes its foundation to Elias Ashmole, who offered to bestow on the University all the collections in natural history which had been bequeathed to him by the Tradescants, the eminent botanists and gardeners at Lambeth; and to add to these his own coins, manuscripts, and books, provided the University would defray the expense of erecting a proper building for their reception. The offer was accepted, and the present edifice raised under the direction of Sir Christopher Wren. It is admired for its just architectural proportions, although the situation is unfavourable, and the portico is nearly obscured in the narrow passage between it and the theatre. The contributions to this museum have been numerous; but in the course of a century the apartments had become much dilapidated, and the collections had sustained great injury and decay, when the interest excited by Paley's work on Natural Theology, and by the physiological lectures of Professors Kidd and Buckland, induced the trustees to exert themselves in putting both the building and collections into a greatly improved condition.

Until 1690 scarcely any kind of paper was made in England except the common brown sort; but the war with France occasioning high duties on foreign paper, the French Protestant refugees settled chiefly in England; and our own paper-makers now began to make white writing and printing paper, though a considerable time elapsed before they reached perfection as to beauty or substance.

An act of parliament preventing the exportation of wool by making it a felony, was passed soon after the Restoration. To escape from this and similar shackles two thousand manufacturers left the kingdom in 1665, and established woollen manufactures in the Palatinate, under the wise patronage of the Elector; and they were soon reinforced by a band of manufacturers from Herefordshire. In 1688, however, about fifty Walloons came over to England, and received royal encouragement in the working and dying of fine cloths from Spanish wool alone, without admixture with inferior wool,—arts unknown to this nation before, and indeed declared to be impossible. George Fox, the founder of the Quakers, in the reign of Charles I. travelled as a missionary through the country, buttoned up in a *leathern* doublet with sleeves, instead of a cloth coat, this being the common dress, at the time, of labouring mechanics, to which class this gifted individual belonged.

Linen has never formed one of the staple manufactures of England, flax having been less cultivated amongst us than on the opposite shore of the Netherlands, a country which, in the fourteenth and fifteenth centuries, supplied the rest of Europe with the finest linens and woollens. When England subsequently advanced in manufacturing arts, the abundant supply of wool pointed out the most suitable branch; and we were contented to continue our imports of linen from the Netherlands, from France, and from Germany, or to favour the manufacture of the sister island in a department which did not excite our jealousy. In Ireland, the linen manufacture dates about two centuries ago, and is said to have owed much of its extension to the measures of the unfortunate Wentworth, in the reign of Charles I. The annual consumption of linen in England a century since was probably not far below that of her double population now, owing to the very general substitution in our time of cotton articles. Then, as at present, the linen manufacture of England was established chiefly in Lancashire, in Cumberland, and in a county very remote from them, namely Dorsetshire.

In 1685, the revocation of the edict of Nantes compelled many merchants, manufacturers, and artificers, to fly from France: and about 70,000 made their way to England and Ireland, with as much property as they were able to remove.

" The first effort of our French refugees," says De Foe, " was our thin black crapes, a manufacture purely their own. I refer to the memory of people conversant with trade how universally it pleased our people; so that the least quantity of wool that ever was heard of in a garment supplying the room of a suit of cloth, it became a general habit, and the ladies of the best quality began to appear in a gown and petticoat under twenty-five shillings, till the meanness of the price giving every servant an opportunity to be as fine as her mistress, it grew a little obsolete among the women. Then the men fell into it. It served gentlemen for waist-coats, all men for linings, and for a time, the clergy for gowns."

A large number who had been engaged in the fabrication of silks resorted to Spitalfields, and contributed much by their knowledge and skill to the improvement of the manufacture in England. The silks called alamodes and lustrings were introduced by them; and to them we are also indebted for our manufactures in brocades, satins, black and coloured mantuas, black paduasoys, ducapes, watered tabbies, and black velvets, all of which fabrics had been previously imported.

A further improvement in the manufacture of silk is traced to the family of the Lombes, who were originally manufacturers at Norwich, but removed to London, and became silk-throwsters and merchants there. They had a house at Leghorn under the firm of Glover and Unwin, who were their agents for purchasing the raw silk, which the Italian peasantry sold at their markets and fairs to the merchants and factors. There were many other English houses at Leghorn, Turin, Ancona, and other parts of Italy, chiefly for exporting silk to England, in part return for which numerous cargoes of salt-fish were, and still are, received from our ports for the consumption of the Italians during their Lent and other fasts. It was at that time customary for the English merchants engaged in the Italian trade to send their apprentices and sons to the Italian ports, to complete their mercantile education by acquainting themselves on the spot with the details of their peculiar line of business. It was professedly in compliance with this custom, but with a deeper ulterior view, that the youngest of the brothers, Mr. John Lombe, who at that time was little more than twenty years of age, proceeded to Leghorn in the year 1715.

The Italians had at that time become so much superior to the English in the art of throwing silk, in consequence of a new invention, that it was impossible for the latter to bring the article into the market on equal terms. The state of the trade induced the Lombes to consider by what means they might secure the same advantage which their improved machinery gave to the Italians: and the real view of the younger brother in proceeding to Italy was, to endeavour to obtain such an acquaintance with it as might enable him to introduce it into this country. The difficulties in the way of this undertaking were very great, and would have appeared insurmountable to any but a person of extraordinary courage and perseverance.

It is said, for instance, in a printed statement of Sir Thomas Lombe's, that—"The Italians having, by the most judicious and proper rules and regulations, advanced and supported the credit of the manufacture, have also, by the most severe laws, preserved the mystery among themselves for a great number of years to their inestimable advantage. As, for instance, the punishment prescribed by one of their laws, for those who discover, or attempt to discover, any thing relating to this art, is death, with the forfeiture of all their goods, and to be afterwards painted on the outside of the prison walls, hanging to the gallows by one foot, with an inscription denoting the name and crime of the person; there to be continued for a perpetual mark of infamy."

The younger Lombe, however, was not to be deterred by the danger and difficulty of the enterprise. On his arrival, and before he became known in the country, he went, accompanied by a friend, to see the Italian silk-works. This was allowed under very rigid limitations: no person was admitted except when the machinery was in action, and even then he was hurried through the rooms with the most jealous precaution. The celerity of the machinery rendered it impossible for him to comprehend all the dependencies and first springs of so extensive and complicated a work. He went with different persons in various habits, as a gentleman, a priest, or a lady; and he was very generous with his money; but he could never find an opportunity of seeing the machinery put in motion, or of giving to it that careful attention which his object required. Despairing of obtaining adequate information from such cursory inspection as he was thus enabled to give, he thought of associating with the clergy, and, being a man of letters, he succeeded in ingratiating himself with the priest who confessed the family to which the works belonged. To him he seems to have opened his plans, at least in part, and it is certain that he found means to obtain his co-operation. According to the scheme which they arranged between them, Mr. Lombe disguised himself as a poor youth in want of employment. The priest then introduced him to the directors of the works, gave him a good character for honesty and diligence, and described him as inured to greater hardships than might be expected from his appearance. He was accordingly engaged as a fillatoe-boy, to superintend a spinning-engine so called. His mean appearance procured him accommodation in the place which his design made the most acceptable to him—the mill. While others slept, he was awake and diligently employed in his arduous and dangerous undertaking. He had possessed himself of a dark lantern, tinder-box, wax-candles, and a case of mathematical instruments. In the day-time these were secreted in the hole under the stairs where he used to sleep; and no person ever indicated the least curiosity to ascertain the extent of the possessions of so mean a lad. He thus went on making drawings of every part of this grand and useful machinery; the priest often inquired after his poor boy at the works, and through his agency, Lombe conveyed his drawings to Glover and Unwins; with them models were made from the drawings, and despatched to England piecemeal in bales of silk. These originals are still, it is believed, preserved in the Derby mills.

After Lombe had completed his design he still remained at the mill, waiting till an English ship should be on the point of sailing for England. When this happened, he left the works and hastened on board. Meanwhile his absence had occasioned suspicion, and an Italian brig was despatched in pursuit; but the English vessel happily proved the better sailer of the two, and escaped. It is said that the priest was put to the torture; but it is affirmed, after Mr. Lombe's return to England, an Italian priest was much in his company; and it is thought that this was either the priest in question, or, at least, another confederate in the same affair. Mr. Lombe also brought over with him two natives accustomed to the manufucture, for the sake of introducing which he had incurred so much hazard.

After his return, Mr. Lombe appears to have actively exerted himself in forwarding the works undertaken by him and his brother, Sir Thomas, at Derby; but he did not live to witness their completion. The common account of his death is, that the Italians, exasperated at the injury done to their trade, sent over to England an artful woman, who associated with the parties in the character of a friend; and, having gained over one of the natives who originally accompanied Mr. Lombe, administered a poison to him, of which he ultimately died.

The document of Sir Thomas Lombe, already referred to, is entitled, "A brief State of the Case relating to the Machine, erected at Derby, for making Italian Organzine Silk, which was discovered and brought into England, with the utmost difficulty and hazard, and at the sole expense of Sir

Thomas Lombe." It commences with describing the capabilities of the machine. "This machine performs the work of making Italian organzine silk, which is a manufacture made out of fine raw silk, by reducing it to a hard-twisted, fine, and even thread. This silk makes the warp, and is absolutely necessary to mix with and cover the Turkey, and other coarser silks, thrown here, which are used for shute, so that without a constant supply of this fine Italian organzine silk, very little of the said Turkey and other silks could be used, nor could the silk-weaving trade be carried on in England. This Italian organzine (or thrown) silk has, in all times past, been bought with our money, ready made (or worked) in Italy, for want of the art of making it here. Whereas now, by working it ourselves out of fine Italian raw silk, the nation saves nearly one-third part; and by what we make out of fine China raw silk, above one-half of the price we pay for it ready worked in Italy." The paper goes on to state, that "the machine at Derby has 97,746 wheels, movements, and individual parts, which work day and night, all which receive their motion from one large water-wheel, and are governed by one regulator; and it employs three hundred persons to attend and supply it with work." After stating the difficulties which had been surmounted in introducing this improvement, the paper thus concludes:—"Upon its introduction, his late most gracious Majesty granted a patent to the said Sir Thomas Lombe, for the sole making and use of the said engines in England, for the term of fourteen years. Upon which he set about the work, and raised a large pile of building upon the river Derwent, at Derby, and therein erected the said machine; but before the whole could be completed, several years of the said term were expired. Then the King of Sardinia, in whose country we buy the greater part of our supply of organzine silk, being informed of his success, prohibited the exportation of Piedmontese raw silk, so that before the said Sir Thomas Lombe could provide a full supply of other raw silk proper for his purpose, alter his engine, train up a sufficient number of work-folk, and bring the manufacture to perfection, almost the whole of the said fourteen years were run out. Therefore, as he has not hitherto received the intended benefit of the aforesaid patent, and in consideration of the extraordinary nature of his undertaking, the very great expense, hazard, and difficulty he has undergone, as well as the advantage he has hereby procured to the nation at his own expense; the said Sir Thomas Lombe humbly hopes the parliament will grant him a further term for the sole making and using his engines, or such other recompense as, in their great wisdom, shall seem meet."

The parliament, considering the matter of much public importance, thought it best to give him a grant of 14,000*l.*, on condition that the invention should be thrown open to the trade, and that a model of the machine should be deposited in the Tower of London for public inspection. It is commonly stated that parliament refused to extend the patent, and granted the money to soften their refusal; but we have seen that Sir Thomas himself suggested some "other recompense" than an extended patent as an alternative. In the course of time similar mills began to be erected in different parts of the country; but in consequence of the difficulties that were experienced in procuring Italian raw silk of the proper size for organzine, the exportation of which was prohibited by the Italians, and also because the mills happened subsequently to find employment for other purposes, the quantity worked into organzine in this country bore, for many years, no proportion to the imports from Italy. The manufacture has, however, been since revived and improved, in consequence of which it is now carried on to a very considerable extent, not only in Derby, but in other parts of the country.

It is remarkable that the English, although they had so long a monopoly of the tin trade, and, moreover, possessed the richest mines in the world, should nevertheless have failed, as it appears, until a comparatively recent period, in their attempts at tin-plating. Beckmann states, that about the year 1670 a company sent to Saxony, at their expense, an ingenious man, named Andrew Yarrenton, in order to learn the process of tinning. Having acquired there the necessary knowledge, he returned to England with some German workmen, and manufactured tin plate, which met with general approbation. Before the company, however, could carry forward business on an extensive scale, a man of some distinction, having made himself acquainted with Yarrenton's process, obtained a patent for this art; and the first speculators were obliged to give up their enterprise, which had cost them a great deal of money. Still no use was made of the patent which had been obtained. Such is the account of the matter as it stands in the authority quoted; but it may be reasonably doubted that the process, carried on by the English adventurer, and his German colleagues, was patented to an individual who himself purloined it.

More certain and remarkable is it, that about the year 1720,—which, on account of the many new schemes, and the deceptive trade carried on in consequence of them, will ever be memorable in the history of English folly,—among the many bubbles, as they were then called, was the formation of an establishment for making tin plate; and this was one of the few speculations of that period which were attended with advantage. The first manufactory of this kind was established in Monmouthshire, at the village of Pontypool, where tin plate was afterwards so extensively and successfully prepared. Towards the latter end of the last century, tin-plate works were erected in this country almost wherever the manufacture of iron was largely carried on; the perfection of the method of laminating the metal by means of rollers, having more than any thing else contributed to the success of these undertakings.

Though the product of the copper mines was now greater than before, from the increased industry of the people, and the improved state of the arts, yet little advantage seems to have been derived to the county of Cornwall at large from the working of this metal. The ignorance in which the mine proprietors were kept by the merchants, with respect to the uses and application of the metal, has been assigned as one reason of the small profits produced. Afterwards, however, all this mystery was dispersed, the mines were inspected, their value determined, and a system of working them to a greater advantage introduced.

In the reign of George I. the Cornish mining system in general, and particularly as it related to copper, was much improved. Mr. John Costar was the person to whom the country is indebted in this respect. Being an excellent metallurgist, and a good natural philosopher and mechanic, he undertook the draining of some considerable mines, and executed the attempt with success. He then introduced a new system of dressing and assaying the ore, improved on the old machinery, and invented new engines: in short, he seems to have given a new character to the copper concerns of Cornwall, and been the father of many of the processes which render them so profitable as they are at present.

The invention of spring or pocket watches is of comparatively recent date. It is true that we read of a watch presented to Charles V.; but this was, in all probability, nothing more than a kind of clock to be placed on a table. The honour of this very useful invention lies between Dr. Hooke and Mr. Huygens; the English ascribe it to the former, and the French and Dutch to the latter. Repeating pocket watches were not known before the reign of James II.

The manufacture of coal-tar on a large scale, and with a commercial object, long preceded the idea of applying the inflammable vapour so abundantly evolved during the process for purposes of illumination. In a work published at Frankfort in 1683, by John Joachim Becher, he says, "In Holland there is turf, and in England there are coals, neither of which are good for burning, either in apartments or smelting houses. I have, however, discovered a method of burning both these to good coals, so that they shall not only produce no smoke or bad smell, but yield as strong a heat for melting metals as that of wood, and *throw out such flames that a foot of coal shall make a flame ten feet long.*" Here we have not only the idea, but an actual description of the phenomenon produced by a common gas apparatus. The author proceeds—"This I have demonstrated at the Hague with turf, and proved here in England with coals, in the presence of Mr. Boyle, by experiments made at Windsor on a large scale. It deserves to be remarked on this occasion, that as the Swedes procure their tar from firwood, I have procured tar from coals, which is in every thing equal to the Swedish, and even superior to it for some purposes. I have tried it both on timber and ropes, and it has been found excellent. The king himself (Charles II.) ordered a proof of it to be made in his presence. This is a thing of very great importance to the English; and the coals, after the tar has been extracted from them, are better for use than before."

The post-office was not established in England till the seventeenth century. There were post-masters, indeed, in more ancient times, but their business was confined to the furnishing of post-horses to persons who were desirous of travelling expeditiously, and to the despatching of extraordinary packets on special occasions. At first, too, the establishment just mentioned was employed only for the conveyance of letters to and from foreign countries. In the reign of Charles I. a letter-office for England and Scotland was placed under the management of Thomas Witherings, and the rates of postage were settled by royal authority in 1635. But this convenience was afforded to only a few of the principal roads, and there was no certainty of the times of departure or receipt of letters committed to it. In the confusion occasioned by the civil war, considerable interruption occurred in the management of the letter-office. The advantages of the institution had, however, become sufficiently apparent at that time to prevent its falling into disuse; and the attorney-general to the Commonwealth was appointed post-master by a resolution of both houses of Parliament. In the execution of his office he first established, in 1649, a weekly conveyance of letters to all parts of the kingdom.

The first turnpike road was established by an act of parliament in the reign of Charles II., but so great was the insensibility to the improvement, that the mob pulled down the gates, and the new plan was supported and enforced at the point of the bayonet. Long after this period, however, travelling was both difficult and dangerous.

It is also worthy of remark, that a fear of what would now be called improvements was cherished by the higher ranks, and that many things which have been actually accomplished were then considered totally impracticable. Thus, for instance, in April 4, 1671, the second reading of a bill was moved in the House of Commons, "for building a bridge over the river Thames at Putney." On that occasion Sir William Thompson thus spoke:—

"Mr. Speaker, — London is circumscribed, I mean the city of London; there are walls, gates, and boundaries, the which no man can increase or extend; those limits were set by the wisdom of our ancestors, and God forbid they should be altered. But, Sir, though these landmarks can never be removed—I say *never*, for I have no hesitation in stating, that when *the walls of London shall no longer be visible, and Ludgate is demolished, England itself will be as nothing*—though, Sir, these landmarks are immoveable, indelible, indestructible, except with the constitution of the country, yet it is in the power of speculative theorists to delude the minds of the people with visionary projects of increasing the skirts of the city, so that it may *even join Westminster.*"

Mr. Boscawen said,—"If there were any advantage derivable from a bridge at Putney, perhaps some gentlemen would find out that a *bridge at Westminster* would be a convenience. Then other honourable gentlemen might dream, that a bridge from the end of *Fleet-market into the fields,* on the opposite side of the water, would be a fine speculation; or who knows but at last it might be proposed to arch over the river altogether, and build a *couple more bridges, one from the palace at Somerset-house into the Surrey marshes,* and another from the *front of Guildhall into Southwark.* (*Great laughter.*) Perhaps some honourable gentlemen, who were interested in such matters, would get up in their places, and propose that one or two of these bridges should be built of iron! (*Shouts of laughter.*) For my part, if this but passes, I will move for leave to bring in half a dozen more bills, for building bridges at Chelsea, and at Hammersmith, and at Marble-hall Stairs, and at Brentford, and at fifty other places besides." (*Continued laughter.*)

Mr. Low declared it to be the opinion of the "worthy chief magistrate," that if *any carts go over Putney bridge,* the city of London was irretrievably ruined! and added, that the river above London bridge would be *totally destroyed* as a navigation.

In the present day, it is not only highly amusing to read these denunciations of misery and ruin, but we are thereby reminded of the fallacy of human judgment and foresight. Not only is there a bridge at Putney, but the forebodings of Mr. Boscawen are almost all realized as relates to the erection of bridges; although not so as to their desolating effects on the city of London. A bridge at Westminster *is* found to be a *convenience;* another has been erected from Fleet-market into the opposite fields, at Blackfriars; even the "couple more" are really in existence, and nearly on the sites pointed out—the Waterloo and Southwark bridges; and, what is still more remarkable, it has not only been "*proposed*," but one of these (the Southwark bridge) *is actually built of iron.* Sir William Thompson, had he lived to the present moment, might have sought in vain for the *walls* of London. Ludgate-bar is demolished; the "wall, gates, and boundaries, set by the wisdom of our ancestors, which no man could increase or extend," have disappeared. London is extended on every side, so that the *skirts* of the city are not to be distinguished by a stranger from Westminster.

The conclusion of this remarkable debate is not less deserving of notice. Sir Henry Herbert, just before the house divided, said: "I honestly confess myself an enemy to monopolies; I am equally opposed to mad, visionary projects; and I may be permitted to say, that in the late king's reign several of these thoughtless inventions were thrust upon the house, but most properly rejected. If a man, Sir, were to come to the bar of the house, and tell us that he proposed to convey us regularly to Edinburgh, in coaches, *in seven days*, and bring us back *in seven days more*, should we not vote him to Bedlam? Surely we should, if we did him justice; or, if another told us he would sail to the Indies in *six months*, should we not punish him for practising upon our credulity? Assuredly, if we served him rightly."

THE

# AGE OF INVENTION.

## THE AGE OF INVENTION.

A.D. 1730—1800.

A MARKED distinction between man in a rude and man in a civilized state is, that the one wastes his force, whether natural or acquired,—the other employs it with economy. The instruments of the former are rude—those of the latter are improved in proportion to his rise in the scale of being. Far, therefore, must we, as a people, have proceeded from original barbarism, when probably no single circumstance distinguishes our country more remarkably from all others, than the vast extent and perfection to which has been carried the contrivance of tools and machines for forming those conveniences, of which so large a quantity is consumed by almost every class of the community. At the period when they are urged on our consideration we have now arrived; and while attending to the claim thus presented, it will be necessary to glance at the literature and science of the same era.

In adverting to a striking case, it must be premised that the superior fineness of some India muslins, and their retaining their appearance longer than European fabrics, have occasioned a belief that the cotton wool of which they are woven is superior to any known elsewhere; but this is so far from being the fact, that no cotton is to be found in India which at all equals in quality the better kinds produced in the United States of America. The excellence of India muslins must be wholly ascribed to the skilfulness and patience of the workmen, as shown in the different processes of weaving and spinning. Their yarn is spun upon the distaff; and it is owing to the dexterous use of the finger and thumb in forming the thread, and to the moisture which it thus imbibes, that its fibres are more perfectly incorporated than they can be through the employment of any mechanical substitutes:—still English have superseded India manufactures.

For a long period, indeed, the machines used in the cotton manufacture of England were nearly as simple as those of India, where Forbes describes some of the people as "fixing their looms at sunrise, under the shade of tamarind and mango trees." None but the strong cottons, such as fustians and dimities, were, for a time, made in England, and for these the demand must always have been limited.

At the date of the commencement of this portion of English history, however, the centre of a period of almost uninterrupted peace—Manchester, as well as many other commercial towns, continued to make rapid strides in wealth, population, and manufacturing skill. Still the weavers were continually pressing on the spinners. The process of spinning and weaving were generally performed in the same cottage, but the weaver's own family could not supply him with a sufficient quantity of weft, and he had with much pains to collect it from neighbouring spinners. Thus his time was wasted, and he was often subjected to high charges for an article on which, as the demand exceeded the supply, the seller could set his own price. A fear of having the looms unemployed alone prevented complaints.

This difficulty was likely to be increased by an invention of Mr. John Kay, in 1738. It suggested a mode of throwing the shuttle so that nearly *twice* as much cloth might be made as was manufactured according to the usual plan. British talent, however, removed this obstacle to progress, and contrived the means by which twenty, fifty, a hundred, or even a thousand threads could be spun at once by a single pair of hands!

The inventor of this mode of spinning by rollers—one fluted longitudinally, and the other covered with leather, acting like many fingers,—was John Wyatt of Birmingham, to whose name and merits justice has not yet been done; and who, could he have applied himself as closely to the perfecting and directing of his machinery as Arkwright afterwards did, would have given the great impetus to the cotton manufacture, thirty years before the efforts of that celebrated individual.

A claim to this invention has been set up for Thomas Highs, reed-maker of Leigh; still it appears that a machine on the same principle as that which was unfinished on his hands, had, beyond all question, been completed, made the subject of a patent, and set to work by Wyatt thirty years before. Mr. Baines * has furnished a clew to extricate us from the labyrinth arising from this contention.—" It is possible," he says, " that Highs may have heard the rumour of Wyatt's invention, may have imitated it, and may thus have become the channel through which the knowledge of the invention was conveyed to Arkwright."

A communication between these parties had a rather singular origin. Arkwright had established himself as a barber, at Bolton, in the year 1760. Acquainted with a chemical process for dying hair, which, as wigs were then universal, was of considerable value, he travelled about to collect it, and to dispose of it when dyed. In 1761 he married a wife from Leigh; and the connexions he formed there are supposed to have led to his acquaintance with Highs' experiments; and it is certain that a few years after he abandoned his former business, and devoted himself to the construction of the spinning machine. He soon made his machine practicable, and in 1769 he took out a patent for the original of the present water-frame and throstle.

Meanwhile, a poor man named Hargreaves first made a machine in the county of Lancaster, which spun eleven threads—it was called the spinning jenny; and thus, though illiterate and humble, he must be considered as one of the greatest inventors

* Note R.

and improvers in the cotton manufacture. The date of his invention was some years before Arkwright obtained his patent for his water-frame, and it differs so completely from that and from Wyatt's machine, that there can be no suspicion of its being other than a perfectly original invention. He is said to have received the first idea of it from seeing a one-thread wheel overturned on the floor, when both the wheel and the spindle continued to revolve. The spindle was thus thrown from a horizontal into an upright position, and the thought seems to have struck him, that if a number of spindles were placed upright and side by side, several threads might be spun at once.

These machines removed the obstacle which had so long impeded the advance of the cotton manufacture. Not only did they turn off a much greater quantity of yarn than had before been produced, but the quality was also superior. The water-frames spun a hard and firm thread, calculated for warps, and from this time the warps of linen yarn were abandoned, and goods were woven wholly of cotton. Manufacture of a finer and more delicate fabric was also introduced, especially calicoes, imitated from those of India. The jenny was peculiarly adapted for spinning weft, so that the two inventions, instead of coming in conflict, were brought into use together.

The cotton manfacture, for some years after this great impulse was given to it, continued to move with comparative slowness. Five years elapsed before Arkwright began to receive a profit. The machinery was still, however, very imperfect, especially in the preparation of the cotton for the spinning-frame. But the manufacturers were on the alert, and the method of carding was brought to perfection. This process is necessary, that the fibres may be disentangled, straightened, and laid parallel, so as to admit of being spun ; and it was formerly done by means of hand-cards. These were brushes made of short pieces of wire, instead of bristles, the wires being stuck into a sheet of leather, at a certain angle, and the leather fastened on a flat piece of wood, with a handle. The cotton being spread on one of these cards, was repeatedly combed with another, till all the fibres were laid straight, when it was stripped off the card in a fleecy roll.

The application of rotatory motion was the grand improvement in carding, a patent for which was granted to Lewis Paul, of Birmingham. This machine was afterwards greatly improved. John Lees gave it a perpetual revolving cloth, called a feeder, on which a given weight of cotton wool was spread, and by which it was conveyed to the cylinder on which the cards were placed. Others arranged that after the wool had been carded on a large cylinder it might be stripped off by a smaller one, also covered with cards, revolving in contact with the larger, but in an opposite direction ; and at length the process was further improved by entirely covering the cylinder with narrow fillet cards, wound round it in a circular and spiral form, the effect of which was to bring off the wool in an unbroken fleece. Arkwright appears to have united these improvements, and to have produced a machine so complete that it has not been improved to the present day.

When this admirable series of machines was made known, and yarns were produced by them far superior in quality to any before spun in England, as well as lower in price, a fresh and mighty impetus was given to the cotton manufacture. Weavers could now obtain an unlimited quantity of yarn, at a reasonable price; manufacturers could use warps of cotton, which were much cheaper than the linen warps formerly used; the cotton fabrics could be sold lower than had ever before been known, and the demand for them consequently increased.

The factory system in England takes its rise from this period. The hand cards, the spinning wheel, the loom, and the jenny of small size, might be used in a cottage; but the machines now in action required more space than that afforded by a limited dwelling, and more power than could be applied by the human arm. Their weight also rendered it necessary to place them in strongly-built mills, and they could not be advantageously turned by any power then known but that of water.

Dr. Darwin thus describes the wonders of Arkwright's establishment on the Derwent, at Cromford:

> —— "Where Derwent guides his dusky floods
> Through vaulted mountains and a night of woods,
> The nymph *Gossypia* treads the velvet sod,
> And warms with rosy smiles the wat'ry god;

His pond'rous oars to slender spindles turns,
And pours o'er massy wheels his foaming urns;
With playful charms her hoary lover wins,
And wields his trident while the Monarch spins.
First, with nice eye, emerging Naïads cull
From leathery pods the vegetable wool;
With wiry teeth *revolving cards* release
The tangled knots, and smooth the ravell'd fleece:
Next moves the *iron hand* with fingers fine,
Combs the wide card, and forms th' eternal line;
Slow with soft lips the *whirling can* acquires
The tender skeins, and wraps in rising spires:
With quicken'd pace *successive rollers move*,
And these retain, and those extend, the *rove*;
Then fly the spokes, the rapid axles glow,
While slowly circumvolves the labouring wheel below."

Still much remained to be done. The water-frame spun twist for warps, but it could not be used with advantage for the finer qualities, as very fine thread was not strong enough to bear the pull of the rollers when winding itself on the bobbins. A machine was now invented by Samuel Crompton, in 1775, called the mule, or the mule jenny, for like the water-frame of Arkwright it has rollers, to reduce the roving, and like the machine of Hargreaves, it has spindles without bobbins to give the twist, and the thread is stretched and spun at the same time by the spindles, after the rollers have ceased to give out the rove. Before this time it was supposed impossible to spin eighty hanks of cotton to the pound, but as many as 350 have since been spun, each hank measuring 850 yards, and forming together a thread 167 miles in length. It was therefore justly entitled to one of its early names—

the *muslin* wheel—from its making yarn sufficiently fine for the manufacture of muslin.

The application of the steam engine to the machinery employed in spinning gave new life to the cotton trade. Its great power and uniformly regular motion supplied just what was wanted, while the principles on which it acted, and the skill with which it was made, led to many improvements in other machines of the time.

Solomon de Caus, engineer to Louis XIII. who visited England in the suite of the Elector Palatine, the husband of the daughter of James I., is believed to have been the first who proposed the raising of water by steam. A patent was granted by Charles I. for several inventions, among which were that of raising "water from low pitts, by fire," and that of raising it "from low places, and mynes, and coal pits, by a new waie never yet in use." The grant thus made to David Ramseye, a groom of the privy chamber, deprives the Marquis of Worcester of the honour usually given him, as his "Century of Inventions" was not published till thirty-three years after.

The first person, however, who constructed a machine in which steam was successfully applied to useful purposes, was *Captain* Savery, who obtained his title from the Cornish miners, according to their practice of giving it to the head engineers. A singular fact may be mentioned in reference to him. Having drank a flask of Florence at a tavern, and flung it when emptied on the fire, he called for a basin of water to wash his hands. A small quantity which remained in the flask began to boil, and steam issued from its mouth. It occurred to him to try what effect would be produced by inverting the flask and plunging its mouth in the cold water. Putting on a thick glove to defend his hand from the heat, he seized the flask, and the moment he plunged its mouth in the water the liquid rushed into the flask and filled it.

It was this circumstance that suggested to Savery the possibility of giving effect to the atmospheric pressure by creating a vacuum in this manner. He thought that if instead of exhausting the barrel of a pump by the usual laborious method of a piston and a sucker, it was exhausted by first filling it with steam, and then condensing the same steam, the atmospheric pressure would force the water from the well into the pump barrel, and into any vessel connected with it, provided that vessel were not more than about thirty-four feet above the elevation of the water in the well. He perceived also that having lifted the water to this height, he might use the elastic force of steam to raise the same water to a still greater elevation, and that the same stream which accomplished this mechanical effect would serve, by its subsequent condensation, to repeat the vacuum and to draw up more water. It was on this principle that Savery constructed his first engine. It was materially improved by Newcomen in 1705. Beighton afterwards simplified its movements, without changing its principle, and from his time no considerable improvement was made till 1769.

Its accomplishment at that time is to be traced to scientific discovery. It was between the years 1759 and 1763 that Dr. Black brought to maturity his speculations concerning heat, which had occupied his attention at intervals from the very first dawn of his philosophical investigations. His discoveries in this department of science were by far the most important of all that he made, and perhaps indeed among the most valuable which appeared during the busy period of the eighteenth century. To enter fully into the nature of his investigations would be improper in this place; but the sum of them all was usually expressed by him in the following propositions.

When a solid body is converted into a fluid, there enters into it, and unites with it, a quantity of heat, the presence of which is not indicated by the thermometer; and this combination is the cause of the fluidity which the body assumes. On the other hand, when a fluid body is converted into a solid, a quantity of heat separates from it, the presence of which was not formerly indicated by the thermometer, and this separation is the cause of the solid form which the fluid assumes.

When a liquid body is raised to the boiling temperature, by the continued and copious application of heat, its particles suddenly attract to themselves a great quantity of heat; and by this combination their mutual relation is so changed that they no longer attract each other, but are converted into an elastic fluid like air. On the other hand, when these elastic fluids, either by condensation, or by the application of cold bodies, are reconverted into liquids, they give out a vast quantity of heat, the presence of which was not formerly indicated by the thermometer.

Thus water when converted into ice gives out 140° of heat; ice when converted into water absorbs 140° of heat; and water when converted into steam absorbs about 1000° of heat, without becoming sensibly hotter than 212°. Philosophers had long been accustomed to consider the thermometer as the surest method of detecting heat in bodies; yet this instrument gives no indication of the 140° of heat which enter into air when it is converted into water, nor of the 1000° which combine with water when it is converted into steam. Dr. Black, therefore, said that the heat is concealed (*latet*) in the water and steam; and he briefly expressed this fact by calling the heat, in that case, *latent heat.*

It was by this discovery that James Watt, the instrument-maker to the University of Glasgow, was led, while engaged in repairing a small working model of Newcomen's steam engine for Professor Anderson, to reflect on the prodigious waste of steam that occurred;—as it was used only to create a vacuum in the cylinder under the piston, and for that purpose was condensed in the cylinder itself, the piston being then forced down by the pressure of the atmosphere.

According to this arrangement the cylinder was alternately *warmed* by the steam and *cooled* by the cold water employed to condense it; and when, after this cooling, the steam was re-admitted, much of it was instantly condensed by the cold cylinder, and a great waste of the steam took place; the waste of fuel was of course equal, and thus the use of the machine was very costly.

Watt now obtained a patent "for lessening the consumption of steam and fuel in fire engines;" and some years afterwards connected himself with Mr. Boulton, of Soho, a man of wealth, enterprise, and mechanical talent, to whose circumstances there will be another opportunity to refer.

Had Mr. Watt searched all Europe he could not have found another person so fitted to bring his invention before the public in a manner worthy of its merit and importance; and although of most opposite habits, it fortunately so happened that no two men ever more cordially agreed in their intercourse with each other. Watt himself more than confirms this account of the "princely Boulton," whose name occupies no second place among those of the large-minded and honourable men to whom our various manufactures are indebted for their introduction and improvement. When, in 1809, he finally closed his long and active career, Watt took an opportunity of speaking of his obligations to his lamented friend. He alludes in the first instance to the renewal of his patent, which was obtained from Parliament about the time that his partnership with Mr. Boulton commenced:—" At the procuring of this Act of Parliament I commenced a partnership with Mr. Boulton, which terminated with the exclusive privilege in 1800, when I retired from business; but our friendship continued undiminished to the close of life. As a memorial due to that friendship, I avail myself of this, probably a last, public opportunity of stating, that to his friendly encouragement, to his partiality for scientific improvements, and his ready application of them to the processes of art, to his intimate knowledge of business and manufactures, and to his extended views and liberal spirit, must, in a great measure, be ascribed whatever success may have attended my exertions." The incalculable value to Watt of such a partner as this may be best estimated by the fact, that the firm expended no less a sum than 47,000*l.* on the speculation in Watt's steam engines before they began to receive any remuneration.

Meanwhile the spirit of improvement which had effected so much for spinning was next directed to the weaving department, and did not rest till that operation also was performed by machinery. In 1785 the Rev. Dr. Cartwright, of Hollander-house, Kent, invented a power-loom, which may be regarded as the parent of that now in use. Other efforts followed, but the great obstacle to the success of the power-loom was, that it was necessary to stop the machine frequently, in order to dress the warp as it unrolled from the beam; which operation required a man to be employed to each loom, so that there was no saving of expense. This difficulty was happily removed by the invention of an extremely ingenious and effective mode of dressing the warp *before* it was placed in the loom.

A lively and interesting description is given of the change produced in the habits and circumstances of the manufacturing population, during the extraordinary increase of the manufacture, by William Radcliffe, joint author with Thomas Johnson of the "Dressing Machine." He describes the change produced in his own parish of Mellor, fourteen miles from Manchester:—

"In the year 1770, the land in our township was occupied by between fifty to sixty farmers; rents, to the best of my recollection, did not exceed 10*s.* per statute acre; and out of these fifty or sixty farmers, there were only six or seven who raised their rents directly from the produce of their farms; all the rest got their rent partly in some branch of trade, such as spinning and weaving woollen, linen, or cotton. The cottagers were employed entirely in this manner, except for a few weeks in the harvest. Being one of those cottagers, and intimately acquainted with all the rest, as well as every farmer, I am better able to relate particularly how the change from the old system of hand labour to the new one of machinery, operated in raising the price of land. Cottage rents at that time, with convenient loom-shop, and a small garden attached, were from one and a half to two guineas per annum. The father of a family would earn from eight shillings to half-a-guinea at his loom; and his sons, if he had one, two, or three alongside of him, six or eight shillings each per week; but the great sheet-anchor of all cottages and small farms was the labour attached to the hand-wheel, and when it is considered that it required six to eight hands to prepare and spin yarn of any of the three materials I have mentioned, sufficient for the consumption of one weaver,—this shows clearly the inexhaustible source there was for labour for every person from the age of seven to eighty years, (who retained their sight and could move their hands,) to earn their bread, say one to three shillings per week, without going to the parish.

"From the year 1770 to 1788 a complete change had gradually been effected in the spinning of yarns; that of wool had disappeared altogether, and that of linen was also nearly gone; cotton, cotton, cotton, was become the almost universal material for employment; the hand-wheels were all thrown into lumber-rooms; the yarn was all spun on common jennies; the carding for all numbers up to 40 hanks in the pound was done on carding engines; but the finer numbers of 60 to 80 were still carded by hand, it being a general opinion at that time that machine-carding would never answer for fine numbers. In weaving, no great alteration had taken place during these eighteen years, save the introduction of the fly-shuttle, a change in the woollen looms to fustians and calico, and the linen nearly gone, except the few fabrics in which there was a mixture of cotton. To the best of my recollection there was no increase of looms during this period, but rather a decrease.

"The next fifteen years, viz. from 1788 to 1803, I will call the golden age of this great trade. Water twist and common jenny yarns had been freely used in Bolton, &c. for some years prior to 1788; but it was the introduction of mule yarns about this time, along with the other yarns, all assimilating together and producing every description of clothing, from the finest book-muslin, lace, stockings, &c. to the heaviest fustian, that gave such a preponderating wealth through the loom.

"The families I have been speaking of, whether as cottagers or small farmers, had supported themselves by the different occupations I have mentioned in spinning and manufacturing, as their progenitors from the earliest institutions of society had done before them. But the mule twist now coming into vogue, for the warp as well as weft, added to the water-twist and common jenny yarns, with an increasing demand for every fabric the loom could produce, put all hands in request, of every age and description. The fabrics made from wool and linen vanished, while the old loom-shops being insufficient, every lumber-room, even old barns, cart-houses, and out-buildings of any description, were repaired, windows broke through the old blank walls, and all fitted up for loom-shops. This source of making room being at length exhausted, new weavers' cottages, with loom-shops, rose up in every direction; all immediately filled, and when in full work, the weekly circulation of money, as the price of labour only, rose to five times the amount ever before experienced in this district, every family bringing home weekly 40, 60, 80, 100, or even 120 shillings per week! It may be easily conceived that this sudden increase of the circulating medium would, in a few years, not only show itself in affording all the necessaries and comforts of life these families might require, but also be felt by those who, abstractedly speaking, might be considered disinterested spectators; but in reality they were not so, for all felt it, and that in the most agreeable way too, for this money in its peregrinations left something in the pockets of every stone-mason, carpenter, slater, plasterer, glazier, joiner, &c.; as well as the corn-dealer, cheesemonger, butcher, and shopkeepers of every description. The farmers participated as much as any class, by the prices they obtained for their corn, butter, eggs, fowls, with every other article the soil or farm-yard could produce, all of which advanced at length to nearly three times the former price. Nor was the portion of this wealth inconsiderable that found its way into the coffers of the Cheshire squires, who had estates in this district, the rents of their farms being doubled, and in many instances trebled."

Here is a strongly-drawn picture of the cottage of the domestic manufacturer before the spinning machinery was invented; and here is also a familiar, striking, and just history, illustrated by a single specimen, of the growth of the great manufacturing villages and towns, which are now thickly spread over the cotton districts of Lancashire and Cheshire.

Thus have the steps been traced by which the manufacture of India has been transferred to this country, and the statement may well be concluded in the just and eloquent language of M. Dupin.

"Watt improves the steam engine, and this single improvement causes the industry of England to make an immense stride. This machine represents, at the present time, the power of three hundred thousand horses, or of two millions of men, strong and well fitted for labour, who should work day and night without interruption, and without repose, to augment the riches of a country not two-thirds the extent of France. A hair-dresser invents, or at least brings into action, a machine for spinning cotton; this alone gives to British industry an immense superiority. Fifty years only after this great discovery, more than one million of the inhabitants of England are employed in those operations, which depend, directly or indirectly, on the action of this machine. Lastly, England exports cotton, spun and woven by an admirable system of machinery, to the value of four hundred millions of francs yearly. The Indies, so long superior to Europe—the Indies, which inundated the West with her products, and exhausted the riches of Europe—

the Indies are conquered in their turn. The British navigator travels in quest of the cotton of India,—brings it from a distance of four thousand leagues,—commits it to an operation of the machine of Arkwright, and of those that are attached to it,—carries back their products to the East, making them again to travel four thousand leagues;—and, in spite of the loss of time, in spite of the enormous expense incurred by this voyage of eight thousand leagues, the cotton manufactured by the machinery of England becomes less costly than the cotton of India spun and woven by the hand near the field that produced it, and sold at the nearest market. So great is the power of the progress of machinery!"

When, however, the cloth is manufactured it has to be bleached, to remove the dirt and grease it has contracted, and also to destroy all the colour belonging to the raw material, so as to make the cloth perfectly white. Bleaching as performed in the middle of the last century occupied from six to eight months, and so little was the art understood in Great Britain, that nearly all the linens made in Scotland were sent to Holland to bleach, and passed through the tedious process in the bleach-fields around Haarlem.

The grand improvement in bleaching was in the application of chlorine. It was discovered in 1774 by Scheele, the Swedish philosopher, who observing that it had bleached the cork of his phial, discovered its property of destroying vegetable colours.

This fact suggested to Berthollet, the French chemist, the application of the acid to the bleaching of cloths made of vegetable fibres. He conceived that if the oxygen could be presented to the cloth in a dense state, and at the same time feebly combined with any other body, it might unite itself to the colouring matter so readily, that the process of bleaching would by that means be greatly accelerated. His skill in chemistry suggested to him a way by which this might easily be done: by immersing a cloth in a liquid containing much oxygen in a loose state, or one in which it was slightly combined with other substances, the effect followed so exactly that he was able to perform in a few hours what required weeks, and even months, by the common process. This improvement was a real gift from the sciences to the arts.

James Watt, who was an accomplished chemist, as well as mechanician, learnt from Berthollet, at Paris, this fact; and returning to England, introduced the practice, with several improvements of his own, with the greatest success at the bleach-field of his father-in-law, near Glasgow. Without knowing this, but acting on the published suggestions of Berthollet, Mr. Henry, of Manchester, made experiments in bleaching, and showed the result by a public exhibition of the bleaching of half-a-yard of calico. This led to a series of improvements, and it is mentioned that a bleacher in Lancashire received fourteen hundred pieces of grey muslin on a Tuesday, which were returned bleached on the following Thursday to the manufacturer, at the distance of sixteen miles, to be packed up and sent off that very day for a foreign market. This is considered, too, as not extraordinary.

Calico printing, first carried on in London, was introduced into Lancashire by Messrs. Clayton of Bamber Bridge, in 1764, who were followed by the grandfather of Sir Robert Peel. Active and enterprising, he began the manufacture of cotton, and he is said to have been one of the first who tried the carding cylinder. It is stated that his earliest experiments in printing were made secretly in his own house; that the cloth, instead of being smoothed by a calender, was ironed by a female of the family; and that the pattern was a parsley leaf. His success ultimately led to the formation of extensive establishments, where great wealth was acquired, and many of the most successful printers and manufacturers in Lancashire were trained.

The old method, still continued for certain parts of the work, was by blocks of sycamore, on the surface of which the pattern was cut in the common way of wood engraving. The surface was applied by means of a handle to a woollen cloth, stretched over a vessel containing the colour, and saturated by it; it was then laid on the piece of cloth, and struck with an iron mallet; and thus the figure on the block was impressed on the cloth. One colour only was used at a time; and when others, as often happened, were required to complete the pattern, the operation was repeated with different blocks. To obtain more delicate patterns than could be produced on wood, copper-plates were employed, and the cloth was printed with a kind of copper-plate printing press.

Each of these modes was tedious, as no more of the cloth could be printed at once than was covered with the wooden block or copper-plate; and a single piece of calico, twenty eight yards long, required the application of the block 448 times.

Cylinder printing, invented by a native of Scotland named Bell, and first successfully applied in Lancashire about 1785, was a great improvement on this plan. For this purpose a polished copper cylinder, adapted in length to the width of the cloth to be printed, has a pattern engraved all round it, and from end to end. It is then placed in a press, and as it turns round, the lower part passes through the colouring matter, which is afterwards removed from the whole surface, except the engraved pattern. The colour being thus left only there, the piece of calico or muslin is drawn tightly over the cylinder which prints the cloth, and this is dried by passing over several metallic boxes which are heated by steam. A piece of cloth may be thus printed and dried in *one* or *two minutes!* Improvements since this, remain to be traced in the concluding chapter of this work.

To advert now to the woollen manufacture, it appears that for upwards of a century and a half, no very essential alteration or improvement was made in its processes beyond the variation of colours and patterns suited to the caprices of fashion; but fortunately for the clothiers, the ingenious inventions and arrangements of Arkwright for carding and spinning cotton-wool, were soon adapted to sheep's-wool, and produced an entire revolution in the woollen and worsted trade. Since this period, the manufactures of heavy woollens and coarse worsted goods have gradually expanded themselves in Yorkshire, Lancashire, and Gloucestershire; where, from the cheapness of living, the industry of the inhabitants, and the abundance of coal, they enjoy immense advantages over what they possessed in mere hand-labour in the midland and western counties, where fuel is scarce.

Still the general character of the woollen manufacture has been that of slow progress, but of little fluctuation; the latter evidently a consequence of its depending less on exportation than on home consumption. In the long period from 1700 to 1780, the exports experienced a regular but not rapid rise, amounting in the latter years to about 3,500,000*l.*, whilst our home consumption increased in proportion to our augmenting numbers. More recently the manufacture has been materially improved; yet on the whole, improvement has been much less rapid in it than in the cotton manufacture.

The traffic of Staffordshire in earthenware was once small, being carried on only by the workmen themselves, or by pedlars, who conveyed the pieces in baskets on their backs, through the adjoining counties. About the year 1690 two brothers, named Elers, came from Nuremberg, in Holland, and settled at Bradwell, where they made an improved kind of red ware, and introduced the art of glazing the vessels, by throwing common salt into the oven at a certain period of the baking. Every precaution was used by the brothers to keep their business secret; and it is probable that this circumstance, joined to the success of the strangers, excited the enmity and jealousy of their neighbours so much, that they were obliged to leave the country. The reason assigned for this persecution was the alarm occasioned by the fumes from their kilns during the time of glazing. These fears subsided, however, when the process was continued by their successor. This man, whose name was Atsbury, had, it is said, become master of their secrets by a singular stratagem. Feigning to be of weak intellect, and looking as silly as he could, he obtained employment in the Bradwell works, and submitted to all the drudgery and contempt which were drawn upon him by his supposed weakness. By this course he was enabled to learn all that was done in the manufactory, and to make models for his own use of all the utensils.

Glazing is also greatly indebted to Bernard de Palissy, a native of France. His parents were in humble circumstances, but he became a draughtsman and land-surveyor. Accidentally meeting with an enamelled cup, he felt very desirous to improve the art, and thenceforward gave himself wholly to experiments on the composition of enamel. Many and great were his disappointments, trials, and sacrifices. At one time he was reduced to such extremity, that, to provide fuel for his furnace, his furniture, and even some of the wood-work of his dwelling, was destroyed; and in order to silence the clamour of his assistant for wages, he stripped himself of a portion of his apparel. At length, however, his success was complete, and he long enjoyed independence and fame.

To Atsbury is generally ascribed the introduction of white stone-ware, by the adoption of calcined or burnt flints. The common story is, that while travelling to London on horseback, in the year 1720, he had occasion, at Dunstable, to seek a remedy for a disorder in his horse's eyes, when the ostler at the inn, by burning a flint, reduced it to a fine powder, which he blew into them. The potter observing the beautiful white colour of the flint after it was burned, instantly thought of the use to which it might be applied in his art.

The celebrated naturalist, Reaumur, was, however, almost the first who connected science with the arts of life—an union now indissoluble, and which has ever since been yielding improvements to which no termination can be foreseen. The chemical examination which he made of Oriental china anticipated what the common experiments of the manufacture might have effected, though not with equal certainty or rapidity; and on his efforts, the Royal French Manufactory of Sêvres was founded. An observation of this had an important influence on the late celebrated Josiah Wedgwood. The early instruction of that extraordinary man was, as usual in his sphere, very limited. Education was supposed in his day to be incompatible with the habits of a man of business; but his first step to eminence appears in the education of himself. Though apprenticed to a potter, he found leisure for the pursuit of valuable knowledge, which afterwards insured his success, and enabled him to take a part in the literary and philosophical society of his time.

Forms and colours engaged his particular attention: of the latter he obtained an endless variety; and for his shapes and ornaments he selected models from the finest standards of beauty and elegance afforded in ancient times. The early talent of Flaxman, so eminent in sculpture, and the skilful pencil of Webber, were also engaged in his service, of which there are evidences in the perfect imitation of the Barberini vase he has left behind him, and in the classic designs which decorate the beautiful imitations of jasper which he invented. Thus his manufactory comprehended every thing his art could attain; and taste, convenience, and comfort, could draw from thence ample gratification. Excellence was his aim, either in articles of common use, or in the choicer productions of his taste; and so ambitious was he for the maintenance of his reputation, that he sacrificed every article which came from the oven in an imperfect state.

Previously to his time the potteries of Staffordshire produced only inferior articles, flimsy as to their materials, and void of taste in their forms and ornaments; the best among them being only wretched imitations of the grotesque and unmeaning scenes and figures portrayed on the porcelain of China. But such have been the effects resulting from the exertions and example of this one manufacturer, that the wares of that district are now not only brought into general use in this country, to the exclusion of all foreign goods, which had before been largely imported, but English pottery has since been sought for and celebrated throughout the civilized world, and adopted even in places where the art was previously prosecuted. An intelligent foreigner, writing on this manufacture, says—"Its excellent workmanship, its solidity, the advantage which it possesses of sustaining the action of fire, its fine glaze, impenetrable to acids, the beauty and convenience of its form, and the cheapness of its price, have given rise to a commerce so active and so universal, that, in travelling from Paris to Petersburgh, from Amsterdam to the farthest part of Sweden, and from Dunkirk to the extremity of the south of France, one is served at every inn upon English ware. Spain, Portugal, and Italy are supplied with it; and vessels are loaded with it for the East Indies, the West Indies, and the continent of America."

With the name of Wedgwood may properly be associated that of Boulton, to which a passing allusion has already been made. The Soho, near Birmingham, that wonderful creation of his master mind, and latterly more renowned for its steam-engines than even for its manufactures in bronze and or-molu, once under the patronage of royalty, originated in the production of superior gilt toys and trinkets. "The eminence from which this celebrated establishment takes its name," to quote an elegant description, "was once a barren heath, on the bleak summit of which stood a naked hut, the habitation of a warrener. At the bottom of it, however, there ripples a little stream, the capabilities of which attracted the discriminating eye of Mr. Boulton. He bought the land, and expended a sum more than equal to the half of his patrimony in building workshops and dwellings for upwards of six hundred artisans. The water of the rivulet he collected into a pool, and made it fall on a water-wheel, which communicated motion to an amazing number of different machines and implements, by whose agency were fabricated, in the highest elegance and perfection, utensils of many kinds in gold, silver, tortoiseshell, and enamel; and many vitreous and metallic compositions, with gilded, plated, and inlaid works. As the works rapidly extended, the power of horses was, for a short time, employed in aid of the water-wheel; but these were at length superseded by an engine on Savory's construction, and, finally, by the Boulton and Watt engines."

But of all the different processes conducted at

Soho, perhaps none have attracted more attention than the application of steam to coining at the Soho Mint. The coining-mill, or engine, which Mr. Boulton first established there in 1783, was afterwards much improved, and ultimately not only produced coins with astonishing expedition, but with an accuracy which the coinage of this country had not previously exhibited. The engine in this mint, as thus improved, worked at once eight machines, each capable of striking from 70 to 84 pieces in a minute, or between 4000 and 5000 in an hour, so that the eight machines together would produce between 30,000 and 40,000 coins in one hour. The following are the processes executed by these machines as operated upon by the steam engine:—Rolling the masses of copper into sheets; fine rolling of the same cold through cylindrical steel-rollers; clipping the blank pieces of copper for the die; shaking the coin in bags; striking both sides of the coin at once, and milling the edges, and immediately displacing it and placing another for the same operation. To their other results the machines add that of preventing fraud, by keeping an accurate account of the coin on which it operates. By this machinery, a few boys of twelve years of age are able to coin about 200,000 coins in the course of six hours. These processes have been thus described by Darwin, with a particular reference to Soho.

"Now his hard hands on Mona's rifted crest,
Bosom'd in rocks, her azure robes arrest;

With iron lips his rapid rollers seize
The lengthen'd bars in their expansive squeeze;
Descending screws with pond'rous fly-wheels wound
The tawny plates, the new medallions round;
Hard dies of steel the cupreous circles cramp,
And with quick fall his massy hammers stamp.
The harp, the lily, and the lion join,
And George and Britain guard the splendid coin."

The improvement in the coin itself may be seen by a comparison of the copper coins before and since 1799, in which year Mr. Boulton contracted for the copper coinage on his improved principle; since which time no alteration has taken place, except perhaps a little improvement in the finish.

Of the produce of his mint, the copper coins now in circulation are specimens; besides which, copper has been coined by contract for the different European states, for the East India Company, and for the Americans. Mr. Boulton's improvements in the coining mill, originally brought into operation at Soho, have also been adopted at the Tower Mint, and by various European governments. This has tended greatly to the improvement of the modern coinage, not only in copper, but in silver and gold, the same process being of course applicable to other metals. Indeed both gold and silver have on different occasions been coined at Soho, not to speak of the various exquisite medals which have from time to time been struck there.

The year 1742 is memorable in the history of Sheffield for the introduction of a new manufacture, which has become an effective auxiliary in advancing that town to the rank it now holds. At that time Mr. Bolsover, an ingenious mechanic, being employed to repair the handle of a knife which was composed partly of silver and partly of copper, was struck with the possibility of uniting the two metals, so as to form a cheap substance which should present only an exterior of silver, and which might, therefore, be used in the manufacture of various articles in which silver had been solely employed. He began a manufacture of articles made of this material, but confined himself to buttons, snuff-boxes, and other light and small wares. Like many other first inventors, he probably did not see the full value of his discovery, and it was reserved for another member of the corporation of cutlers of Sheffield, Mr. Hancock, to show to what other uses the copper plated in this new method might be applied, and how successfully it was possible to imitate the finest and most richly embossed plate. He employed it in the manufacture of candlesticks, tea-pots, waiters, and most of the old decorations of the sideboard, which, previously to his time, had been formed of wrought silver. The importance of the discovery now began to be fully understood: various companies were formed, and workmen were easily procured from among the ingenious mechanics of Sheffield, while the streams in the neighbourhood furnished opportunities of erecting mills for rolling out the metals. Birmingham early obtained a share in this lucrative manufacture; but the honour of the invention belongs to Sheffield, as it is supposed to stand unrivalled in the extent to which the manufacture is carried, and the elegance and durability of its productions.

The general disuse of the old pewter ware, once so common in this country, has been followed by the introduction of another metal, in the manufacture of which a degree of ingenuity is constantly displayed, to which the ancient pewterers were altogether strangers. The modern material, the base of which is tin, has been called Prince's metal, more commonly Britannia metal, and by the workmen white metal. It is not only wrought into all the variety of elegant and useful articles to which silver is applied, but along with its capability of receiving almost every modification of which that precious metal is susceptible, it also very much resembles it in colour and brilliancy; it possesses also, when quite new, and in some articles of a fine quality, candlesticks in particular, an effect which an inexperienced eye might easily, before the metal became common, have mistaken for silver. The beauty of this metal, when wrought into a variety of articles, is not more striking thán its cheapness in the manufactured state is surprising. This latter circumstance results, independently of the price of the material itself, from the extensive application of machinery, and the extreme lightness of body with which wares in Britannia metal can be produced; a lightness, however, which is always obtained at the expense of durability, as well as of shape.

No branch of industry has had, however, a more rapid increase than our iron-works. About a century ago it was computed, that we required an annual import of 20,000 tons of foreign iron, and which afterwards increased to 50,000 tons. This supply was furnished by Sweden and Russia, and though burdened with duty, it was more in quantity than double our native produce; but after the year 1780 discoveries were fortunately made which greatly increased our supply at home. Bar-iron had been manufactured here, as on the continent, with charcoal fuel only, coal being considered inapplicable to that purpose. Under that impression the rapid consumption of the wood in the neighbourhood of our different iron-works compelled a removal at a great expense from one spot to another, and was on the point of causing an alarming decay of business, when the iron-masters, after much perseverance, accomplished their object by different means. It was the introduction of charred pit-coal or coke, that not only arrested the destruction of our forests, but laid anew the foundation of our present extensive manufactories of native iron.

But the use of coke in smelting iron would probably have been impracticable to any considerable extent, unless under peculiarly favourable circumstances, if the assistance of the powerful blast of the steam-engine had not been called in to act on the kindled fuel. The possibility of adapting the new mechanical force to the production and maintenance of a continuous and sufficiently forcible stream of air was first perceived by Mr. Isaac

Wilkinson, an eminent ironmaster, who first employed coke as fuel under the influence of a steam-urged blast. His son John carried into full operation the speculations of his father. When Messrs. Boulton and Watt first commenced their manufactory of steam engines, John Wilkinson was the only person competent to execute their castings. They were made by him at his foundry near Wrexham. At this place all the ponderous castings for the steam engines required at the Cornish mines were executed, and conveyed through the whole weary distance by Mr. Wilkinson's teams, until a disagreement between the contracting parties led to the erection of the magnificent founding establishment at Soho.

Isaac Wilkinson wanted that firmness and constancy of purpose that distinguished his son, but was possessed of quick discernment and versatile talents, and was by them elevated from an originally low condition. Alluding to his first bringing into action the steam-engine blast, at his works near Wrexham, he said, in his old age, to a young friend, "I grew tired of my leather bellows, and I determined to make *iron* ones. Every body laughed at me, but I did it; and then they said, 'Who could have thought it!'" To the same gentleman, in 1779, he said, "You will live to see waggons drawn by steam; I would have made such a waggon myself if I had time." He was on the verge of an important discovery, for he distilled coals in order to extract the tar, as Lord Dundonald did some years afterwards, without being aware that the gas evolved might be detained and made highly useful.

About the year 1780 the consumption of foreign iron having considerably increased throughout the nation, the price was fast approaching to double what it had been during the twenty years preceding. The use of coke having become general, manufactories on that principle increased rapidly throughout the kingdom; competition and the acknowledged deficiency in quality operating as a stimulus to ingenuity and experiment.

According to the best testimony, the first person who introduced, or rather attempted a better process was an ironmaster in the county of Gloucester, of the name of Cort; but, like too many other inventors, although he secured his practice by a patent, he was unsuccessful, and ruin overtook him before he could turn to his own advantage that scheme which was presently matured, and became so profitable in the hands of others. The first individual who succeeded, and derived from it a princely fortune, was a resident of South Wales, who had the judgment to perceive, and the spirit to patronise, the ingenuity of a person who, acting as his engineer, carried toward perfection the art of *puddling.** The process was quickly introduced into every part of the country where the iron trade was carried on; besides, as the invention, by superseding foreign iron, made some noise, and at the same time promised well, many individuals became impressed with the

* Note S.

idea, not merely that iron was the most valuable of metals, but that its preparation was the direct way to wealth. This infatuation was too powerful to be withstood; the business was rushed into with capitals of from 10,000*l.* to 100,000*l.* Iron-works multiplied rapidly, the quantity produced exceeded the consumption, competition reduced the price below the expense of manufacturing, and not a few adventurers had to tell a tale of disappointment and ruin.

As the taste for luxuries was cultivated the enterprise of the whitesmith increased, and the consumption of pit-coal becoming general, the transition from and-irons to fire-places composed of connected bars was obvious and easy, the new contrivance, for a time, exhibiting some traces of its origin. In rural districts, where the village blacksmith was the only artificer in iron, proofs of this fact are frequently apparent in the massive grates, the bars of which are riveted into stout iron standards, rising at each end to a considerable height above the fire, and terminating in large knobs of the same metal, the brightness of which harmonizes with the general neatness. In the houses of the nobility the grates were of course of a more expensive and ornamental description, still retaining, however, as their most conspicuous feature, two ornamental pillars or standards in front, similar to those which exhibited the taste or ingenuity of the manufacturer in the ancient and-irons. Besides these supports, the back plate, cast from a model of carved work, was added, and generally beneath the lowest bar a filigree ornament of bright metal, which, under the designation of a fret, still retains its place in many modern stoves.

From about the year 1780 to 1800, the London and country markets were chiefly supplied by a diversity known to the trade as Bath, Pantheon, and Forest stoves; the black castings for which were provided largely from Scotland, as well as from various places in England, where, in some instances, the recent manufactures have been brought to such an amazing degree of perfection. The three stoves above named, and which were in such large demand a generation ago, differed from each other but little, except in the form and decorations of their front plates, which, with the bars, whether bowed or straight, commonly consisted, when the article was light, of a single casting.

The credit of having first suggested the practicability of constructing iron bridges has been claimed for the notorious Thomas Paine, who is said to have conceived the idea from considering the fabrication of a spider's web. In 1787 he presented to the Academy of Sciences at Paris the model of a bridge which he had invented; and during the greater part of the following year he resided at Rotherham, in Yorkshire, where a bridge, chiefly of wrought iron, was constructed under his direction by the Messrs. Walker. It appears, however, that Mr. Pritchard, an architect of Eyton Turret, Shropshire, suggested, some years before, the construction of wide iron arches, capable of admitting the passage of the water of such a river as the Severn; and in fact, the first practical exhibition of the scheme, on a large scale, was the erection of the bridge at Colebrook Dale, chiefly in accordance with his plans. In 1790 Mr. Burdon formed a scheme for throwing an arch of cast iron over the river Wear, at Sunderland. The weight of it is two hundred and sixty tons. The arch is the segment of a large circle, of which the chord or span is two hundred and thirty-six feet. This bridge was, at the time of its erection, considered to be the largest arch in the world; and being placed, too, at a considerable elevation above the river, it forms a remarkably picturesque object.

It appears, from a description of suspension bridges communicated some years since to the Edinburgh Philosophical Journal, that the first chain bridge constructed in this country is believed to have been one over the Tees, forming a communication between the counties of Durham and York. It is supposed, on good authority, to have been erected about 1741, and is described by Hutchinson, as "a bridge, suspended on iron chains, stretched from rock to rock, over a chasm near sixty feet deep, for the passage of travellers, particularly miners. The bridge is seventy feet in length, and little more than two feet broad, with a hand-rail on one side, and planked in such a manner that the traveller experiences all the tremulous motion of the chain, and sees himself suspended over a roaring gulf, on an agitated and restless gangway, to which few strangers dare trust themselves."

The art of laminating ductile metal by passing it between a pair of rollers is by no means an invention of modern times, though at what period it began to be practised as a succedaneum in the process of flatting the material by hammering, does not appear. The ingenuity, however, of the last generation of iron-masters not only carried the power of the rolling machinery to its utmost extent, in spreading out metallic sheets to the fineness of silk and the flexibility of ribands, but more especially distinguished themselves by its application to the manufacture of native iron in lieu of the forge, which had always been considered as indispensable. At present, therefore, instead of working the bloom of iron under a ponderous hammer, until it is brought to the form of a bar, a process requiring considerable dexterity in the forgeman, the red-hot mass, on being drawn from the puddling furnace, is reduced by being successively passed between massy rollers; which not only expel the heterogeneous matters from the iron, but perform the operation of bringing it into the shape required with incredible celerity, but little ingenuity being at the same time demanded of the workmen.

The use and value of rolled iron in the manufacture of an immense variety of small articles are almost beyond conception—certainly beyond enumeration. Wolverhampton and its neighbourhood abound with establishments for the conversion of this convenient material into those neat and economical wares which have become so common in every family. Among these articles are trays and waiters, varying in size from a snuffer-dish of a few inches in length, to the plateau sufficiently large to hold the entire tea equipage of a numerous party. These universal requisites are either simply painted or varnished, or, as is most commonly the case, they are japanned with a most beautiful and durable ground, on which are laid colours and gilding with so much taste and effect, that the individuals who execute these designs deserve more praise than is usually given them. The method of japanning wares of this description, originally taken up by the Birmingham manufacturers almost as an invention suggested by their peculiar staple, has now, through the combination of science and long experience, obtained a high degree of perfection. No place in the world can indeed rival the artificers of this famous emporium in the degree of elegance and finish presented by many of the more expensive fabrications, the body of which consists of a few pennyworths of rolled iron.

Besides these elegant and highly prized wares, an inconceivable diversity of pans, boxes, buckets, baskets, scrips, &c. are now found in every hardwareman's stock, the body of which consists of iron reduced to sheets between smooth laminating rollers. A large proportion of these utensils are fabricated by merely connecting the edges of the metal, where they require to be fastened, by overlapping the margins, or at most by the means of a few rivets; thus by the simplest contrivances, and from one of the cheapest materials, ingenuity forms innumerable articles, which, when neatly varnished, are handsome, and have become indispensable.

About fifty years since a person of the name of Huntsman, residing at Attercliffe, near Sheffield, conceived the idea of reducing steel to a fluid. He pursued the experiment with complete success, and was for some time the only noted manufacturer of an article which, bearing his name, is still held in high estimation. His success gave rise to competition, and Mr. Booth, of Brush House, established extensive and successful works at Rotherham. The refining of steel, however, has decayed at the latter place, in consequence of the amazing extent to which the art is practised and the business carried on in the neighbouring town of Sheffield. The prodigious number of furnaces constantly at work, the number of hands employed, and the amount of steel cast into ingots, to be tilted or rolled for the various purposes to which the material is applied, excite the astonishment of visiters. This town has not only become by far the largest laboratory and emporium in the world for cast steel, but, in consequence of being the seat of the cutlery and edge-tool trades in general, the facilities for experiment and adaptation on the spot have enabled the Sheffield steel-makers to surpass all others in the perfection to which they have carried this important branch of our national industry. It is indeed a remarkable fact, that this very town, which was formerly indebted to Syria for the steel used in its manufactures, now exports a material of its own conversion to the Austrian forges, and to other places on the continent of Europe.

The manufacture of brass was introduced into Birmingham by the family of Turner, in about 1740: they erected works at the south end of Coleshill-street. Under the black clouds which arose from their huge tunnel, some of the trades collected their daily supply of brass; but the major part was drawn from the Macclesfield, Cheadle, and Bristol companies. More recently many have engaged in the manufacture of this metal, of which much is used in the manufacture of clocks.

It would be erroneous to imagine that these time-pieces, as we now have them, ought to be attributed to any single inventor; the several parts would doubtless be the production of different persons. It is generally however stated that the art of making clocks, such as are now used, was either first invented, or at least revived in Germany little more than two hundred years ago. Most writers on this subject have given descriptions of various ingenious clocks, now or formerly to be seen on the continent, nor does our own country seem to have wanted artists of celebrity in this line.

From the above period, the art of clock-making, to say nothing of the taste for constructing automata, has, like every other handicraft depending on the progress of science, undergone many and great alterations and improvements. Few elderly persons can have failed to notice the changes which, in its external appearance, the ordinary house-clock has undergone. First, there was the narrow, dark-faced, mysterious looking box, with an hour hand only, and a circular glazed hole in the door; then the respectable oak-bodied piece of furniture, bearing date from the beginning of last century, with its brass face, silvered hour circle, and blued steel pointers; lastly came the more expensive case of inlaid cabinet-work, the handsome painted dial, brass pointers, seconds' index, and frequently other ingenious movements. These are the useful clocks found in almost all the houses of tradesmen, and even the better sort of mechanics, in most parts of England. Among the higher ranks a variety of elegant and expensive time-pieces are constantly in demand, the making of which affords employment to a considerable number of hands: "table-clocks" of some sort are generally preferred in London, on account of their taking up little room. In addition may be mentioned the German clocks, having wooden or brass wheels, and which are sold so cheap, with or without "'larums" or "cuckoos," that they are met with in thousands of the poorer cottages throughout the kingdom.

Every town, indeed, has its clock-makers, whose business is generally to finish the works sold by the first fabricators in a certain state, to put them into appropriate cases, and afterwards to clean and keep them in repair. Chronometers, and the more valuable descriptions of time-pieces, are made in London; but great quantities of capital thirty-hours and eight-day clocks are manufactured at Lichfield, Newcastle-under-Lyne, and other places. The brass work, however, is commonly cast in Birmingham or Sheffield, while the pinions and various parts of iron and steel are forged, turned, cut, and sold at surprisingly low prices, by the ingenious artisans of Lancashire.

Excepting the essential articles of food and shelter, there is perhaps scarcely any thing more necessary to our comfort than artificial light. Without its aid, a considerable portion of time in the climates inhabited by civilized men must be wasted in idleness; and although the privation might not be felt by the listless dwellers in the torrid zone, to us who live in the region of unequal days and nights, the want of it would operate as a check on improvement, and a great bar to the provision of the necessaries of life.

To avert these evils various well-known means have been adopted, among which will readily occur various kinds of lamps, on which brass has also been extensively employed. Of these, till a recent date, the principle of the burner was the same; and although many ingenious contrivances were adapted to this part, they all had in view the equable flow of oil to the wick, or the maintenance of the oil to remedy the most important defects. A great alteration, however, was proposed and perfected by M. Argand, a citizen of Geneva, about fifty years ago. To understand fully the nature of his improvement, it must be remembered, that a plentiful supply of air is necessary to the existence of flame. A small wick produces of course a small flame; but, in consequence of that smallness, almost every particle of the flame is in contact with the air, and the light is very brilliant. By increasing the size of the wick the flame is enlarged, but then the interior portion, which is deprived of air, is but imperfectly inflamed; the light is in consequence brown and dull, and much of the oil burned passes off in smoke without being inflamed at all. The only mode found of increasing the body of flame, without destroying its brilliancy, was by increasing the number of little wicks, which were placed side by side in a line. This produced a good light, but it was unsightly and troublesome to arrange, and by no means so brilliant as might be expected from the same quantity of light in a compact form. It occurred therefore to Argand, that if this line of wicks could be placed in a circle, and a current of air admitted through the interior of the circle, while the outside air was applied to the external surface, the power of a large wick would be obtained with all the brilliancy of a small one. This was effected in the following manner:—A small tube, about three inches long, and half an inch in diameter, was soldered at one end, withinside another tube of the same length, but double the size, leaving a space between the two, open at one end and closed at the other. A wick was formed by a piece of cotton woven round without a seam, and fixed to a brass ring fitted to the space between the two tubes, and raised or depressed by a worm or groove cut in the inner tube, or by a rack and pinion. The oil was admitted to the wick by a pipe connected with a reservoir, and passing through the outer tube. Thus was formed a ring of light; but the lamp did not at first answer the expectation of the inventor; the light was not brilliant in proportion to its size, and could not be got to rise much above the wick. Every attempt to increase its height by a more copious flow of oil, or by raising the wick, only produced a volume of smoke. This defect would have been fatal had not accident discovered a remedy. This was the glass chimney which, by increasing the current of air, produced a complete combustion of oil, and as great a light as could possibly be derived from the quantity consumed. This accidental discovery is thus related by the younger brother of Argand:—"My brother had long been trying to bring his lamp to bear. A broken-off neck of a flask lying upon the chimney-piece, I happened to reach it over to the table, and to place it over the circular flame of the lamp; immediately it rose with brilliancy. My brother started from his seat with ecstasy, rushed upon me in a transport of joy, and embraced me with rapture." Thus was the Argand lamp formed; the most important improvement discovered in artificial light before the introduction of gas, and on which no improvement has since been made. More convenient arrangements have been made to supply oil, more elegant forms have been adopted, and all unnecessary shadows obviated, but the burner remains essentially the same as Argand formed it.

This invention received almost immediately the support to which so useful a discovery was entitled. The Argand lamp was adopted by all to whom a good and steady light was desirable. Persons engaged in delicate operations requiring much light, as engravers and watchmakers, and who had hitherto been compelled to suspend their occupation at the approach of twilight, could now work by night as well as by day. The experimental chemist too, was put in possession of a powerful aid in the prosecution of his investigations by the use of this lamp, which gave a considerable and easily graduated heat, much more manageable than that of any furnace that could be constructed.

Nor should the application of these lamps to light-houses be overlooked. Here, with reflectors of copper coated with silver, formed to the parabolic curve of a mould made with the utmost precision, and then polished, they are indeed of incalculable value. Such buildings are by no means of modern invention, but that of chief celebrity of recent date, and probably of most ingenious construction, is the one built on the Eddystone rocks. Their peculiar position exposes them to the great swells of the Bay of Biscay and the Atlantic Ocean, between all the southern and western points of the compass; and there are some circumstances connected with the extent, bearings, and peculiar configurations of the rocky groups themselves, which augment the fury of the waves in a very high degree. After hard gales of wind in the Bay of Biscay have been succeeded by a perfect calm and unruffled sea, such is the effect of the ground-swell on the peculiar slope of these rocks, that the sea breaks on them in so frightful a manner, as not only to obstruct the work that might be done on them, but even to prevent a landing; and this "at times, when, figuratively speaking, one might go to sea in a cockle-shell."

Favourable circumstances often introduce men of ability and genius to the world. Thus, when a light-house at Eddystone was destroyed by fire in 1755, the proprietors applied to the President of the Royal Society, and were immediately recommended to John Smeaton, who had, however, never before practised as an architect or engineer; but for the work he had now to undertake he was singularly qualified, and in it he was eminently successful. It is gratifying to state that Smeaton caused the inscription to be sunk in one of the granite courses of his noble edifice, "Except the Lord build the house, they labour in vain that build it;" and that on the morning after its completion he proceeded with his assistants, artificers, and workmen, to return thanks to the Author of all good. After his last visit to the rock in 1787, he said to a friend, "I am now so perfectly satisfied of the stability of the edifice, that I think nothing but a convulsion of nature can destroy it." His words are likely to be verified; after the lapse of nearly eighty years this lighthouse stands at Eddystone—a noble monument of his mechanical sagacity.

In adverting to other edifices it should be remarked, that in the beginning of the eighteenth century a taste for the style of building practised in France and Germany, which had probably been introduced by William III., prevailed for a time very generally in England, and is exhibited in many of the mansions of that period, particularly in the British Museum, London, and Blenheim House, Oxfordshire. The façades of such edifices present many of the features of the worst style of Italian architecture; and in the interior disposition of the mansions of this period the communications with the different apartments are very defective, for instead of a separate access to each, it is often necessary to get at one by going through several others. Notwithstanding however the faults of the latter building, particularly the want of unity of design, its magnitude gives it a majestic appearance, worthy of the residence of the Duke of Marlborough for whom it was built. This edifice was executed by Sir John Vanbrugh.

The ecclesiastical architecture of England, which had been affiliated by Jones and Wren to that of the religious edifices of ancient Rome, received sundry improvements from James Gibbs, who has left a distinguished monument of his taste and skill in the church of St. Martin's in the Fields. The churches of this period differ from those of Sir Christopher Wren in having a portico at the western extremity, and in the steeple being raised over the body of the building, so that it appears to stand on the roof instead of resting on the ground. The propriety of this situation may be questioned, but, from the roof of the portico being a continuation of that of the building, there results an unity of composition, which is one of the greatest merits of these churches, and gives them a character approaching nearly to that of the religious edifices of the ancients.

The Roman architecture in England may be said to have arrived at perfection in the latter part of the eighteenth century, and one of its finest monuments is Somerset House. One of the first churches in the Grecian style is that at Ayott St. Lawrence, in Hertfordshire. It was built about the same time, and since then a considerable number of churches have been erected in London, and in various parts of the country, in imitation of different Grecian temples, but generally with few of the decorations which are found on the ancient models.

About the same period the domestic architecture of England was destined to considerable improvement from the genius of the Earl of Burlington, who, abandoning the caprices of the French School, cultivated a purer style by contemplating the remains of the ancient architecture in Italy, and by a diligent study of the writings of Palladio. In 1717, or 1718, he made designs for the improvement of the mansion built by his father in Piccadilly, which were afterwards executed. This building exhibits a specimen of the style of architecture subsequently employed to a considerable extent in the mansions of the nobility.

From the Revolution to the accession of Geo. III. the progress of agriculture was by no means so considerable as we should be led to imagine from the great exportation of corn. It is the opinion of well-informed writers, that very little improvement had taken place, either in the cultivation of the soil or in the management of live stock, from the Restoration down to the middle of the last century. Even clover and turnips, the great support of the present improved system of agriculture, were confined to a few districts, and at the latter period were scarcely cultivated at all by common farmers in the northern parts of the island. But the gradual advance in the price of land produce soon after the year 1760, occasioned by the increase of population, and of wealth derived from manufactures and commerce, gave a more powerful stimulus to rural industry, augmented agricultural capital in a greater degree, and called forth skill and enterprise on the part of the cultivators. Most of the inventions for increasing produce and economising labour have either been introduced, or improved and greatly extended, since that time; and by means of both, the free surplus has been vastly increased for the supply of the general consumption.

Meanwhile horticulture received attention, but false tastes often appeared. The sheers were applied to the lovely wildness of form with which the hand of nature had adorned each various species of tree and shrub. The venerable oak, the majestic elm, the romantic birch, the aspiring circuit of the lime, the regular round of the chestnut, and the almost moulded orange tree, could not escape the Gothic hands of the avowed and fantastic admirers of symmetry. It was forgotten that, like beauty's self, when unadorned, they were adorned the most. The compass and the square were thought of more use in plantations than the nurseryman. The measured walk, the quincunx, and the étoile, imposed their sameness on every royal and noble garden. Trees were headed, and their sides pared away; knots of flowers were more defensively subjected to a marked regularity, and leisure, as Milton says,—

——"in *trim* gardens took his pleasure."

These vagaries went on till London and Wise had stocked all our gardens with giants, animals, monsters, coats of arms, and mottoes, in yew, box, and holly. Absurdity could then advance no farther, and the tide turned. Bridgman, the next fashionable designer of gardens, was far more chaste; he banished verdant sculpture, and did not even advert to the square precision of the foregoing time. The leading step, however, to all that has succeeded, was the destruction of walls for boundaries, and the invention of fosses. No sooner was this alteration made, than levelling, mowing, and rolling followed. The contiguous ground of the park, without the sunk fence, was to be harmonised with the lawn within; and the garden, in its turn, wasto be set free from its prime regularity, that it might assort with the wilder country without. Much, according to Walpole, was accomplished by Kent, "who saw all nature was a garden, and bestowed the arts of landscape on the scenes he handled." Succeeding artists have carried improvement much farther. The introduction of foreign trees and plants, which we owe principally to Archibald, Duke of Argyll, contributed essentially to the richness of colouring so peculiar to our modern landscape. The mixture of various greens, and the contrast between our forest-trees and the Northern and West Indian firs and pines, are improvements more recent than Kent, or but little known to him. Each florid shrub, and each tree of delicate or bold leaf, are new tints in the composition of our gardens.

A love of flowers, and a great degree of skill in their cultivation, were long ago imported into the ancient commercial city of Norwich, with its worsted manufacture, from Flanders; and out of this state sprang something like the study of systematic botany. These pursuits, however, were mostly confined to the humblest of the community, particularly among the then very numerous bodies of journeymen weavers, dyers, and others in similar circumstances. Towards the middle of the eighteenth century several of the opulent merchants seem to have acquired, by their intimate connexion with Holland, not only this taste for horticulture, but likewise an ambition to be distinguished by their museums of natural curiosities. Green-houses of exotic plants, except oranges and myrtles, were, however, at this time scarcely known; and the celebrated Sir James Smith mentions his having seen with wonder, about fifty years ago, one of the first African geraniums that ever bloomed in Norwich. If, however, the progress of natural science were slow in that part of the kingdom, the wealthy manufacturers, becoming their own merchants, found it necessary to acquire a knowledge of various foreign languages, in order to carry on their widely extended commerce. A happy mixture of literature and taste for many years distinguished this city above its rivals in opulence and commercial prosperity.

The London school has long maintained a rank superior to most other seats of botanical science. At its head stood the illustrious Sir Joseph Banks, who, from the time of returning from his celebrated and adventurous voyage, devoted himself to the practical cultivation of natural science for the advantage of others, as he had long pursued it for his own pleasure and instruction. With such an establishment as his, aided by the perpetual resources of the numerous public and private gardens around, botany might well flourish. Travelling botanists, too, were despatched, under the patronage of the affluent, to enrich our gardens from the Alps, the Cape of Good Hope, and the various parts of America. Every new acquisition was scrutinized, and received its allotted name and distinction from the hand of the correct and classical Solander, who one day was admiring with Collinson, Fothergill, or Pitcairn, the treasures of their respective gardens, and another labouring with the distinguished Ellis at the more abstruse determination of the intricate family of marine productions, whether sea-weeds, corallines, or shells. His own acquisitions, and those of his friend and patron, in the South Sea Islands, the hazardous shores of New Holland, or the nearly fatal groves or swamps of Java, were recorded by his pen, and perpetuated by the labours of the engraver.

Just at the time when the Banksian school had most firmly established its credit and its utility, a great additional weight was given to England in the scale of natural science, by the acquisition of the entire museum, library, and manuscripts of the great Linnæus and his son, which was obtained by Sir J. E. Smith, after the death of the latter. Thus, instead of wasting time in conjecturing what Linnæus and the botanists with whom he corresponded meant, their original specimens, named by their own hands, were possessed.

A curious circumstance may here be mentioned in connexion with the Ulex Europæus, the furze or whin. Though found in flower in England throughout every month in the year, it cannot stand the cold of the winter in Sweden. When Linnæus first saw it flowering in this country, he is said to have fallen on his knees, and offered his thanksgivings to the Author of nature. With this plant Sir J. E. Smith commenced the study of botany. "I received Berkenhout," he says, "on the 9th of January 1778, and began on the 11th with infinite delight to examine the Ulex Europæus, the only plant then in flower. I then first comprehended the nature of systematic arrangement, and the Linnæan principles, little aware that at that instant the world was losing the great genius who was to be my future guide, for Linnæus died on the night of the 11th of January, 1778." Since the death of Sir James, the museum, books, &c., of the immortal Swede, became the property of the Linnæan Society, established in the year just mentioned — a society formed under the immediate auspices of this most worthy heir of Linnæus, its first president.

More truth than appears at the first glance will be found in the statement of one of the correspondents of "the Idler," in reference to the time in which he wrote. "All the faults of my life were for nine months circulated through the town with the most active malignity, because I happened to catch a moth of peculiar variegation; and because I once outbid all the lovers of shells, and carried off a nautilus, it was hinted that the validity of my uncle's will ought to be disputed." The pursuit of natural history was once considered a species of insanity, and a will has been declared invalid if the testator were a naturalist. But such a state of things was now passing away never to return. Availing himself of the labours of Ray, Linnæus had reduced into a systematic arrangement all the known productions of nature, and assigned to each two Latin names: of these, the first name was common to several individual kinds, the last name to one kind only. To explain this by an example: the *wolf*, the *fox*, and the *dog*, are very similar in form and in manner of living; these three, together with some others much resembling them, he considered as constituting a family, or, as he termed it, a *genus*, and to this *genus* he gave the name *Canis*. Then each animal, the wolf, fox, dog, &c., he considered a separate kind, which he termed a *species*; thus he called the wolf *Canis lupus*, the fox *Canis vulpes*, and the dog *Canis familiaris*. This plan of nomenclature has been universally received.

Linnæus considered universal nature as tripartite, or animal, vegetable, and mineral. Each of these is now the subject of a separate science; zoology treats of animals; phytology, more commonly called botany, treats of vegetables; and geology of minerals; the latter science including the solid fabric of the earth itself within its scope. Such a division of nature is comprehensive though it is not perfect; thus water and the air which we breathe are not considered; nevertheless animals, vegetables, and minerals, are the three most obvious portions or kingdoms in nature.

Zoology, it has been said, treats of animals. In this science Linnæus, with that discrimination which attends genius, detected those differences of external form which, when recorded, enabled the student pretty readily to ascertain for what animal or group of animals each description was intended. This was not sufficient for the more modern philosopher; he clearly saw that difference of external form was but variation of structure, detected in those parts which met his eye; he concluded there must be other differences hidden from his eye quite as important as those which were so obvious: he saw too, that structure was exquisitely adapted to economy or mode of life; and he justly concluded, that from structure he might predicate economy, or from observed economy predicate structure. Another step was yet wanting; it was necessary to have some form as a type, and to appreciate and describe other forms by their variation from such typical form. For centuries the structure of the human frame has been well understood; the bones, muscles, blood-vessels, &c. have been accurately defined and named; and the necessity for a typical form was no sooner felt than supplied, for it was instantly perceived that a vast number of animals possessed essentially the same parts as man; and that, though the parts varied greatly in proportion, yet they were always comparable with the same parts in man. Thus arose the grand science of comparative anatomy, a science which compares the parts of animals with the same parts in man, and describes the animal by the difference; thus comparative anatomy, itself a science of differences, has become the guide of the zoologist.

The science of comparative anatomy has shown that the fin of a whale and the foot of a dog are not only attached in the same way, and represent in position the hand of a man, but that they are identically constituted, containing the same bones, joints, &c., thus establishing the grand principle of uniformity of structure. These facts have now become so generally yet gradually known, and so universally yet slowly admitted, that it is difficult either to date their introduction, or to assign their discoverer his due meed of praise. There seems to have arisen simultaneously a spirit of inquiry, which has led directly and irresistibly to the discovery of truth.

Europe never teemed with more illustrious discoverers than it did about half a century ago: the whole range of the sciences, from the simplest application of human ingenuity up to the noblest traits of the intellect, found enthusiastic and successful votaries. The whole circle was one of living flame. The French philosophers collected the contributions of all Europe, and by embodying them in one magnificent work, claimed for themselves the peculiar guardianship and supremacy of human genius. Law, policy, and religion, had long possessed their codes: the French philosophers boasted that in the "Encyclopédie" they had first given the code of science. Hating the evil purposes of

Diderot and D'Alembert, it is impossible to look on their labours without wonder. France had within a few years outstripped all competition in the higher branches of mathematical learning; but she now invaded the more stubborn precincts of English and German research; seized on chemistry and natural history; and by the success of Lavoisier and Buffon, gave science a new and eloquent power of appeal to the reason and imagination of man.

Glancing at the state of things which existed long before this period, it will be found that chemistry was considered by the public in general as nothing else than the art of preparing medicines. The pharmacopœia constituted the codex of the chemist; and the object of the student was to acquire the art of preparing all the medicines contained in the pharmacopœia, or to contrive new, safer, and more efficacious remedies, than those already known: hence the reason why it constituted an essential point of every medical education. The business of the professors of chemistry was to teach medical students the method of preparing the chemical medicines, which they were to employ when they entered on practice.

Chemistry continued to be considered in this country as nearly synonymous with pharmacy, till Dr. Cullen began his memorable career in the College of Glasgow. He had viewed chemistry with the enlarged eye of a philosopher, and was aware of the importance it would assume as soon as it was properly cultivated. He contemplated the splendid career which future chemists would run, and the celebrity which would be attached to their names. He had the merit of giving a beginning to philosophical chemistry in Great Britain. It was by his lectures that the taste of Dr. Black for chemistry was first formed; and the lectures of the latter fed the flame the former had kindled.

It was about the middle of the eighteenth century that chemistry shook off the trammels of pharmacy, and began to aim at the rank of an independent science. At first her steps were slow and hesitating. The dogmas of the alchemists still clung to her like fetters, and damped all her energies; but at length she stood forth in her proper and desired freedom.

Dr. Black's two great discoveries—the doctrine of latent heat, and the composition of lime-stone—led the way to a general investigation of the effects of heat, and to the discovery and description of the different gases. M. Welcke, Secretary ot the Stockholm Academy, published, in 1772, a curious paper on the quantity of heat absorbed by snow when it melts. It appears probable that he derived his first notions of the subject from Dr. Black. He published also, in the same work, a very beautiful set of experiments, by which he investigated the specific heat of ten metals, and likewise of agate and glass. The publication of the interesting paper on the same subject, by Lavoisier and Laplace, was about two years later. There can be no doubt that Lavoisier was already well acquainted with what had been done in Great Britain, though, contrary to his usual practice, he makes no allusion to those by whom it was accomplished.

At this period the minds of chemists were enthralled by the phlogistic theory* of Beecher and Stahl, which, however, was overturned by Lavoisier after a most laborious investigation of ten years. He demonstrated that combustion is not a *decomposition*, as had been hitherto supposed, but a *combination*. In common cases the combustible unites with oxygen, one of the two constituents of common air: hence the necessity of air for combustion, and hence the reason why the product of combustion is heavier than the combustible from which it is formed.

We have now arrived at one of the most remarkable and splendid epochs of chemical science, adorned by discoveries which have been rarely equalled either in number or importance, and ushered in by a series of sterling facts and memorable investigations. Dr. Priestley's attention was especially directed to the doctrine of air, in consequence of residing near a public brewery, where he amused himself by experiments on the fixed air produced by fermentation. From various experiments, he concluded that the noxious air, resulting from combustion, and from the breathing of the different animal tribes, formed part of the nourishment of plants; and that the purity of our atmosphere, and its fitness for respiration, were materially dependent on the functions of growing vegetables. The first of August 1774 has been called the birth-day of

* Note T.

pneumatic chemistry, though others have thought that till then it was a sickly and puny bantling, from the bad nursing of the early chemists, but that from the admirable domestic arrangements of Priestley it suddenly became a healthy and vigorous child.

On discovering oxygen, a species of air which greatly supported combustion, he considered its superior fitness for the support of life; he therefore introduced mice into it, and found that they lived longer than in an equal bulk of atmospheric air; he then had the curiosity to taste the gas himself, and after two or three respirations, he felt, or fancied he felt, a peculiar sensation of lightness or ease of the chest. "Who can tell," says he, "but that in time this pure air may become a fashionable article in luxury! Hitherto only two mice and myself have had the privilege of breathing it."

Other discoveries were made by this eminent man, whose labours have been of great value, but whose philosophical notions were blended with much that is erroneous. He seems to have possessed unjust notions of the difference between phlogisticated and dephlogisticated air; and instead of regarding them as distinct chemical principles, adopted the notion of one elementary substance, charged in the one instance with the imaginary essence of inflammability, and free from it in the other. In these inquiries, however, he frequently verges on more correct and refined ideas.

While Priestley at home, and Scheele in Sweden, were thus extending the boundaries of knowledge, the Honourable Henry Cavendish was not less successfully employed. He explained the properties of hydrogen or inflammable air, and of nitric acid. To him also belongs the honour of discovering the composition of water, which led to a variety of other discoveries scarcely inferior in importance, while it tended to elucidate a variety of intricate phenomena in nature and art, in which that universal fluid is concerned. This discovery became a great instrument in subverting the doctrine of phlogiston. He is indeed fairly entitled to the highest encomiums. It has been said, by one well prepared to pronounce so favourable and exalted a decision: "Every sentence he has written will bear microscopic examination." His efforts were no less disinterested than successful. His family were noble, and he could not therefore be prompted by the desire of distinction; his affluence was princely, and consequently he was free from the calls of necessity,—it was a thirst for knowledge and a love of truth that secured his obedience to the voice of science, and has invested his name with higher honours than those of rank, however exalted, or wealth, however great, can possibly confer.

Lavoisier availed himself of the numerous and important discoveries of Cavendish, Priestley, and Scheele, which he verified; while his own experiments were conducted with a degree of care and precision, and at an expense *hitherto unknown*. He demonstrated that charcoal, when burnt, combines with oxygen, and is converted into carbonic acid; that sulphur, by uniting to oxygen, becomes sulphurous acid; and that the calces of mercury, iron, and tin, and all the metallic calces, are combinations of the respective metals and oxygen.

Still Lavoisier's papers, numerous and conclusive as they are, produced little effect on his contemporaries. He experimented, and demonstrated, and published for ten years, without making a single convert. Every chemist opposed him in every country; and his final success was not owing so much to the goodness of his cause, as to his address in enlisting the vanity and nationality of his countrymen on his side. With a few remarkable exceptions, the elder chemists, in every country, continued to the last faithful to the doctrine of phlogiston; but the young men in every nation embraced the new doctrines of the French chemist. Thus Lavoisier wears the rare honour of completely eradicating the leaven of alchymy, which, till his time, continuing kneaded with chemistry, had polluted the whole mass. He set the votaries of the science of chemistry at complete liberty; the materials for thinking and experimenting were laid before them; and without being insensibly warped by preconceived opinions, they were enabled to exercise their own judgments. Most of his peculiar theories and opinions, plausible and seducing as they were, have been subsequently shown to be erroneous. But the service he performed, by sweeping away all old prejudices and trammels, was of vast importance.

About twenty years later Bergman devoted the whole of his attention to the improvement of the analytical art. He examined various mineral waters, and gave a minute detail of the methods by which he determined the constituents of each. He attempted to analyse the precious stones, and drew up a set of rules for analysing the mineral bodies in general. So much confidence was placed in his accuracy, that his determinations of the composition of salts were long taken as the data from which chemists calculated the results of their analyses. About the same time, Scheele applied his wonderful powers to the same subject; and the skill with which he investigated the constitution of several bodies, till then unknown, is truly astonishing. But it was Klaproth who first reduced the art of analysis to general principles, and who laid so many examples before the public, that others were enabled, by studying his writings, to acquire the same kind of skill. Next to Klaproth, analytical chemistry is most indebted to Vauquelin. He systematized the art of analysis, and published a minute detail of the methods which he followed. Meanwhile, another branch of analysis was proceeding with alacrity, and the fixed alkalies and earths, hitherto deemed simple, were shown to be compounds of oxygen and metals.

The original discovery of the Galvanic power was, like many others, singularly accidental. The wife of Lewis Galvani, a physician and physiologist of Bologna, being in a declining state of health, employed as a restorative, according to the custom of the country, a soup made of frogs. A number of these animals, prepared to be cooked, happened to lie in Galvani's laboratory, on a table near the electrical machine. While this was in action, an attendant happened to touch, with the point of a scalpel, the crural nerve of one of the frogs, that was not far from the prime conductor, when the muscles of the limbs were observed to be instantly thrown into strong convulsions. This experiment was performed during the absence of Galvani, but it was noticed by his lady, who, much struck by the appearance, communicated it to her husband. He repeated the experiment, tried it in different ways, and perceived that the convulsions only took place when a spark was drawn from the prime conductor, while the nerve was, at the same time, touched with a substance which was a conductor of electricity. At the time that this accidental discovery was made, Galvani was engaged in a set of experiments, the object of which was to prove that muscular motion depends on electricity, and it appeared in a very remarkable manner to confirm his hypothesis, so that he was induced to prosecute his inquiry with redoubled diligence.

The true discovery of Galvani was that of a delicate animal electrometer. The conclusion ought to have been, that combinations of the metals were rendered electrical by contact. But ideas very remote from this were formed by Galvani and his followers. They conceived that the metals were merely the conductors of an ethereal fluid existing in the animal organs, and that this fluid was the cause of irritable action. Innumerable experiments were now made by Humboldt and others, and the most romantic notions were entertained of their result.

The same year that Galvani made his observations, Bennet showed that the metals gained electrical powers by contact or friction; and he was enabled to determine this by an extremely delicate instrument of his own invention, in which gold-leaf is exposed to the body examined, and in which, by particular artifices, the electricity is increased. One of his simplest experiments was to touch a plate of copper with the blade of a knife,—an effect is found to be produced, in a slighter degree, similar to that produced by the friction of sealing-wax. This discovery, which contained the solution of the experiment of Galvani, though published, was neglected for ten years, till the singular phenomena comprehended under the name of Galvanism began to occupy the public attention.

Volta, in opposition to Galvani, always asserted that these phenomena were merely owing to the electricity of the metals, and made still more decisive experiments than Bennet on the subject; this philosopher also put the question beyond all doubt by the grand invention of the new electrical battery, in which the powers of the electrical machine, the Leyden phial, and the organ of the gymnotus, are, as it were, combined and concentrated.

Solids were, till the time of Volta, supposed to be the only substances which could be made electrical, or, as it was usually called, excited; but Volta showed that fluids are possessed of this property. One of his experiments was to fill a cup of silver with a solution of liver of sulphur; a leg of a frog made to touch both the silver and the solution undergoes violent contractions. Even elastic fluids are capable of exhibiting electrical effects. Thus, a strong stream of air forced against brass, connected with gold leaf, very sensibly affects it; and probably all the substances in nature are capable of exhibiting this power.

The Voltaic battery was as an alarm-bell to experimenters in every part of Europe; and it served no less for demonstrating new properties in electricity, and for establishing the laws of this science, than as an instrument of discovery in other branches of knowledge; exhibiting relations between subjects before apparently without connexion, and serving as a bond of union between chemical and physical philosophy.

Passing for the present from Galvanism ot Electricity, it should be observed, that after the researches of Grey and Du Fay, nothing that materially affected the progress of the investigation was ascertained till 1745, the year of the discovery of the Leyden phial. This extraordinary apparatus was first employed by the Canon Von Kleist, of Kamin; but a similar combination was soon after invented by Cunæus and Muschenbroeck, of Leyden. Kleist's form of the experiment was a phial held in the hand, having a nail in it; Muschenbroeck's form was a phial half filled with water. Nothing in the history of electricity is more singular than the first accounts of the electrical shock, as given by these very feeble and imperfect instruments; and the astonishment of the discoverers seems almost to have deprived them of their reason.

Muschenbroeck, writing to Reaumur, states, that "the effect from a small glass bowl was so violent that he lost his breath and his sensation, and was two days before he recovered from the effects of the blow and the terror, and that he would not take a second shock for the whole kingdom of France." No other example is necessary to demonstrate how much the imagination and the senses influence each other. Other philosophers, with a much more perfect and more powerful apparatus, repeated the experiment without any such terrible effects, and referred to the cowardice of the professor what was only the effect of his surprise.

No single philosophical discovery ever excited so much popular and scientific attention as that of the Leyden phial. In the same year in which it was discovered, a number of itinerant experimenters procured a livelihood in different parts of Europe, by travelling from place to place, and showing its operation. About the middle of the last century, an immense number of facts had been ascertained, which were constantly accumulating, and some principles had been developed; but a general theory for connecting the insulated observations, and giving them the form of a body of science, was still wanting. The foundations for this theory were laid by the ingenuity and industry of our countryman, Dr. Watson; the construction of it is owing to the sagacity of Dr. Franklin.

He proved that the conductor in contact with the rubber of the electrical machine had an opposite electricity from that of the great conductor; that the outside and inside of the Leyden phial were likewise in opposite states; and that an equilibrium was made by their mutual agency; and he referred all the phenomena to the redundancy or deficiency of a single fluid. The experiments adduced by Dr. Franklin in support of his hypothesis were most ingeniously contrived and happily executed. A singular felicity of induction guided all his researches, and by small means he established very grand truths. He endeavoured too to remove all mystery and obscurity from his subject, he wrote equally for the philosopher and the uninitiated, and he rendered his details amusing as well as perspicuous—elegant as well as simple.

The theory of negative and positive electricity was soon made, by M. Æpinus, of the Academy of Petersburgh, the subject of mathematical illustration. A more popular, and not less refined view of the same doctrine was shortly after furnished by

Mr. Cavendish, who combined delicacy of physical experiment with elucidations derived from the higher branches of mathematical science, and whose researches in electricity have the same exalted character as in the other departments of natural philosophy. The magnificent effects produced from the accumulation of electricity by large machines and jars, soon led philosophers to reason from artificial concerning natural processes. Such an influence it was impossible to consider passive in the external world, and the most striking analogies soon led to the discovery of its most obvious operations. Dr. Stukely and the Abbé Nollet had observed the similarity between the electrical spark and lightning and the report of thunder; but Dr. Franklin was the first philosopher who conceived the bold idea of bringing lightning from the clouds,—who first imagined that by pointed conductors, charged electrical clouds might be made harmless, and the matter of the thunderbolt quietly conveyed from the atmosphere to the earth. The simple apparatus of a school-boy's kite, held by means of a silk handkerchief attached to a hempen string, with a key for a conductor, enabled him, in June 1752, to verify this grand idea. The practical application soon followed, and, what rarely happens, the same philosopher had the glory of discovering a noble principle in nature, and of making it of public utility.

In 1774 a new inquiry was introduced by Mr. Walsh. The powers of the torpedo and gymnotus to give shocks had long been known, but he proved, by the most satisfactory experiments, that the effect was electrical; and Mr. Cavendish contrived to imitate the electricity of these fishes by a number of Leyden jars, weakly charged. After this period electricity was not for some years distinguished by any grand advances. This was the great era of chemical discovery, and philosophical minds were fully busied with other important investigations.

Astronomy, however, made progress. Bliss replaced Bradley in 1762, but he held the office only three years, and had no time to distinguish himself as an observer, although a few of his observations are appended to the volumes that contain Bradley's. During a space of forty-seven years Maskelyne, who succeeded him, observed the heavens with an attention and care of which there are few instances. He had for this purpose, instruments unquestionably superior to those of any of his contemporaries; the quadrants of Bird and Graham, the transit made for Bradley, and the sector with which the latter had discovered the aberration, were long unequalled in any observatory; but he, in addition, improved the mechanical part of their use.

Maskelyne also called the attention of the Commissioners of Longitude to the practicability of the method of lunar distances, and proposed to them to establish a nautical almanac, which should contain such an ephemeris of the moon's path as would make the object in view attainable. The lunar tables of Mayer furnished the proposed materials for the moon's places; and on the adoption of the scheme of Maskelyne, a parliamentary reward of 3000*l.* was given to Mayer's widow. To Maskelyne we are thus indebted for a work which has, more than any other, contributed to the advancement of navigation, in the removal of the great difficulty of finding the longitude. The first nautical almanac was published in 1767, and was continued by Maskelyne to the end of his life. Since his time a very slender portion of mathematical knowledge will enable a diligent observer to turn his means to good account in the promotion of sidereal and even of planetary astronomy.

Our countryman, the celebrated John Harrison, who, in 1767, obtained the parliamentary reward of 20,000*l.* for the invention of his admirable time-piece for ascertaining the longitude at sea, is one of many examples of self-taught genius. Brought up as a carpenter, he very early discovered a taste for mathematical science, which is said to have been first awakened by a manuscript copy of some of the lectures of Saunderson, that accidentally fell into his hands. Before he was twenty-one years of age, he had made two wooden clocks, without having received any instructions in the art, or any assistance in the work. He was first induced to think of applying himself to the construction of marine chronometers by living for some time in sight of the sea. In 1728 he first arrived in London, in order to prosecute this object; but he had to devote to it the anxious labours of nearly forty years before his inventions were perfected, or their general merit fully recognised.

The art of watchmaking owes several valuable improvements to Harrison, among which may be particularly mentioned the gridiron pendulum, and the expansion balance-wheel: the one serves to equalize the movements of a clock, and the other those of a watch, under all changes of temperature; and both depend on the alteration under change of temperature of two different metals, which are so employed to form the rod of the pendulum and the circumference of the wheel, that the contraction of the one exactly counterbalances the expansion of the other.

One of the finest discoveries of the eighteenth century is that of the achromatic telescope, or, as the name intimates, one without colour; and if we owe to those founded on the principles of reflection the great discoveries of sidereal astronomy, it is by means of the achromatic telescope, as applied to certain transit instruments and divided circles, that the nicest measurements of celestial arcs have been taken, and those accurate results obtained which have led to the completion of astronomical theories, and to the perfection of the lunar and planetary tables.

After the penetrating genius of Sir Isaac Newton had pronounced "the improvement of reflecting telescopes to be desperate," no slight honour must belong to the individual who dared to hope where he had despaired, and who triumphed over the difficulties which baffled the theoretical and practical skill of that distinguished man. This fortunate individual was Mr. Chester More Hall, of More-Hall, in Essex. In imitation of the divine mechanism of the human eye, he was led, in 1729, to the combination of media of different refractive powers; and a few years after he had actually completed several achromatic object-glasses of flint and crown glass. No account of this invention was, however, published.

When John Dollond, the son of French parents, whom the revocation of the edict of Nantes compelled to find an asylum in England, began his labours, he was doubtless entirely ignorant of those of Mr. Hall, and may be said to have reinvented the instrument just mentioned. "I have," he says, "after numerous trials, and a resolute perseverance, brought the matter at last to such an issue that I can construct refracting telescopes with such apertures and magnifying powers, under limited lengths, as, in the opinion of the best and undeniable judges who have experienced them, far exceed any thing that has been produced, as representing objects with great distinctness and in their true colours." This, which must be pronounced the finest and most important improvement made in optics since the great discovery of the unequal refraction of the several rays of light, was the result of a long series of trials, directed with great judgment and ingenuity, but very little aided by the powers of calculation. Such a procedure was probably the best suited, however, to the habits of the artist, and it had at least the advantage of leaving behind it no doubt or hesitation.

Others carried forward this important work, among whom was Herschel, a musician, residing at Bath, though a native of Hanover, which he had left in early youth. He devoted his leisure to the construction and improvement of reflecting telescopes, with which he continued ardently to survey the heavens. His zeal and assiduity had already attracted the notice of astronomers, when he announced to Dr. Maskelyne, that on the night of the 13th of March, 1781, he observed a shifting star, which from its smallness he judged to be a comet, though it was distinguished neither by a nebulosity nor a tail. The motion of the star, however, was so slow as to require distant observations to ascertain its path. This proved to be the Georgium Sidus, or, as it is now classically denominated, Uranus. Animated by this happy omen, he prosecuted his astronomical observations with unwearied zeal and ardour, and continued, during the remainder of a long life, to enrich science with a succession of splendid discoveries.

When we compare the twenty and forty feet telescopes of Dr. Herschel, which were in use at the close of the eighteenth century, with the six-inch reflectors of Newton, which were the largest that had been executed at its beginning; and when we contrast the discoveries in sidereal astronomy to which they led with our knowledge of the starry heavens in the days of Newton; we cannot avoid the conclusion, that the boundaries of astronomy were more widely extended by the reflecting telescope alone, and during the latter half of the eighteenth century, than during the whole period of its past history.

In the history of human inventions we can generally trace some continuous line by which the labours of one age are connected with those of another, and by which the discoveries of an individual gradually ascend above those of his predecessors. But in the astronomical records of the eighteenth century, the human mind started out of its ordinary sphere, and in the picture which emblazons its triumphs, the individual labours of Dr. Herschel occupy the foreground in vivid colouring and in powerful delineation. In surveying the ocean on which the history of this period embarks us, his discoveries are as the sea-lights which throw their full radiance over the deep, while the efforts of many are but as the glimmerings of animalcular existence, which scarcely shoot beyond the pellicle which covers them.

After Dr. Herschel withdrew from the toils of science, no individual arose to extend his telescopic labours. Mr. Ramage, of Aberdeen, indeed, constructed several reflectors approaching in magnitude to those of Dr. Herschel; but the exertion of a private individual speedily finds its limits, and it is probable that this branch of practical astronomy will take a retrograde course till some British sovereign shall extend to it the munificence of George III.

Attention to aerostation was first given in France. The result eclipsed the minor triumphs of science. The balloon inspired all France—king, philosophers, and populace — with enthusiasm. The palpable powers of this machine, its beauty as an object, the theatrical nature of the spectacle presented at the ascents, and the temerity of the aerial navigators, rising in a floating "argosie" of silk and gold, filled the quick fancy of France with dreams, alike gay, evanescent, and unprofitable.

The almost contemporaneous discoveries of Franklin's conductors, Mongolfier's balloon, and Herschel's Uranus, gave rise to the remark, that the young audacity of America claimed the seizure of the lightning; that the balloon was an emblem of the showy volatility and ambitious restlessness of France; while the discovery of a new planet was not unsuited to the serious thought of the people of England. In this country of course the observation originated. As the sculptor represented the superiority of the man to the lion, while could the lion have engaged the services of the artist, the contrary had been the case, so France and America would have instituted a comparison more complimentary to themselves, or have allowed the occasion to pass without one.

The close of the seventeenth century had witnessed the birth of a new science, which assumed in its infancy the pompous name of the Theory of the Earth. Starting with a few ill-ascertained facts, and uniting these by fantastical assumptions, it pretended to go back to the origin of worlds, as it were, to sport with them, and to create their history. Its arbitrary methods and pompous language seemed to remove it to a distance from the other sciences; and, in fact, scientific men long excluded it from the circle of their studies.

A happy reformation as to the examination of the earth was commenced by two celebrated men, Pallas and Saussure, and completed by Werner, of Freyberg. With him begins the most remarkable epoch of the science of the globe—an epoch indeed which he himself may be said to have filled; for he had the good fortune to witness the universal prevalence of his views, although they were novel in their character, and foreign to the previous notions of most naturalists. In a few years the little school of Freyberg, originally designed only for the instruction of some miners for Saxony, again presented the appearances of the earliest universities of the middle ages. Pupils flocked to it from every civilized country; and even in the most remote places aged individuals and men of science, who had already attained the highest celebrity, hastened to acquire a knowledge of the German language, for the sole purpose of being in a condition to hear and understand the great oracle of geology.

Meanwhile a circumstance occurred which must be mentioned. Haüy was the son of a small linen manufacturer, who at length procured a bursary in the college of Navarre, and afterwards became a teacher in that establishment. His leisure hours were occupied in the study of botany ; but by a fortunate accident his attention was withdrawn from plants, to examine the structure of minerals. His mind had been for some time filled with ideas relative to the contrast presented by the vegetable and mineral kingdoms, inasmuch as in the complicated forms of flowers, fruits, and other organised bodies, a never-failing unity of form pertained to each individual plant or herb, whilst the same stone or salt, without its composition being changed in the slightest degree, exhibited itself in cubes, prisms, and other shapes. Occupied with these reflections, he accidentally dropped from his hand a beautiful specimen of calcareous spar, crystallized in prisms, one of which was broken in such a manner as to present a new crystal, differing in form from the prism, but having the surfaces not less smooth. On examination, the inclinations and angles were found to be similar to the rhomboid crystals of Iceland spar. He further examined pieces of spar crystallized in other forms, and he still found the same rhomboid which had first struck him, the fragments which fell from it being also small rhomboids. The importance of the discovery at once flashed on his mind, and like Archimedes starting from the bath, he exclaimed, "All is found!" The conclusion at which he arrived was this, that the molecules, or, as it were, component parts of calcareous spar, have invariably the same geometrical figure; the variety of external forms which the masses assume arising from the manner in which the smaller crystals composing it are arranged. By examining a number of substances, Haüy completely established the fact, that this was a law of nature which obtained universally. Each mineral was found to have identical constituent molecules, a nucleus always similar to itself, and laminæ, or accessory layers, producing all the varieties of external form.

Nothing could be more brilliant than the prospects which seemed to open themselves to the science of mineralogy at the epoch of Werner and Haüy. The German professor gave a facility and clearness to the determination of minerals by external characters, far exceeding any thing which had been taught before; he introduced a system of classification which appeared to lend itself very happily to the known relations of minerals; and he announced the possibility of distinguishing, by the mineral characters of the mountains of the earth, the place which their strata occupied in an invariable chronological series, and their meaning as the record of remote but ascertainable epochs in the physical history of the globe; an application of mineralogy which of itself was sufficient to give to the study a most attractive dignity and interest.

The French crystallographer, on the other hand, laid before his hearers a science which detected the most beautiful symmetry, simplicity, and constancy, in the midst of apparent complexity and instability; which undertook to determine the forms and laws of aggregation of the component atoms of bodies; and which boasted that, in the most remarkable manner, its predictions and suggestions, founded on differences which the unassisted eye could not appreciate, had been confirmed by the testimony of chemical analysis, summoned as a witness for that purpose. The visions so natural in such circumstances have not, however, been realized. Instead of our knowing exactly the chemical constitution of every mineral species, of finding chemistry ever ready to confirm the arrangements and classifications otherwise made, or if not, to offer something steady and unexceptionable in their place, though forty years have elapsed since Haüy began to compare the results of crystallography and chemistry, we have as yet very few minerals of which the chemical constitution is not liable to some dispute;—scarcely a single species of which the rule and limits are known, or in which two different analyses, taken at random, might not lead to different formulæ;—and no system of classification which has obtained general acceptation, or is maintained, even by its proposer, to be free from gross anomalies.

A more favourable account must be given of the healing art. From the revival of letters to the commencement of the eighteenth century, the great aim and object was to apply to medicine the same scientific principles which had been found successful in the advancement of the other departments of philosophy. The most distinguished medical writers of that period had therefore employed themselves rather in collecting opinions, and in reasoning on them, than in examining the grounds on which they were formed, or inquiring in what degree they were applicable to explain the phenomena of the animal economy. For the most part they failed in their direct object; but, at the same time, a considerable body of information was gradually acquired, and the views which now began to be unfolded in consequence of the pathological speculations of Hoffman, and the practical observations of Sydenham and others, led to the same spirit of inductive investigation in medicine which had been for some time adopted in the other divisions of natural science. Notwithstanding occasional interruptions, the progress of knowledge has therefore been rapidly and steadily advancing. Experiments well contrived and patiently conducted have been performed in every department of physiological and medical science; observations have been made with more minuteness, and recorded with more accuracy; an improvement in chemistry has introduced the most important reforms into pharmacy; while the discovery of various new articles of the materia medica has given additional and powerful means of opposing the progress of disease.

A series of interesting circumstances in connexion with practical medicine must now be noticed. Towards the close of the eighteenth century the small-pox continued, notwithstanding every effort, to commit fearful ravages. The progress of intelligence, and the improvements effected in the art of inoculation, combined indeed greatly to extend that practice, to the advantage of individuals, but unhappily without any corresponding diminution of the general mortality. Though the prudent were preserved, the careless and improvident, who generally form the bulk of mankind, had their dangers increased. The sources of infection were multiplied, and small-pox, which formerly used to visit country districts only at long and uncertain intervals, was now to be met with in all parts at all times. In London, inoculation was widely diffused among the lower ranks of society; but as the precaution of seclusion was not taken, the contagion was daily encountered in the open streets. So extensive indeed was its influence, that the total deaths by small-pox throughout England was estimated at about 45,000 annually; but at length a discovery was made which has proved, in the issue, of universal importance.

Very early in life, Edward Jenner, a native of Gloucestershire, evinced a strong inclination to the study of natural history, and during his apprenticeship to an eminent surgeon, his attention was frequently called to a notion current in the dairy districts of the country, that cows were subject to a disease called the cow-pox, which, being sometimes communicated to the milkers, protected them from the small-pox. One such occasion is particularly recorded. A young countrywoman came into the shop to seek advice ; and when the subject of small-pox was mentioned in her presence, she immediately said, "I cannot take that disease, for I have had cow-pox." Young as Jenner then was, this remark enchained his attention; he dwelt with the deepest interest on the statement thus casually made by an uninstructed peasant, and he to some extent foresaw the consequences which might result from so extraordinary a circumstance. Many difficulties, however, arose in the course on which he now entered; nor were there wanting medical men, who knew of the cow-pox and its reputed powers, but who attached no value to the facts adduced, and thought that a further prosecution of the subject would only terminate in doubt and disappointment. These obstacles damped for a while, but did not extinguish, the ardour of his mind. He soon ascertained that the cow was subject to a variety of eruptions on the teats; he was led to discriminate between them, and was induced also to believe that only *one* was possessed of specific power over the human body. This he called the *true* cow-pox.

The next step of the inquiry convinced him that the true cow-pox itself was liable to progressive changes, and that it was only at one period of its course, in its acmé of intensity, when it was endowed with specific and preventive properties. While pursuing this branch of the subject, Jenner was struck with the idea that it might be practicable to propagate the disease by inoculating, first from the cow, and finally from one human being to another. At what precise period of his career this brilliant thought first occurred to him is not accurately known, but it was probably early in 1780. About eight years after he visited London, and took with him a drawing of the casual cow-pox, as seen on the hands of milkers; but the physiologists and physicians of London saw in this only a curious and barren fact.

Hitherto Jenner had taken no decisive step to ascertain the practicability of inoculating for the cow-pox, on the success of which his whole scheme mainly rested; but at length, in May 1796, the decisive experiment was made: one child was vaccinated with matter taken from another; he passed through the disease in a manner perfectly satisfactory; and he was afterwards inoculated for the small-pox, which, though carefully conducted, produced no effect.

This important discovery was now proclaimed to the world as the result of much thought and deliberation, matured through the long period of twenty years. The eagerness with which vaccination was adopted, formed a singular contrast to the events which, eighty years before, marked the introduction of the small-pox inoculation into England. It shows how much education had opened the minds of the people at large, who, within twelve months of the discovery, greatly encouraged vaccination; and it also bears honourable testimony to those medical practitioners, who at once renounced the prejudices of earlier life, and a large share of most profitable practice. The honour of commencing vaccination in London is due to Mr. Cline.

The "First Series" of Dr. Cullen, and the Treatise on the Blood, &c., by Mr. Hunter, are considered the most important systematic works on medical subjects, which were published in Britain during the latter part of the eighteenth century. Of the former it was said, that if the indolence of his disposition had not prevented, he might have risen to as great eminence in chemical science as Newton had previously done in mechanical philosophy. The grand discovery of Hunter was that of the life of the blood. The idea greatly surprised the medical profession when first promulgated; but it was demonstrated by the clearest inspection of natural phenomena, and a happy course of experiments, that the coagulation of the blood was an act of life. From this one fact the pathologist was enabled to comprehend a great variety of phenomena, which without it must ever have remained obscure.

Finding that his experiments in natural history could not be carried on advantageously in the midst of a large town, Hunter purchased, with his hard-earned savings, a piece of ground about two miles from London, and built on it a house, well known by the name of Earl's Court. This was his favourite summer retreat, where he spent a large portion of his time, and provided, at great expense, for the animals he collected around him. No person of common curiosity could pass this original dwelling without making inquiry concerning its proprietor; and, on a nearer survey, a lawn was discovered in the rear, covered with birds, and beasts, and creeping things of the strangest selection in nature.

It was here he carried on his experiments on digestion, on exfoliation, and on all other subjects in reference to the animal economy. Not only the common bee, but the wasp, the hornet, and the less known species of bees, were made subjects of inquiry; here also he completed his series of preparations of the external and internal changes of the silk-worm, and also another of the incubation of the egg; here, too, it was that he pastured and trained the buffaloes, which he harnessed and trotted through the streets of London so late as 1792. The growth of vegetables was also a favourite subject of inquiry, and one in which he was at all times engaged in prosecuting some experiments.

Making anatomical preparations was, in the time of that distinguished man, a new art, and very little understood. Every skilful specimen, therefore, became an object of admiration; and as many were required for the use of his lectures, and his brother. Dr. Hunter, had himself an enthusiasm for the process, he left no means untried to infuse into his relative a love for his favourite pursuit. How well he succeeded, the collection he afterwards made will sufficiently evince.

The museum of John Hunter was purchased by parliament for 15,000*l.*; it was committed to the College of Surgeons, and has since that time been enlarged. The most valuable part of the collection is that in the area of the great room, consisting of upwards of two thousand preparations, which were the results of his experiments on the inferior animals, and of his researches in morbid human anatomy. All these were originally arranged as illustrative of his lectures. The first division alone, in support of his theory of inflammation, contains 602 preparations. Those illustrative of specific diseases amount to 1084. There are besides, 652 dried specimens, consisting of diseased bones, joints, and arteries. On the floor there is a very fine collection of the skeletons of man and other animals; and if the council of the College continue to augment this collection with the same liberal spirit which they have hitherto shown, it will be creditable to the nation. The osteological specimens amount to 1936; but the most interesting portion, and one of the most gratifying exhibitions in Europe to a philosophical and inquiring mind, is that which extends along the whole gallery. Hunter found it imposible to explain the functions of life by the investigation of human anatomy, unaided by comparison with the simpler organization of brutes; and therefore he undertook the amazing labour of examining and preparing the simplest animals, gradually advancing from the lower to the higher, until, by this process of synthesis, the structure of the human body was demonstrated and explained.

To take one small compartment, in order to understand the effect of this method:—suppose it is wished to learn the importance of the stomach in the animal economy: the first object presented to us is a hydatid, an animal, as it were, all stomach; being a simple sac, with an exterior absorbing surface. Then we have the polypus, with a stomach opening by one orifice, and with no superadded organ. Next in order is the leech, in which we observe the beginning of a complexity of structure; it possesses the power of locomotion, and has brain, and nerves, and muscles, but as yet the stomach is simple. Then we advance to creatures, in which the stomach is complex; we find the simple membraneous digesting stomach; then the stomach with a crop attached, to macerate and prepare the food for digestion; then a ruminating stomach, with a succession of cavities, and with the gizzard in some animals for grinding the food, and performing the office of teeth; and, finally, all the appended organs necessary in the various classes of animals for performing the primary and essential office of assimilating new matter to the animal body.

An important institution of a more general kind had been for some time arising. The British Museum may be said to have originated in the bequest of Sir Hans Sloane, who, dying in 1752, left his immense collections of every kind to the nation, on the condition of paying 20,000*l.*, in legacies, to different individuals; a sum considerably less than the intrinsic value of the medals, coins, gems, and precious metals of his collection. This bequest included a library of 50,000 volumes, among which were 3566 volumes of MSS. in different languages; an herbarum of 334 volumes; other objects of natural history, to the number of six-and-thirty or forty thousand, the descriptive catalogue of which filled thirty-eight volumes in folio, and eight in quarto; and the house at Chiswick, in which the museum was deposited.

The Harleian collection of MSS. amounting to 7600 volumes, chiefly relating to the history of England, and including, among many other curious documents, 40,000 ancient charters and rolls, being about the same time offered for sale, parliament voted a sum of 40,000*l.* to be raised, and vested in trustees, for the establishment of a national museum. Of this money, 20,000*l.* were paid to the legatees of Sir Hans Sloane; 10,000*l.* were given for the Harleian MSS. and 10,000*l.* for Montagu-house as a receptacle for the whole. Sloane's museum was removed thither, with the consent of the trustees. In 1757 George II. presented to the museum the whole of the Royal Library collected by our kings, from the time of Henry VII. to that of William III., which included the libraries of Archbishop Cranmer, of Henry Fitzallan, Earl of Arundel, and of the celebrated scholar Isaac Casaubon; and in 1759 the British Museum was opened to the public.

The zoological additions have not kept pace with the other departments of the British Museum. Sir

Joseph Banks, however, presented the whole of his superb collection of animals, formed during his voyage round the world; and other contributions have been made, with the same solicitude for the public welfare.

While the various circumstances now recorded were transpiring, the literary history of our country was not without interest. As Addison gave the tone, character, and fashion, to the prose of his day, so Pope conferred a like donation on the verse. Yet numerous as were his imitators, no one rose to the highest rank. The works of Thomson and Goldsmith, however, furnish exquisite examples of beautiful delineations of nature. In those of Beattie and Akenside, philosophy is seen invested in the charms of polished versification, and highly-poetic imagery. In classic elegance and lyric fire, Collins and Gray may justly claim an honourable distinction.

"The era of our modern literature," says Montgomery, "extending from Elizabeth to the close of the Protectorate, was that of nature and romance combined: it might be compared to an illimitable region of mountains, rocks, forests, and rivers,—the fairy land of heroic adventure, in which giants, enchanters, and genii, as well as knights-errant, and wandering damsels guarded by lions, or assailed by fiery flying dragons, were the native and heterogeneous population; where every building was a castle or a palace, an Arcadian cottage, or a hermitage in the wilderness."

"The second era, from Dryden to Cowper, bore a nearer resemblance to a nobleman's domain, surrounding his family mansion, where all was taste and elegance and splendour within; painting, sculpture, and literature forming its proudest embellishments:—while without, the eye ranged with voluptuous freedom over the paradise of the park,—woods, waters, lawns, temples, statues, obelisks, and points of perspective so cunningly contrived, as to startle the beholder with unexpected delight; nature and art having changed characters; and each, in masquerade of the other, playing at hide and seek amidst the self-involving labyrinths of landscape gardening."

One cause of Cowper's great popularity appears in the irresistible claim he possesses to the appellation of "the Poet of Nature;" which Johnson gave, not without justice, to the bard of Avon. To employ the language of Beattie: "Monstrous sights please but for a moment, if they please at all, for they derive their charm merely from the beholder's amazement. I have read, indeed, of a man of rank in Sicily, who chose to adorn his villa with pictures and statues of the most unnatural deformity; but it is a singular instance, and one would not be much more surprised to hear of a man living without food, or growing fat upon poison. To say of any thing that it is 'contrary to nature,' denotes censure and disgust on the part of the speaker; as the epithet 'natural' intimates an agreeable quality, and seems, for the most part, to imply that a thing is as it ought to be—suitable to our own taste, and congenial to our own disposition. . . . . Think how we should relish a painting in which there was no regard to colours, proportions, or any of the physical laws of nature; where the eyes and ears of animals were placed on their shoulders, where the sky was green, and the grass crimson !"

At the remotest distance from conceptions of this order, *he* appears, in whose works we frequently find an echo of the sentiment he has thus expressed :—

> -" Sweet nature's ev'ry sense,
> The air salubrious of her lofty hills,
> The charming fragrance of her dewy vales,
> And music of her woods—no works of man
> May rival these; these all bespeak a power
> Peculiar, and exclusively her own.
> Beneath the open sky she spreads the feast;
> 'Tis free to all—'tis every day renewed :
> Who scorns it, starves deservedly at home."

But if Cowper is entitled to be designated the "Poet of Nature," to him has been justly given the highest of all titles, that of the Poet of Christianity. In this character he has but one rival—the author of the "Paradise Lost." An admirable anonymous critic says, "He rarely equals Milton in sublimity, to which his subjects but seldom led; he excels him in easy expression, delicate pleasantry, and generous satire; and he resembles him in the temperate use of all his transcendent abilities. He never crushes his subject by falling upon it, nor permits his subject to crush him by falling beneath it. Invested with a sovereign command of diction, and enjoying unlimited freedom of thought, he is never prodigal of words, and he never riots amidst the exuberance of his conceptions; his economy displays his wealth, and his moderation is the proof of his power; his richest phrases seem the most obvious expression of his ideas, and his mightiest exertions are made apparently without toil. This is one of the grandest characteristics of Milton. It would be difficult to name a third poet of our country who could claim a similar distinction. Others, like Cowley, overwhelm their theme with their eloquence, or, like Young, sink exhausted beneath it, by aiming at magnificent but unattainable compression; a third class, like Pope, whenever they write well, write their best, and never win but at full speed, and with all their might; while a fourth, like Dryden and Churchill, are confident of their strength, yet so careless of their strokes, that when they conquer it seems a matter of course, and when they fall, a matter of no consequence, for they can rise again as soon as they please. Milton and Cowper alone appear always to walk *within* the limits of their genius, yet up to the height of their great argument. We are not pretending to exalt them above all other British poets; we have only compared them together on one point, wherein they accord with each other, and differ from the rest. But there is one feature of resemblance between them of a nobler kind. These good and faithful servants, who had received ten talents each, neither buried them in the earth, nor expended them for their own glory, nor lavished them in profligacy, but occupied them for their Master's service, and we trust have both entered into His joy. Their unfading labours, (not subject to change, from being formed according to the fashion of this world, but being of equal and eternal interest to man in all ages,) have disproved the idle and impious position which vain philosophy, hating all godliness, has endeavoured to establish,—that religion can neither be adorned by poetry, nor poetry ennobled by religion."

The prose of this period is also of considerable value. Among those to whom literature is greatly indebted appear Wollaston, the author of the valuable volume called "The Religion of Nature Delineated;"—Watts, whose philosophical works are highly estimated;—Hartley, who obtained deserved distinction by his "Observations on Man;"—Reid, who brought the science of mind within the grasp of ordinary powers;—Adam Smith, with whose name will continue to be associated his "Theory of Moral Sentiments," and his "Inquiry into the Wealth of Nations;"—Campbell, who may justly demand for his "Philosophy of Rhetoric" a careful perusal from all who aim at accuracy of thought and expression, and whose exposure of the sophistry of Hume, in reference to miracles, invests him with special honour;—Dugald Stewart, admirable alike for the depth and clearness of his speculations on Mental Philosophy, and for the elegance and force with which they are conveyed;—and Paley, whose chief works are entitled to high praise.

In history great distinction was gained. Hume, though engaged in other works, is better known by his "History of England;" Gibbon, the Tacitus of modern times, chiefly owes his literary celebrity to his "Decline and Fall of the Roman Empire;" and the labours of Robertson, in the same department, are deservedly held in high repute, and cannot be too extensively known. This triumvirate of British historians exemplified in their very dissimilar styles, the triple contrast and harmony of simplicity, elegance, and splendour. Unhappily the two former are tainted with infidelity; this, in their perusal, should be kept fully in view, for here, as in other cases, to be forewarned is to be forearmed.

One of the brightest luminaries that ever appeared in our literary hemisphere was Sir William Jones. In the short space of forty-seven years, he acquired a knowledge of arts, sciences, and languages, which has seldom been equalled, and scarcely, if ever, surpassed. While the mere catalogue of his writings shows the extent and variety of his learning, an examination of them proves its depth and its value. Whatever be the topic, his ideas flow perspicuously and freely; and his style, always polished, rises, when necessary, into animation and force.

The various works of Samuel Johnson secure for him a prominent and distinguished place in our literary history. Unlike those of many writers, they instruct while they amuse; and deeply interesting the mind, exert a genial influence on the heart. Among them, too, appears his Dictionary of the English language, which, he remarks, "while it was employed in the cultivation of every species of literature, was itself neglected; suffered to spread, under the direction of chance, into wild exuberance; resigned to the tyranny of time and fashion; and exposed to the corruption of ignorance, and caprices of innovation."

It is uncertain how long this immense undertaking had been the object of contemplation. When once asked in what way he attained the amazing knowledge of our language, by which he was enabled to realize his design, he answered, that it was not the effect of particular study, but that it had grown up in his mind insensibly. It is stated by Mr. James Dodsley, that several years before, when Johnson was sitting one day in his brother Robert's shop, he heard the latter suggest that such a work would be well received; and that, though Johnson seemed at first to catch at the proposal, he said, after a pause, abruptly and decidedly, "I believe I shall not undertake it." It is well that circumstances subsequently occurred to alter his intention. To this subject, it is obvious from his plan issued in 1747, he had given much thought; and he mentions that many of the writers, whose testimonies were to be produced as authorities, were selected by Pope, which proves that he had been furnished with whatever hints that eminent poet had contributed towards a great literary project, which had been the subject of important consideration at a former period.

He began his task by giving his first care to a diligent perusal of all such English writers as were most correct in their language, and under every sentence which he meant to quote he drew a line, and noted in the margin the first letter of the word under which it was to occur. He then delivered these books to his clerks, who transcribed each sentence on a separate slip of paper, and arranged the same under the head referred to. By these means he collected the several words, and their different significations; and when the whole arrangement was alphabetically formed, he gave the definitions of their meaning, and collected their etymologies from Skinner, Junius, and other writers on the subject.

"I have devoted this book, the labour of years," he says in his preface, "to the honour of my country, that we may no longer yield the palm of philology, without a contest, to the nations of the continent. The chief glory of every people arises from its authors: whether I shall add any thing by my own writings to the reputation of *English* literature must be left to time; but I shall not think my employment useless or ignoble, if, by my assistance, foreign nations and distant ages gain access to the propagators of knowledge, and understand the teachers of truth; if my labours afford light to the repositories of science, and add celebrity to Bacon, to Hooker, to Milton, and to Boyle."

The latter portion of Dr. Johnson's life was, as Mrs. Piozzi observes, nothing but conversation, and that conversation was watched and recorded from night to night and from hour to hour, with zealous attention and unceasing diligence, by one who united the volatile curiosity of a man about town with the drudging patience of a chronicler. "Boswell," says one of his numerous critics, "was the very prince of retail wits and philosophers. Other works furnish us with curious particulars, but minute and disjointed: they want picturesque grouping and dramatic effect. We have the opinions and sayings of eminent men, but they do not grow out of the occasion; we do not know at whose house such a thing happened, nor the effect it had on those who were present. We have good things served up in sandwiches, but we do not sit down, as in Boswell, to 'an ordinary of fine discourse.'

"The 'Life of Johnson' is one of the best books in the world. It is assuredly a great, a very great work. Homer is not more decidedly the first of heroic poets,—Shakspeare is not more decidedly the first of dramatists,—Demosthenes is not more decidedly the first of orators, than Boswell is the first of biographers. He has distanced all his competitors so decidedly, that it is not worth while to place them: Eclipse is first, and the rest nowhere. We are not sure that there is in the whole history of the human intellect so singular a phenomenon as this book. Many of the greatest men that have ever lived have written biography—Boswell has beaten them all. This book resembles nothing so much as the conversation of the inmates in the Palace of Truth."

Alluding to the distinguished writers of this and former times, it has been well observed:—"These illustrious names in prose are so many pledges, that the language in which they immortalized their thoughts is itself immortalized by being made the vehicle of these, and can never become barbarian like Chaucer's uncouth, rugged, incongruous medley of sounds, which are as remote from the strength, volubility, and precision of those employed by his polished successors, as the imperfect lispings of infancy, before it has learned to pronounce half the alphabet, and imitates the letters which it cannot pronounce with those which it can, are to the clear, and round, and eloquent intonations of youth, when the voice and the ear are perfectly formed and attuned to each other."

Of the capabilities of our language much has been said, with probably the ordinary amount of truth and falsehood; but less of error would have arisen, had it been distinctly perceived that words are greatly dependent for their effect on the ability of him who employs them. What a difference is there between the sounds produced even from the *same* instrument, by an unskilled village musician, and by a master of the art, who makes it "discourse most eloquent music." To know what power the

English language has, we must go to the most distinguished of English authors and orators, remembering that, great as may be their efforts, its resources are still far from being exhausted.

"Let us not hear," says an anonymous critic, "a polished language blamed for the defects of those who know not how to put it forth. It must be wielded by the master before its true force can be known. The Philippics of Demosthenes were pronounced in the mother-tongue of every one of his audience; but who among them could have answered him in a single sentence like his own? who among them could have guessed what Greek could do, though they had spoken it all their lives, till they heard it from his lips? *The secret of using language is to use it from a full mind.*"

It may be safely conceded to common fame and to partial friendship, that Porson was the greatest critic of his own or any other age. "Nothing," it is said, "came amiss to his memory. He would set a child right in his twopenny fable book, repeat the whole of the moral tale of the Dean of Badajoz, a page of Athenæus on cups, or of Eustathius on Homer." The memory of Porson was one of almost, if not altogether unparalleled perfection. It gave him the complete and instant command of all his stores of erudition; he could bring to bear, at once, on any question, every passage from the whole range of Greek literature that could elucidate it; he could approximate, on the instant, the slightest coincidence in thought or expression, and the accuracy was quite as surprising as the extent of his recollection. Many distinguished men were his contemporaries, who engaged in sacred criticism, and left us works worthy of their noble powers.

The romances of the last century went out of fashion with its square-cocked hats, and their offspring appear in novels. The change was at least inviting; and it must be admitted, attraction was increased by works of ten volumes being reduced to two. Now, instead of imaginary heroes and extravagant passions, an effort was made to depict domestic life, and to touch the feelings by pictures of real nature. To this change Scarron seems to allude sarcastically when he says, that he gave up a new comic history because he had heard that his hero had just been hanged at Mans.

It was long before the idea occurred of comprehending and discussing the whole circle of knowledge in such a work as has now, for some time, borne the name of an Encyclopædia. The most noted and valuable of the early encyclopædias was that of Alstedius, which appeared in two large folio volumes. It consists of thirty-five books, of which four explain the nature and requisites of the various studies which form the subjects of the rest. Then follow others on Philology, Speculative and Practical Philosophy, Theology, Jurisprudence, Medicine, the Mechanical Arts, History, Chronology, and Miscellaneous Subjects. Nearly a century elapsed from the publication of this work by Alstedius, before any considerable attempt was made towards an Encyclopædical Dictionary.

The first work of the kind, professing to embrace a detailed view of the whole body of the sciences and arts, was that of Dr. Harris, "The Lexicon Technicum." It was published in London in 1710, and is generally considered as the first great advance to the form and objects of the more modern encyclopædias; but though it professed to bear a general character, its explanations were principally confined to the mathematical and physical sciences, as to which it was fully on a level with the knowledge of that age.

The Cyclopædia of Mr. Chambers was given to the world in 1728; and exemplifies the first attempt that had yet been made at once to arrange knowledge by the alphabet, and to exhibit a view of its relations and dependencies. With all its defects, (and from these what work is free?) it must be considered as the production of a mind of no ordinary comprehensiveness and vigour, as well as one of the greatest and most useful literary works ever completed by a single hand.

The popularity of this work led at length to a series of Universal Dictionaries modelled on its plan, the earliest of which bore the names of Barrow and Owen; and to its being made the foundation of the Encyclopédie in France, the most extensive and celebrated work of the kind that had yet appeared in the world. A few years after the conclusion of this continental effort, the first edition of the Encyclopædia Britannica was published, and was followed, in the course of years, by others, whose various titles have become familiar.

The individual who first exerted that spirit of inquiry into the literature of the old English writers, by which the works of our great dramatic poet have of late been so signally illustrated, was Mr. William Oldys. In 1737 he published "The British Librarian; exhibiting a compendious Review or Abstract of our most scarce, useful, and valuable Books, in all Sciences, as well in Manuscript as in Print." He also contributed several articles to the General Dictionary, and the Biographia Britannica. It is said he had a number of small parchment bags inscribed with the names of the persons whose lives he intended to write, into which he put every circumstance and anecdote he could collect, and from thence he drew up his history. His bibliographical talents were not eclipsed by those of any contemporary.

A literary work, on a new plan, was first suggested in 1750, and by some attributed to the Dodsleys, but by others to Edmund Burke; it was called the Annual Register, which soon obtained considerable celebrity, and was for some years under the superintendence of that eminent man.

The modern business of reporting for the public prints had already taken its rise. Johnson had even furnished speeches for them which he had not heard, but reasoning as he supposed the eminent individuals would whose names were given, he provided the readers of the journals with some orations of transcendent excellence. When, for instance, a speech of Lord Chatham's was lauded, in his hearing, by some distinguished man, he acknowledged that he had written it; on which his surprised and delighted auditor exclaimed, "Then, Doctor, you have surpassed Cicero himself."

In 1782 Mr. James Perry was chosen by the proprietors of "The Gazetteer" to be the editor of that respectable paper, shares in which were then held by some of the principal booksellers in London. His entrance on this business was signalized by an improvement suggested by himself, which greatly accelerated the diffusion of parliamentary intelligence through the medium of the public press. Until this period, each newspaper had but one reporter in each house of parliament; and the predecessor of Mr. Perry had been in the habit of settling with the public his arrear of debates, by protracting the reports of them for weeks, and even months, after the session had closed; while Mr. Woodfall, in "The Morning Chronicle," found means to keep pace with public business by bringing out a sketch of one night's debates on the evening of the following day. The son of the printer undertook, without any assistance, the arduous task of furnishing these reports. He possessed a most extraordinary memory, as well as amazing powers of literary labour. It is asserted that he has sat through a long debate, not making a single note of the proceedings, and afterwards written a full and faithful account of what had occurred, extending to sixteen columns, without a single interval of rest. Mr. Perry's plan, which consisted in the employment of a company of reporters, each relieving the other in succession, was adopted; and in consequence of this arrangement, "The Gazetteer," published in the morning, contained as full a report as Mr. Woodfall was able to publish in the evening, and sometimes at midnight.

The fine arts now made a remarkable progress. Before the accession of George III. there was no English school, either of painting or sculpture; and the only native artist of celebrity was Hogarth. His pictures are not imitations of still life, or mere transcripts of incidental scenes or customs, but powerful moral satires, exposing vice and folly in their most ludicrous points of view, and with a profound insight into the weak sides of character and manners, in all their tendencies, combinations, and contrasts. "Other pictures," it has been said, "we *see*, Hogarth's we *read*." The zealous patronage of the sovereign now gave a considerable impulse to the arts; but allusion can only be made to a few persons who practised them with success. As a landscape painter, the merits of Wilson are great; his conceptions are generally noble, and his execution vigorous and glowing; the dewy freshness, the natural lustre, and harmonious arrangement of his scenes, have seldom been exceeded. He rose at once from the tame insipidity of common scenery into natural grandeur and magnificence. His whole soul was in his art, and he talked and dreamed landscape.

Opie, too, deserves honourable mention. "He painted what he saw," says West, "in the most masterly manner, and he varied little from it. He saw nature, in one point, more distinctly and forcibly than any painter that ever lived. The truth of colour, as conveyed to the eye through the atmosphere, by which the distance of every object is ascertained, was never better expressed than by him. Other painters frequently make two separate colours of objects in light and in shade,—Opie never. With him no colour, whether white, black, primary, or compound, ever, in any situation, lost its respective hue." To his intellectual vigour we have strong testimony. "Mr. Opie crowds more wisdom," said Horne Tooke, "into a few words than almost any man I ever knew; he speaks, as it were, in axioms; and what he observes is worthy to be remembered."

Morland had a wonderful facility in seizing those propitious coïncidences; those light, ornamental, and minute properties and graces, which contribute such an ample store to the genuine stock of original composition of consummate art. The harmonious combination of his back grounds; his drapery, ever natural and decorous, without confusion or perplexity; his children also, his sheep, his horses, his pigs, and all the appendages of the rural landscape, including every other department of picturesque scenery; are still classed among the finest of modern productions.

Gainsborough was a man of versatile talents, of delicate taste, and of an elegant and feeling mind. The idea of the necessity of improving on nature, and giving what is called a flattering likeness, was universal in this country in his time; and we therefore need not wonder at an artist giving the air of an Adonis to the driver of a hay-cart, or modelling the features of a milk-maid on the principles of the antique. Still some of his pictures are entitled to great praise, as, for instance, that of the Shepherd Boy in a Storm, in which the unconscious simplicity of the boy's expression, looking up with timid wonder and folded hands; the magpie above, evidently engaged in noisy chattering; and the rustling of the coming storm in the branches of the trees, produce their full impression on the mind.

The portraits of Sir Joshua Reynolds are considered his best pictures; of these his portraits of men are the most successful; the next in value are his pictures of children. The words of Burke are a little loftier and warmer than necessary, yet much less could not properly be said: "Sir Joshua Reynolds," he says, "was, on many accounts, one of the most memorable men of his time. He was the first Englishman who added the praise of the elegant arts, to the other glories of his country. In taste, in grace, in facility, in happy invention, and in tho richness and harmony of colouring, he was equal to the greatest masters of the renowned ages. In portrait he went beyond them; for he communicated to that description of the art, in which English artists are most engaged—a variety, a fancy, and a dignity, derived from the higher branches, which even those who professed them in a superior manner did not always preserve when they delineated individual nature. His portraits remind the spectator of the invention and the amenity of landscape. In painting portraits he appeared not to be raised upon that platform, but to descend upon it from a higher sphere."

At this period, 1760, a plan was formed by the artists of the metropolis, to draw the attention of their fellow-citizens to their labours, with a view both to the increase of patronage, and the cultivation of taste. Hitherto works of that kind produced in the country, were seen only by a few; the people in general knew nothing of what was passing in the arts. Private collections were then inaccessible, and there were no public ones; nor any casual display of the productions of genius, except what the ordinary sales by auction occasionally offered.

In consequence of this, it was conceived that a Public Exhibition of the works of the most eminent artists could not fail to make a powerful impression; and, if occasionally repeated, might ultimately produce the most satisfactory results. The scheme was no sooner proposed than adopted; and being carried into immediate execution, the result exceeded the most sanguine expectations of its projectors.

The first, or probationary exhibition, which opened

April 21, 1760, was at a large room in the Strand, belonging to the Society for the Encouragement of Arts, Manufactures, and Commerce, which had then been constituted five or six years. Owing to some inconvenience which arose, a spacious room, which was one near the Spring Garden entrance to the Park, was engaged for the second display. On the full proof of the efficacy of the plan, the artists solicited a Royal Charter of Incorporation; and his Majesty was pleased to accede to their request. This measure, however, which was intended to consolidate the body of artists, was of no avail: on the contrary, it was probably the cause of its dissolution; for in less than four years a separation took place, which led to the establishment of the Royal Academy, and finally to the extinction of the incorporated society.

For many centuries sculpture in this island, as well as elsewhere, had submitted to strange alliances; the charges for carving statues were mixed with tailors' bills and goldsmiths' accounts; and sculptors were numbered with common menials, and paid by the week. Architecture had been long its principal patron, but when a change took place in the style of our public buildings, works of art were required capable of telling their own tale, and worthy of claiming a separate and independent fame. Tyranny long established, however, is not readily overthrown. The architects succeeded in maintaining their authority over the services of foreign sculptors, whom want of subsistence allured to the

British market, and dictated monuments something in the mathematical principles of their profession. The names of Kent, Gibbs, and Chambers, appear on our public monuments as inventors of the designs, while the artists who executed them are mentioned as mere modelling tools or chisels, which moved as they were directed by these architectural lords-paramount. Rysbrach, Scheemacker, and even Roubiliac, were fain to submit to the thraldom. In truth, the architects of those days were mighty men. Not contented with planning the houses in which the nobles lived, they laid out the gardens in which they walked—cooled their summer seats and arbours with artificial cascades—hung gods and seasons upon the ceilings of their galleries—sketched the cradles for their children—dictated the form and flowers of their ladies' dresses—and following them to the family vault, erected a triumphant monument in honour of their virtues. Wilton at last resisted, and claimed the right of inventing his own designs. Unhappily, as a sculptor he has but little merit; his works do not reflect the honour which might be wished to accompany what he gained by this memorable emancipation, but the name of him who secured it ought, in justice, to be blended with the mention of its occurrence.

Wood-engraving, in a very rude form, is of early date. The persons to whom in modern times it is most indebted are two brothers, Thomas and John Bewick, of Newcastle-upon-Tyne, the latter of whom died in early life. The remotest recollection of the former's tenacious and powerful memory was that of lying for hours on his side between dismal strata of coal, near a glimmering and dirty candle, plying the pick with his little hands. Occasionally sent to school, and treated with considerable, though, in his own apprehension, deserved severity, he passed his truant hours of sunshine in loitering along the river banks, watching the sand-martins hovering like butterflies about the precipitous promontories, or the speckled trout sporting among the flies that streaked the dimpling waters beneath; and in these seasons Nature deposited in his fertile mind the seeds which have since so luxuriantly sprung up, and have raised him to a distinguished rank as an illustrator of her works.

His first tendency to drawing was noticed by his chalking the floors and grave-stones with all manner of fantastic figures, and by sketching the outline of any known character of the village, dogs or horses, which were instantly recognised as faithful portraits. The halfpence he obtained were always laid out in chalk or coarse pencils, with which, when taken to the church of Ovingham, he scrawled over the ledges of the bench with ludicrous caricatures of the clergyman, the clerk, and the more prominent of the congregation; and when his chalk was exhausted, he resorted to a pin or nail as a substitute. These boards are now in the possession of the Duke of Northumberland, by whom they were replaced.

In consequence of his propensity to drawing, some liberal people had him bound apprentice to an engraver on copper and brass; and genius as he was, he was employed to cut clock-faces and door-knockers. After his apprenticeship, he worked for a short time in London, but he disliked it exceedingly, and joyously returned to the braes and bonny banks of his much-loved home. He now received his first prize from the Society of Arts for the "Old Hound," in an edition of Gay's Fables. A glance at this cut will show in what a low state wood-engraving was; yet even here are readily visible some lines and touches of the future master of his art. Constantly studying animals, he was led to his History of Quadrupeds, from which he obtained very considerable celebrity. This was increased by his History of British Birds, published some years after. He very seldom engraved from any other copy than nature, having the bird always alive if possible, or other subject before him, and sketching the outline on the block, filling up the foregrounds, landscapes, and light foliage of trees, at once with the tool, without being previously pencilled. All his blocks were cut on box-wood, some across, at right angles with the growth of the tree; and, when finished, were exactly the thickness of the height of the metallic types, with which the blocks were afterwards incorporated in the pressman's form or iron frame. One surface of the block was made extremely smooth, on which was sometimes traced, in black and white lines, the figure or design; the white was then cut out, and the black left. This, it will be observed, is a process directly opposite to that of copper or steel engraving, in which what is necessary for the representation is cut away, and the remaining surface is untouched. His tools, many of his own contrivance and making, were various in sizes and sorts: some broad gouges for wide excavation; some narrow, for fine white lines; and some many-pointed for parallels, which, either straight or wavy, he cut with rapidity, by catching the first tooth of the tool in the last stroke, which guided it equidistant with the former. So great was the facility he acquired,that simply with the graver, and a little, but often no outline, he worked the design on the blank block at once. His horse-traveller in a storm, where he shows black and white rain, is a specimen of the use of *two* blocks. In early life he had cut a vignette for the Newcastle newspaper, and some years since it was calculated that nine hundred thousand impressions had been worked off; yet was the block still in use, and not perceptibly impaired. His edition of Æsop's Fables contains some masterly productions of invention and execution. His figures and animals have their usual life and spirit, and the scenery is as admirable as the actors. Landscapes, trees, buildings, towered cities, still life, interior walls and utensils, streets and houses, with all the intricacy and accuracy of perspective, are profusely and variously depicted in the background of these minute engravings.

The art of printing was greatly advanced by Mr. William Bulmer. During his apprenticeship, he formed a friendship with Thomas Bewick; and at this time invariably took off the first impressions of his blocks, and among them that of the Huntsman and Old Hound, for which he obtained the premium already mentioned. When Mr. Bulmer first came to London, his services were engaged by Mr. John Bell, who was then publishing his Miniature Editions of the Poets. About 1787 an accidental circumstance introduced Mr. Bulmer to the late George Nicol, Esq., bookseller to George III., who was then considering the best method of carrying into effect the projected National Edition of Shakspeare, which he had suggested to Messrs. Boydell, ornamented with designs by the first artists of this country. The result was the establishment of the "Shakspeare Press," under the firm of Messrs. W. Bulmer and Co., and the publication of the work in a manner which threw a new lustre on the threefold arts of painting, engraving, and printing. The elegant and splendid volumes which were afterwards produced, are too numerous for recapitulation.

Jonathan Battishill seems to be the last connecting link between the old and present race of musicians, amongst whom is to be found much ability for choral music, though they did not produce many instrumental compositions of equal talent. This composer and Samuel Webbe may be considered as the founders of glee-writing—a species of composition in which this country has no rivals.

The compositions of Handel were also in another way very effective. From his childhood he discovered such a propensity to music, that his father, intending him for the civil law, forbade his meddling with musical instruments of any kind. His son, however, found means to obtain a little clavicord, on which he amused himself while the family were asleep. At nine years of age he began to compose the Church Service for voices and instruments; and for three successive years he was accustomed to compose a service every week. He arrived in London in 1710, where he was soon introduced at court, and honoured with marks of royal favour. His compositions were various, among which his Oratorio of the Messiah has been the most popular. "Handel," says Dr. Burney, "was superior, in the strength and boldness of his style, the richness of his harmony and complication of parts, to every composer who has been most admired for such excellencies; and while fugue, contrivance, and a full score, were more generally reverenced than at present, he remained wholly unrivalled. All that the greatest and boldest musical inventor can do, is to avail himself of the best effusions, combinations, and effects, of his predecessors; to arrange and apply them in a new manner; and to add, from his own sources, whatever he can draw that is grand, graceful, gay, pathetic, or in any other way, pleasing. This Handel did in a most ample and superior manner, being possessed, in his middle age and full vigour, of every refinement and perfection of his time,—uniting the depth and elaborate contrivance of his own country with Italian elegance and facility, as he seems, while he resided south of the Alps, to have listened attentively to the most exquisite compositions and performances of every kind that were then existing."

The Piano Forte has been called a national instrument, because it is said to have been the invention of the poet, Mason. He had seen the attempts of the Germans to make keyed dulcimers, which were in some degree susceptible of the forte and piano; but as they were all constructed on one principle; required a particular touch of the finger, which it was very difficult to acquire, and which spoiled it for harpsichord practice; as they were also deficient in precision and delicacy; and as the performer was by no means certain of producing the exact strength of sound intended;—Mr. Mason removed these imperfections, by detaching the mallet entirely from the key, and giving them only a momentary connexion,—an improvement which distinguishes the pianoforte from all other instruments. The British instruments are unrivalled as to workmanship, and vast numbers of them have been sent to all parts of the continent.—But this section must now be concluded with a few facts in reference to means of communication.

It was not till the year 1660 that the public took any active part as to the highways; and even then, for a long time, but little was done. On two persons making the journey from Glasgow to London on horseback, in 1739, there was no turnpike road till they came to Grantham, within one hundred and ten miles of London. Up to that point they travelled on a narrow causeway, with an unmade soft road on each side of it. They met, from time to time, strings of pack-horses, from thirty to forty in a gang,—the mode by which goods were then transported from one part of the country to another. The leading horse of the troop carried a bell, to give warning to passengers coming in an opposite direction; and when they met these trains of horses with their packs, they were compelled to make way for them, and pass into the road-side, the causeway not affording room for both. In 1754 improved turnpike roads were made; but the opposition attending their first introduction was renewed, and so difficult was it to reconcile the people to this important change, that a law was passed in the reign of George II. making it *felony* to pull down a toll-bar.

For many years after that time the mails were conveyed either on horseback or in small carts; and instead of being the most expeditious and safe conveyance, the post had at length become one of the slowest and most easily robbed of any in the country. The letter-bags from the Post-office were, previously to 1784, entrusted to boys, who were ill-paid, and frequently of very doubtful characters. They travelled on miserable horses, and were equally unable to defend themselves from the attacks of robbers, or to escape by flight. In fact, the waylaying of these boys for the purpose of robbery, was at that time an affair of constant occurrence, and often not without suspicion of collusion on the part of the carriers.

It occurred, therefore, to Mr. Palmer, Comptroller-general of the Post-office in Bath, that a very great improvement might be made in the conveyance of letters, in regard to economy as well as speed and safety. The principal part of his suggestion was the discontinuance of the horse-post, and the employment of coaches, which, considering their liability to attack from robbers, were each to be provided with *a guard.* It was also proposed that the times of the coaches bearing mails leaving the country towns should be so regulated as to secure, so far as possible, their simultaneous arrival in London at an early hour every morning; and that all of them should leave the metropolis at the same hour in the evening. The first mail-coach on Mr. Palmer's plan left London for Bristol on the 2d of August 1784; the great opposition encountered being surmounted. The consequences proved very beneficial; the use of mail-coaches extended to every part of the empire; and while the letters were conveyed in less than half the time under the old system, the coaches afforded, by their regularity and speed, a most desirable mode of travelling.

The business of the London Post-office arose from very small beginnings; and at first a house of moderate size afforded sufficient accommodation for carrying forward all its details. As these increased, additions were made, until they became insufficient, and the noble edifice lately erected, indispensable.

It is singular that, notwithstanding the obvious advantages of the telegraph, it should not have been applied to services of practical utility prior to 1793. In that memorable year a line of communication was established between Paris and Lisle, a distance of upwards of a hundred miles. Intelligence was thus conveyed with such accuracy and despatch, that the Republican operations were essentially facilitated; and the English became anxious to possess an invention which in reality was their own! The first description of this machine, as constructed by M. Chappe, was carried to Frankfort, where two working models were made, which fell into the possession of the late Duke of York. In consequence of this incident, various experiments were tried, and the importance of the medium was so manifest, that a series of coast stations soon gave intelligence to the Admiralty, with an astonishing degree of activity.

Many ingenious improvements were from time to time brought forward. The following is the method submitted by the original inventor. His plan was to erect three masts, united by a spar across the top, with the upper part of one of the two spaces thus formed occupied by a screen, behind which the store of gigantic characters was to be kept, and one at a time drawn forward into the empty space, as required to be exhibited. The inventor so clearly foresaw the great advantages to be derived therefrom, that he affirms the stations might be thirty or forty miles apart, provided they are judiciously selected, so as to be backed by the sky. He attributes to the then recent invention of telescopes, the idea of thus procuring almost instantaneous communication with distant places. Nor did he overlook the propriety of the meaning of the signals, being known only to persons at the two extremities of the line, requiring those at the intermediate parts merely to repeat. After minutely enumerating the arrangements desirable for his purpose, he concludes with "thinking that all things may be made so convenient, that the same character may be seen at Paris within a minute after it had been exposed in London."

The interior navigation of England is justly regarded as one of the prime sources of her prosperity. It was long since remarked, that, important as were the advantages of foreign commerce, they were not equal to that carried on by the different parts of a great country within itself; and that all the countries, distinguished by wealth and civilisation, had been remarkable for the extent of their means of inland conveyance, either bestowed by nature or formed by art. China, Holland, and Lombardy, have afforded striking instances of canal navigation and its advantages; but in those countries vast flat plains of soft materials, and already traversed by numerous rivers, invited to such operations, which might be easily accomplished. The territory of England, on the contrary, is diversified by many rugged tracts; and its eastern and western rivers, and their tributaries, which it was the main object to unite, were separated by a chain of considerable and somewhat rugged hills. Until the middle of last century, the making of canals did not enter into the English economy.

The first modern canal actually executed in England was not begun till the year 1755. An Act of Parliament was then obtained for rendering navigable the Sankey Brook, which flows into the river Mersey from the neighbourhood of the now flourishing town of St. Helen's, through a district abounding with valuable beds of coal. On surveying the ground, however, with more care, it was considered better to leave the natural course of the stream altogether, and to cut a canal, which was eventually extended to about twelve miles in length, and proved a successful effort to the projectors, as well as a valuable public accommodation.

The Sankey Canal prompted the first efforts of the Duke of Bridgewater. Having property at Worsley, about seven miles from Manchester, very rich in coal-mines, but which had hitherto been unproductive for want of an economical means of transport, he determined to cut a canal, and engaged the services of James Brindley, a man pre-eminently adapted for such an enterprise. Many difficulties were in his way, and among them it was necessary to carry the canal across the river Irwell. Undaunted by them, he proceeded in his work; though when he showed an engineer where he proposed to rear his aqueduct, and endeavoured to explain the mode of his procedure, the man only shook his head, and remarked that "he had often heard of castles in the air, but that he was never shown before where any of them were to be erected." In a few months after the aqueduct was begun the first boat passed over it, the whole structure forming a bridge of above two hundred yards in length, supported on three arches, of which the centre one rose nearly forty feet above the surface of the river; on which might be frequently beheld a vessel passing along, while another, with all its masts and sails standing, was holding its undisturbed way directly under its keel.

An Act of Parliament was afterwards obtained by the Duke, for carrying a branch of his canal to communicate with Liverpool, so as to unite that town with Manchester. This portion is more than twenty-nine miles in length, is carried by an aqueduct over the Mersey, and passes also over several valleys of considerable width and depth. Since that time canal navigation has been widely extended; and it remains for us once more to consider the advancement of our country in various respects.

THE

# AGE OF PROGRESS.

## THE AGE OF PROGRESS.

A.D. 1800—1836.

WHAT a happy contrast do we, as a people, present even to the subjects of the Celestial Empire! Such is their force of ancient usage, and their dread of innovation, that a Chinese never stops to inquire what he ought to do on any pressing emergency; but what Yao and Chun did in a similar case three thousand years ago. In one sense, time may be said to stand still in China; but here advancement has been long apparent, and it is the characteristic feature of the present age.

To take an instance from a remote part, it may be remarked, that only half a century ago Cornwall was in a very different state. The country was traversed by bridle-paths rather than by carriage-roads; carriages were almost unknown, and humbler vehicles were very little used. "I have heard my mother relate," says Dr. Davy, "that when she was a girl there was only one cart in the town of Penzance; and that if a carriage occasionally appeared in the streets, it attracted universal attention." Pack-horses were then in general use for conveying merchandise, and the prevailing manner of travelling was on horseback. At that period the luxuries of furniture and living enjoyed now by people of the middle class, were confined almost entirely to the great and wealthy: in the same town, where the population was about 2000 persons, there was only one carpet, the floors of rooms were sprinkled with sea-sand, and there was not a single silver fork. The only newspaper which then circulated in the west of England was the Sherborne Mercury; and it was carried through the country, not by the post, but by a man on horseback, specially employed in distributing it.

What is the state of Penzance now? It has a population of about 7000 souls; a harbour, successively enlarged till it has become a work of great magnitude, generally crowded with shipping; its streets are handsome, almost entirely of recent erection, and lighted with gas; it has a public library, a geological and agricultural society, a mechanics' institute, and another to diffuse useful knowledge among the people generally; a neighbourhood highly cultivated, abounding in garden-grounds and gentlemen's villas, with excellent roads in all directions, even to the Land's End; and an ample number of carriages, public and private, of various descriptions. Its present improved and flourishing condition is owing to many causes, but chiefly to those which have operated on England generally during the period under consideration, and have effected throughout the country a similar augmentation of wealth, and in many particulars an amelioration of circumstances.

To commence our review with science, it cannot be disputed that the true origin of all that has been done in electro-chemistry was the accidental discovery of Messrs. Nicholson and Carlisle of the decomposition of water, by the pile of Volta, April 30, 1800. These gentlemen immediately added to this capital fact the knowledge of the decomposition of certain metallic solutions, and the circumstance of the separation of alkali on the negative plates of the apparatus. Mr. Cruickshank, in pursuing these experiments, added to them many important new results, such as the decompositions of muriates of magnesia, soda, and ammonia, by the pile; and that alkaline matter always appeared at the negative, and acid at the positive pile; and these effects were followed by those of Mr., afterwards Sir H., Davy. His predilection for chemistry was strong, and he saw at once the celebrity likely to accrue from a successful development of the laws which regulate the chemical phenomena connected with the action of the Voltaic battery. He accordingly devoted himself to the study of these phenomena.

The Royal Institution was founded in the year 1800, after a plan of Count Rumford; with the intent of diffusing a knowledge of science, and of its applications to the common purposes of life, and of exciting a taste for science among the higher ranks. Its commencement was very auspicious, and in its service Mr. Davy was engaged. Some time after, he also, succeeded in demonstrating that the galvanic energy has the property of decomposing compound bodies, according to a determinate law; oxygen and acids attach themselves to the positive pole of the battery, while hydrogen, sulphur, metals, alkalies, and earths, attach themselves to the negative pole. He inferred from this, that oxygen and acids are naturally negative, while hydrogen, sulphur, metals, earths, and alkalies, are naturally positive. This led to the conclusion, that chemical affinity is merely a case of electrical attraction—that bodies combine because they are in opposite electrical states, and that, in order to produce decomposition, we have only to bring them into the same electrical state. This hypothesis, known by the name of the *electrical theory*, was generally adopted by chemists; and it is by means of it that the nature of combination and decomposition is at present attempted to be explained.

Davy drew, as a consequence from his theory, that if the current of electricity can be made sufficiently large, it will decompose all compound bodies whatever. He tried potash and soda, and succeeded in showing that they are compounds of peculiar metals and oxygen. It was immediately inferred that the *earths* also are metallic oxides. This was demonstrated by Davy himself with respect to the alkaline earths; and it has been since shown that all the earths proper are also oxides, though the bases of all of them are not metals.

Davy succeeded also (chiefly in consequence of the important labours of Gay-Lussac and Thenard,) in satisfying chemists that *chlorine* is not a compound, but a simple substance, analogous to oxygen in its nature, and, like it, attracted by the positive pole of the Voltaic battery. The subsequent discovery of *iodine* and *bromine*, substances analogous in their nature, and the probable evidence that the base of *fluoric acid* is a substance of a similar kind, have completely new-modelled the Lavoisierian theory. There are five substances analogous to oxygen, which may be called *supporters* of combustion : they are all capable of uniting with combustible bodies, and the union may be attended with the phenomena of combustion. When they combine with one set of combustible bodies they form *acids;* when with another set, *alkalies* or *bases.* Thus there are at least five different classes of acids, and as many different classes of alkalies. Acids and alkalies of the same class unite together, and form *salts;* but acids and bases of different classes mutually decompose each other, and in general, therefore, cannot unite. Thus there are as many classes of salts as there are of acids and bases. Such is an imperfect sketch of the present chemical theory, which may be fairly considered as originating with Sir H. Davy, though it has been carried a greater length than he anticipated, and many new facts have been discovered, of which he was ignorant.

This eminent man also engaged in zealously applying chemistry to the common arts, particularly to agriculture and tanning; and it appears that he never lost sight of the usefulness of science in relation to our every-day wants. He seems, too, to have been in these cases indifferent to gain, and to have thought his duty was done when he had pointed out the application of a scientific truth or principle to the arts of life ; well aware, to use an expression of Lord Bacon's, that "the applying of knowledge to lucre diverts the advancement of knowledge, as the golden ball thrown before Atalanta, which, while she stoops to take up, the race is hindered."

To the same distinguished individual is owing a discovery, which ranks among the most valuable presents conferred by the hand of science—the miner's safety lamp. It consists of a common oil lamp, the flame of which is everywhere surrounded by wire-gauze: the apertures in it should never exceed one-twentieth of an inch square; the wire of which it is constructed may be from one-fortieth to one-sixtieth of an inch in diameter, and of iron or brass, but the former is preferable. The principle of safety appears in the cooling power of the wire in regard to flame. If a piece of wire-gauze, sufficiently fine, be held horizontally in the centre of an inflamed jet of carburetted hydrogen gas, it will cut off the upper part of the flame, while the lower half continues to burn ; the gas passes through the wire, and the upper half may still be inflamed again in the usual way, after having been so far cooled by the intercepting wire as to be extinguished. So in the wire cage of the lamp, the gas flame continues to burn, but it cannot make its escape through the wire in an inflamed state, so as to cause an explosion of the external atmosphere.

While these circumstances were occurring, the subject of chemical combination drew the attention of Mr. Dalton, one of the most original thinkers of modern times. His mind was attracted by the way in which oxygen unites with simple bodies. With some it combines only in one proportion; with a great many in two; and with several in three, four, or even six proportions. The law on which this proceeds he thus explained:—Every simple substance is composed ultimately of particles incapable of farther division, to which, therefore, he gave the name of *atoms*. It is the atoms alone that enter into chemical combination with each other. One atom of one body may unite with one atom of another, or with two atoms, or with a greater number. The atom of every body has a peculiar weight, discoverable by the proportions in which it enters into combination with other bodies. Thus it is obvious that the weights of the atoms of carbon and oxygen are to each other as the numbers six to eight, or three to four. If the atom of oxygen be eight, that of carbon will be six. From other examples it is seen that if an atom of oxygen weigh eight, that of sulphur will be sixteen, and that of azote fourteen; so that an atom of sulphur is just twice as heavy as an atom of oxygen.

Dalton saw at once the importance of determining the numbers representing the weights of the atoms of bodies. In the first volume of his Chemical Philosophy he gave a catalogue of most of the simple bodies, and of the most remarkable compounds; to each of which he attached the number which he considered as representing its atomic weight, assuming that of hydrogen to be unity. Unfortunately his numbers, even with his last corrections, are very wide of the truth.

About this time, however, Professor Berzelius, of Stockholm, was much struck by the idea which Richter started and prosecuted—that numbers may be affixed to each acid and base, denoting the weights of each which reciprocally saturate each other. The opinion itself appeared likely to be true; but the numbers of Richter were obviously inaccurate. Berzelius undertook, therefore, the arduous task of making a new set of experiments, in order to put the truth or error of Richter's theory beyond doubt. This work was very difficult and laborious; but he at last arrived at numbers exceedingly near the truth. His first published paper contained the determination of the composition of thirty-three compound bodies, settled with a degree of precision which exceeded every thing of the kind hitherto exhibited in chemistry; but this laborious investigation having been given to the world in the Swedish language, remained for a short time unknown to chemists in general.

While engaged in these investigations, he became acquainted with the atomic theory of Dalton. This induced him to extend his researches to simple substances, and their more immediate combinations, as well as to acids and bases. No one who is not conversant with the practical details of chemistry, can have any conception of the immense labour which this undertaking implied. It seems to have occupied Berzelius almost day and night for a period of five or six years; but the importance of the results obtained was a full compensation for the toil incurred. He not only established the opinion of Richter beyond the reach of controversy, but demonstrated also the truth of Dalton's theory; and proved, to the satisfaction of every competent judge, that chemical substances never combine except in definite proportions.

Still in his theory there was much that was complicated and erroneous, and fortunately our chemists have followed a much simpler plan. Dalton laid it down as an axiom that when two bodies unite only in one proportion, we ought to consider the compound as constituted of an atom of each, unless there be some reason for a contrary conclusion; and that, when a salt is *neutral*, or possessed neither of acid nor of alkaline properties, it is a compound of one atom of acid and one atom of base. These axioms have been adopted by the British chemists in all their investigations. Dr. Prout, in a very elaborate and ingenious paper, endeavoured to show that the atoms of all other bodies are multiples of the atomic weight of hydrogen. Hence, if we make the atom of hydrogen unity, that of every other body will be a whole number. Gay-Lussac confirmed the view thus given by Prout. To the law he laid down there is no exception among simple bodies, and those compounds only constitute exceptions, which contain either one atom, or an odd number of atoms, of hydrogen.

Among those who have rendered, of late, important aid to science, our countryman, Wollaston, holds a high place. To a faculty of minute observation, applied by himself so advantageously, the chemical world is indebted for the introduction of more simple modes of experimenting—for the substitution of a few glass tubes and plates of glass for capacious retorts and receivers, and for the art of making grains give the results which previously required pounds. Of his fondness for such means an amusing proof is mentioned. Shortly after he had witnessed Davy's brilliant experiments with the galvanic battery, he met a brother chemist in the street, and taking him aside, pulled a tailor's thimble and a small phial out of his pocket, and poured the contents of the one into the other. The thimble was a small galvanic battery, with which he instantly heated a platinum wire to a white heat.

Wollaston discovered two metals, palladium and rhodium, and a method by which platinum can be made ductile and malleable. He drew it into wire $\frac{1}{5000}$ of an inch in diameter, highly valuable for the construction of telescopes; and even reduced some portions to the inconceivable tenuity of $\frac{1}{30,000}$. One of his peculiarities was a great jealousy of any person entering his laboratory. He once said to a friend, who had penetrated, unbidden, within sight, "Do you see that furnace?" And on a reply in the affirmative being given, he rejoined, "Then make a profound bow to it, for this is the first and will be the last time of your seeing it." The same feeling was discovered, together with his disposition to employ small means, when a foreign philosopher expressed great anxiety to see the same object. His reply promised the desired gratification; but he immediately produced a small tray, containing some glass tubes, a blow-pipe, two or three watch-glasses, a slip of platinum, and a few test bottles.

Wollaston's Camera Lucida is an acquisition of peculiar value to many persons, as it enables those unskilled in drawing to preserve the remembrance of what they see, and gives a fidelity to sketches hardly attainable by other means. The adaptation of measurement by reflection to the purposes of crystallography, by the invention of his goniometer, introduced into that department of science a precision and certainty which the most skilful observers were before unable to attain; and his paper on the distinctions of the carbonates of lime, magnesia, and iron, affords one of the most remarkable instances that can be mentioned of the advantage derivable from the union of crystallography with chemical research.

To Dr. Thomas Young we owe a valuable theory of light—that of interferences; but one which would require too much space to be here particularly explained. It was suggested by a very trifling object—soap-bubbles, so brightly coloured, and so light, that they had scarce escaped from the pipe when they became the sport of the most imperceptible currents of air. His studies on this subject led to the idea of an extremely simple instrument, with which the measurement of the smallest bodies can be easily effected. The eriometer, as it is called, still so little known to observers, has this immense advantage over the microscope, that it gives at once the mean size of millions of particles comprised within the field of vision. It possesses, besides, the singular property of becoming negative when the particles differ too much from each other; or, in other words, when the question of determining their dimensions cannot be answered. He applied this instrument to measure the globules of the blood of different classes of animals, the dust furnished by different species of vegetables, and the fur employed in the manufacture of stuffs; from that of castor, the finest of all, to that of the fleeces of the common flocks of the county of Sussex, which, placed at the extremity of the scale, are composed of filaments four and a half times larger than the hair of the castor.

The great principles of magnetism, first reduced to determinate laws by Mr. Barlow, were placed in the closest connexion by the grand discovery of electro-magnetism by Oersted, in 1819. This was followed up by the researches of many philosophers, pursuing the numerous new analyses which the subject so abundantly offers; and they have thus jointly contributed to form the new science of electro-dynamics.

After Mr. Faraday had proved the identity of the magnetic and electric fluids, by producing the spark, heating metallic wires, and accomplishing chemical decomposition, it was easy to increase these effects by more powerful magnets, and other arrangements. The following apparatus is now in use, which is in effect a battery, where the agent is the magnetic instead of the Voltaic fluid, or, in other words, electricity.

A very powerful horse-shoe magnet, formed of twelve steel plates in close approximation, is placed in a horizontal position: an armature, consisting of a bar of the purest soft iron, has each of its ends bent at right angles, so that the faces of those ends may be brought directly opposite and close to the poles of the magnet when required: two series of copper wires, covered with silk, in order to insulate them, are wound round the bar of soft iron as compound helices; the extremities of these wires having the same direction, are in metallic connexion with a circular disc, which dips into a cup of mercury, while the ends of the wires in the opposite direction are soldered to a projecting screw-piece, which carries a slip of copper with two opposite points. The steel magnet is stationary; but when the armature, together with its appendages, is made to rotate horizontally, the edge of the disc always remains immersed in the mercury, while the points of the copper slip alternately dip in it and rise above it. By the ordinary laws of induction, the armature becomes a temporary magnet while its bent ends are opposite the poles of the steel magnet; and ceases to be magnetic when they are at right angles to them. It imparts its temporary magnetism to the helices which concentrate it; and while one set conveys a current to the disc, the other set conducts the opposite current to the copper slip. But as the edge of the revolving disc is always immersed in the mercury, one set of wires is constantly maintained in contact with it, and the circuit is only completed when a point of the copper slip dips in the mercury also; but the circuit is broken the moment that point rises above it. Thus, by the rotation of the armature the circuit is alternately broken and renewed; and as it is only at these moments that electric action is manifested, a brilliant spark takes place every time the copper point leaves the surface of the mercury. Platina wire is ignited, shocks smart enough to be disagreeable are given, and water is decomposed with astonishing rapidity by the same means, which proves beyond a doubt the identity of the magnetic and electric agencies, and places Mr. Faraday, whose experiments established the principle, in the first rank of experimental philosophers.

In connexion with this fact, it may be stated that Sir Edward Parry, in his voyage to discover the north-west passage round America, sailed near the magnetic pole; and in 1824, Captain Lyon, on an expedition for the same purpose, found that the magnetic pole was then situated in 63° 26′ 51″ north latitude, and 80° 51′ 25″ west longitude. It appears, from later researches, that the law of terrestrial magnetism is of considerable complexity, and the existence of more than one magnetic pole in either hemisphere has been rendered highly probable: that there is one in Siberia seems to be decided by the recent observations of M. Hanstein; it is in longitude 102° east of Greenwich, and a little to the north of the sixtieth degree of latitude; so that by these data, the two magnetic poles in the northern hemisphere are about 180° distant from each other. But Captain Ross, who some time since returned from a voyage in the Polar Seas, has ascertained that the American magnetic pole is in 70° 14′ north latitude, and 96° 40′ west longitude. The magnetic equator does not exactly coincide with the terrestrial equator; it appears to be an irregular curve, inclined to the earth's equator, at an angle of about 12°, and crossing it in at least three points in longitude 113° 14′ west, and 66° 46′ east, of the meridian of Greenwich, and again somewhere between 150° 30′ of west longitude, and 116° east.

Since the commencement of the present century various other branches of scientific knowledge have been successfully cultivated. Among them may be mentioned the polarization of light, and the radiation of heat, so much elucidated by the sagacity of Professor Leslie; the nature of vapour, the laws of evaporation, and the elasticity of fluids, investigated by Dalton and Gay-Lussac; the laws of cooling, determined by Coulomb and Petit; the specific heat of gases and vapours; the conducting of heat through solids and fluids; and the theory of dew.

Astronomy, meanwhile, has not been neglected; and one of the most interesting consequences of attention now given to the heavens, has been the discovery of two revolving comets of short periods. Ever since Halley's famous prediction of the return of the comet of 1684, these bodies have been diligently searched after, in the hope that some of them would be recognised as former visiters of our system; but till the year 1819 no other comet was discovered which was known with certainty to have been observed in a previous revolution. In that year, Professor Encke, of Gotha, noticed that the elements of a comet, then visible, were those of one which had appeared in 1805, and which, according to the computations, must have completed four revolutions in the interval between 1805 and 1819. This discovery was confirmed by the return of the comet to its perihelion in 1822, when it was seen at Paramatta, exactly in the situation indicated by the computations of Encke. It has also been observed in its two subsequent revolutions, so that no doubt can now remain of its being one of the permanent bodies of the solar system. Another periodic comet was recognised in 1825.

Encke's comet will still be an object of diligent observation. "Of all the wonders that astronomy has disclosed to us," observes Sir W. Herschel, "there is none more astonishing than to see this dim, misty, all-but-incorporeal thing, whose parts can have no more cohesion than the floating particles of the lightest fog, borne along by its inertia, and commanded by its gravity, like the denser planets, with which it must henceforth be associated. We look to this comet as the revealer of many secrets—such as whether there exist a ponderable, or at least material, ether in the planetary spaces, or any vestige of unabsorbed nebulous matter in our system, susceptible of being caught up by it, and thus diminishing its speed and retarding its progress."

A passage in the history of optical instruments yet remains of peculiar interest. An English achromatic telescope found its way to the village of Brenetz, in the Canton of Neufchatel. A defect of sight had compelled M. Guinand, a maker of watch-cases, to construct his own spectacles. From this he was led to grind the lenses of small refracting telescopes, which he mounted in tubes of paste-board. To such a mind, the sight of the achromatic telescope, which belonged to his master, must have been an object of high interest. He was allowed to separate the lenses, and study its properties; and such was his zeal to imitate this optical wonder, that he obtained some flint glass from England, and actually constructed with it several achromatic telescopes. The badness of the glass, however, and the impossibility of procuring it of the size he required, inspired him with the ambitious resolution of making good flint glass for himself! No chemist in England or France would have ventured on such a task with any hopes of success; but ignorance was in this case power, and glass fortunately was not an exciseable commodity in the village of Brenetz. He studied the chemistry of fusion: between 1784 and 1790 he made daily experiments in his blast furnace with meltings of three or four pounds each; he noted down the circumstances and the results of each experiment. Partial success invigorated his efforts, and the news of learned academies having offered prizes for the object at which he strained, animated him with fresh and glowing excitements.

Having abandoned his profession for the more lucrative one of making bells for repeaters, his means became more ample, and his leisure hours more numerous. He purchased a piece of ground on the banks of the Doubre, where he constructed a furnace capable of fusing *two hundred weight* of glass. The failure of his crucibles, the bursting of his furnace, and a thousand untoward accidents, that would have disconcerted any other mind, served only to invigorate his. The disappointments of one day were the pedestal on which the resolutions of the succeeding one reached a higher level; and in the renewed energy of his spirit, and the increasing brightness of his hopes, the unlettered peasant seems to have felt that he should ultimately triumph. The threads, and specks, and globules which destroyed the homogeneity of his glass, were the subjects of his constant study; and he at last succeeded in obtaining considerable pieces of uniform transparency and refractive power, amounting sometimes to twelve, and in one case to eighteen inches in diameter. He at last acquired the art of soldering together two or more pieces of good glass, and though the line of junction was often marked with globules of air, or particles of sand, yet by grinding out these imperfections by means of a wheel, and by replacing the mass in a furnace, so that the vitreous matter might expand, and fill up the hollows thus made, he succeeded in effacing every trace of junction, and was consequently able to produce with certainty the finest discs of glass.

Rumours of Guinand's success had now begun to spread throughout Europe, and the first philosopher who availed himself of the intelligence was M. Fraunhofer, of Munich, who had the charge of the optical part of the establishment of Benedictbaiern. He was so pleased with the specimens which were sent to him, that he repaired, in 1804, to Brenetz, and persuaded M. Guinand to go to Bavaria, where he settled in 1805, and continued for nine years, engaged in the manfacture of flint glass.

In 1820, long after his return to Switzerland, the celebrated French artist, M. Lerebours, visited him, and not only obtained all the glass which M. Guinand then had, but commissioned a fresh supply. M. Cauchoix, another excellent Parisian artist, procured other pieces, and splendid achromatic telescopes have thus been manufactured in the French capital. Though possessing the deepest interest, England seemed the least alive to these great discoveries. She sent no delegate to Brenetz, she made no offer for the secret; but in 1822 a piece of Guinand's glass was obtained by the Astronomical

Society of London, and formed into a telescope by our excellent artist, Mr. Tulley. Its homogeneity and purity, nay, its absolute perfection, has established the value and the efficacy of Guinand's process.

The visit of Guinand to Munich, in 1805, led to a new era in the history of the achromatic telescope. Commencing with all the knowledge of the Swiss artist, Fraunhofer devoted his mind to the perfection and simplification of his methods. Striæ, and imperfections of a minute kind, which the practised eye of an optician could alone detect, still required to be eradicated; and even the crown glass, which had hitherto been supposed an object of easy attainment, required the labour of a whole year to bring it to perfection. In order to gain these ends, Fraunhofer reconstructed the furnaces at Benedictbaiern, procured all the instruments which were necessary for his purpose, and took upon himself the charge of all the meltings. Four quintals of glass was the average quantity with which he wrought, and he at last succeeded in determining the causes of his failure, and in obtaining distinct processes, by which he could manufacture discs of flint glass eighteen inches in diameter. In these laborious and perplexing experiments, Fraunhofer injured his health, and quickened the progress of that insidious disease which carried him off so prematurely from the sciences.

But while Fraunhofer had thus supplied himself with the finest materials for his art, he had prepared his mind, by the study of optics, both in its mathematical and practical branches, for carrying into effect his great views for the improvement of the telescope. His discovery of fixed lines in the spectrum enabled him to determine, with minute accuracy, the absolute, as well as the relative, refractive and dispersive powers of his glass; and his skill in practical mechanics conducted him to the construction of a machine for giving the last polish to his lenses, an operation in which the errors of the previous process of grinding were corrected, in place of being exaggerated, and in which the result was made perfectly independent of the skill of the workman.

With such means and accomplishments, Fraunhofer began the most difficult task to which human genius was ever applied. The resources of his powerful mind never, for a moment, failed him; and though the malady which beset his delicate frame often broke the continuity of his labours, and disappointment often threw its shadows across his path, yet, sustained by the ardour of his genius, and by the liberal patronage of his sovereign, he triumphed over every obstacle. The great achromatic telescope of Dorpat, with which Professor Struve has made such important observations, will remain an imperishable monument of his genius, even if it has not been exceeded by his later and larger instrument. Had he been spared a few years, he would have astonished Europe with an achromatic object-glass *eighteen inches* in diameter:

but the honour of executing such a work has been left for another age, and probably for another country than Bavaria.

While, too, the eyes of astronomers have been attentively fixed on the heavens, others have increased our acquaintance with the globe appointed as our habitation. To this the engagements of trade and commerce have greatly contributed; nor have any called forth a more daring and adventurous spirit than those connected with dealing in fur. The French, soon after their establishment in Canada, were the first who brought this commerce into repute, by extending their traffic in skins to the remotest settlements of the Indian tribes in North America. When they had carried on this trade for nearly half a century it was thought to be so advantageous, that it furnished the most powerful motive for incorporating the English Hudson's Bay Company. The vast countries which surround this opening abounded with animals whose furs and skins were far superior in quality to those found in less northerly regions, and therefore of great value; and a charter was accordingly granted by Charles II. to the Governor and Company of Adventurers of England engaged in that trade. They were to have the sole commerce of and to all the seas, bays, straits, creeks, lakes, rivers, and sounds, in whatever latitude, which lie within the entrance of the straits, commonly called Hudson's Straits; together with all the lands, countries, and territories, on the coasts of such bays, seas, and straits, which were then possessed by any English subject, or the subjects of any christian state.

By means of this trade we have become pretty accurately acquainted with nearly three-fourths of the immense continent of North America, extending from the Gulf of Mexico, on both sides of the country, to the Frozen Ocean, on the north. The indefatigable exertions of the fur merchant, stimulated by the prospect of attaining great profits from his hazardous undertakings, have given a partial acquaintance with the arts and refinements of civilized life to savage men, who would have otherwise remained for many ages immersed in heathen darkness and barbarity. Thus a more accurate geographical knowledge of a vast range of country has been accompanied by the extension of the arts of social comfort and peace. How strange, too, is the revolution which the fur trade has experienced! The north of Asia formerly supplied us with every valuable kind, obtained at a great expense from the Italian states, the traffic of which was, at one time, boundless, and the use of which led to an enactment, in the reign of Edward III., that all persons who could not spend a hundred pounds a year should be absolutely prohibited the use of fur. At present we send, by means of the possessions of Hudson's Bay, furs to an immense amount even to Turkey and China.

The uncertainty and confusion that prevailed in the geography of the interior of Africa induced a few learned and scientific individuals to form themselves into an association for promoting discoveries in the interior of Africa; under whose patronage those important additions made by Horneman, Mungo Park, Burkhardt, and others, were effected. The expeditions of Denham and Clapperton have since cleared away all those conjectural speculations of the courses of rivers, ranges of mountains, and positions of lakes and cities, many of which are now ascertained to have no existence, while others that do exist are found to be placed on the maps several hundred miles out of their true situations, to the utter confusion of topographical consistency. In short, our maps of this great continent were very little better than those of the sixteenth century, wherein, as Swift facetiously says,—

> "Geographers, in Afric's maps,
> With savage pictures fill their gaps;
> And o'er uninhabitable downs
> Place elephants for want of towns."

It had long been known, too, that a number of broad estuaries opened into the bight or bay of Biafra—a tract of country on the coast of Western Africa; but, owing to a strange want of enterprise, or some other cause, European vessels trading on this coast have not hitherto ascended any of these beyond fifty or sixty miles from its embouchure. Recently, however, Lander, the traveller, in descending the Niger, arrived by one of these channels in the bight of Biafra; thus solving the great problem of African geography, and leaving no doubt that the system of river-channels, extending from Benin to Biafra, constitutes the delta of the Niger, through which, by a number of outlets, it discharges itself into the sea.

Our improvements in geography are, indeed, of very recent date; and it was fortunate that Major Rennell was induced to relinquish his original profession, and to devote the whole energy of his mind to literary pursuits. Germany could boast of Cluverius and Cellarius, and France of her D'Anville, but no eminent geographer had before adorned this country. Rennell amply redeemed us from this great reproach. To the industry of the former, and to the acuteness of the latter, he added a sagacity which reconciled discordant passages of history; a perseverance which ransacked every source of information; and a professional tact, which, in analysing the military movements of the ancients, not only facilitated his researches, but stamped his decisions with a general conviction of their accuracy. But there was still another quality which marked his writings—the ingenuous candour with which he states the difficulties he could not vanquish, or acknowledges the happy conjecture of others.

Not contented with passing over the surface, increased attention has been given to the successive changes that have taken place in the organic and inorganic kingdoms of nature, and inquiry made into the causes of these changes, and the influence they have exerted in modifying the surface and external structure of our planet. These investigations have not been confined to our own land, but have been shared with ourselves, during the last half century, by the Germans and the French. The systematic study of what may be called mineralogical geology had, as we have seen, its origin and chief point of activity in Germany, where Werner first described with precision the mineral characters of rocks. The principle that every distinct geological deposit has its appropriate suite of fossils, was first promulgated by Mr. W. Smith, who may be justly styled the Father of Modern Geology; and who, aided by others, classified the secondary formations. The establishment of the Geological Society, in 1807, the object of which is rather to collect and publish facts than to propound or support theories, has greatly contributed to diffuse an interest in this study through the most intelligent classes of the community; while the foundation of the third branch of the science, that relating to the tertiary formations, was laid, in France, by the splendid work of Cuvier and Brongmait, published in 1808. Comparing the result of observations in the last thirty years with those of the three preceding centuries, sanguine expectations may be entertained of the degree of excellence to which geology may be carried, even in the present generation. The practical advantages it has already yielded have not been inconsiderable; but our generalizations are yet imperfect. "Meanwhile, the claim of first discovery," says Lyell, "is our own; and as we explore this magnificent field of inquiry, the sentiment of Niebuhr may be continually present to our minds,—that he who calls what has vanished back again into being, enjoys a bliss like that of creating."

Allusion has already been made to the rise of Comparative Anatomy, in connexion with which the name of Cuvier stands pre-eminent. It was he who found that all animals were not referrible to man. Many presented characters, even distinct organs, with which man was not supplied. It was therefore necessary to assume other types of form to supply the deficiency; and Cuvier, in his great work, called "The Animal Kingdom," arranges all animals under four grand divisions: the animals in each division having a structure different from those in the other divisions, or rather being formed on a different plan. These divisions he called—*Vertebrated*, containing Man, Quadrupeds, Birds, Fishes, and Reptiles; *Annulata*, containing Crabs, Lobsters, Spiders, Insects, and Worms; *Mollusca*, containing Snails, and Shell-fish; and *Radiata*, containing Star-fish, Polypi, &c. Mac Leay has increased the number to five, by separating the Polypi from the *Radiata*, under the name *Acrita;* and Newman has increased the number to seven, by separating the headless Shell-fish from the *Mollusca*, under the name *Acephala*, and the Worms from the *Annulata*, under the name *Annelida*. The great divisions of animals now stand thus:—1. Vertebrated Animals; 2. Insects; 3. Worms; 4. Shell-fish with heads; 5. Headless Shell-fish; 6. Star-fish; 7. Polypi.

In all of these divisions, or, more properly, provinces of animals, the more solid or bony parts are those which naturalists chiefly examine in ascertaining or describing them. In the vertebrated animals the bones are entirely internal, and, being firmly united together, form a framework, to which the muscles and softer parts are attached. In other animals, as crabs, lobsters, insects, &c., the skin itself is hardened and bony, and there is nothing internally which exactly corresponds with the bones of animals; this hardened skin is therefore resorted to for characters, and its variation of form is accurately described.

The circulation of blood in animals was discovered by Harvey; but so lately as the close of the last century it was supposed to be peculiar to the vertebrated animals, and Linnæus even asserts as a distinguishing character, that these alone possess blood. Of late years the microscope has shown that the circulation of blood is peculiar to no province of animals,—it is found to exist in the most minute insects, and even in some of the half-vegetable polypi. A most extraordinary discovery has also lately been made, by means of the microscope, as regards torpid animals; it has been found that they have a circulation of blood as perfect, though somewhat less rapid, than when in their full vigour and activity. The observations have been made on the membraneous wing of a torpid bat—an object which exhibits excellently the mode in which the blood of animals pervades and traverses the whole frame. The webbed foot of a frog also exhibits the circulation of blood in a clear and beautiful manner. The student, in examining these objects, must always bear in mind, that, in proportion as the microscope increases the surface over which the blood flows, so does it increase the rapidity of the circulation, and therefore the excessive rapidity with which the blood appears to travel is not real. Carus, Bowerbank, and Lister, have been the principal labourers in this branch of zoology.

Various groupes of animals have become the subjects of separate sciences; thus the natural history of birds is called Ornithology; that of fishes, Ichthyology; that of worms, Helminthology; and that of insects, Entomology. The mind of Cuvier, comprehensive though it was, could not compass the task of framing a separate anatomical nomenclature for each province of animals: no human powers could achieve such a task. The anatomical nomenclature in entomology he scarcely ventured on, leaving that interesting portion of his great work to his friend and coadjutor, Latreille. This author, though possessing a most intimate knowledge of entomology, made no progress in this branch of the science, although another French naturalist, Savigny, had, in 1816, clearly demonstrated that uniformity of structure existed as certainly in insects as in vertebrated animals; yet Latreille declined availing himself of the discovery. It was left to our countryman, Newman, to elaborate and establish a uniform anatomical nomenclature for insects; and this task he has accomplished without inventing a single new name, or causing the slightest confusion or obscurity in the conflicting nomenclature of others who have preceded him. His observations are published in "The Grammar of Entomology," and "The Entomological Magazine;" and by the assistance of these an insect may now be described with the same precision as a vertebrate animal.

Zoology has for many years received that attention on the continent of Europe which the more intelligent inhabitants of this country are now beginning to bestow on it. In this country, however, much has already been done; and Bingley's "History of British Quadrupeds," Bewick's "British Birds," Yarrel's "British Fishes," and "Stephens's Illustrations of British Entomology," all of them published by our countrymen, and all of them reflecting great credit on the land in which we live, are entitled to strong recommendation. With works which teach the elements of the science, we are not at present well provided. The "Grammar of Entomology" has been already mentioned, and the publication of similar Grammars of Ornithology, Ichthyology, &c. may be anticipated, but, unhappily, such works do not at present exist.

Much has been said and written in reference to phrenology, which bears only a recent date. Dr. Gall, its inventor, was a native of Wirtemberg. "In the ninth year of my age," he says, "my parents sent me to one of my uncles, who was a clergyman in the Black Forest; and who, in order to inspire me with emulation, gave me a companion in my studies. I was, however, frequently reproached for not learning my lesson as well as he did, particularly as more was expected from me than from him. From my uncle, we were both put to school at Radstadt; and there, whenever our task was to learn by heart, I was always surpassed by boys who, in their other exercises, were much my inferiors. As every one of those, who were remarkable for this talent, had large and prominent eyes, we gave them the nick-name of *ox-eyed.* Three years after this we went to school at Bruchsal, and there again the ox-eyed scholars mortified me as before. Two years later I went to Strasburgh, and still found that, however moderate their abilities in other respects, the pupils with prominent eyes all learned by heart with great ease.

" Although I was utterly destitute of previous physiognomical knowledge, I could not help concluding that prominent eyes were the mark of a good memory, and the connexion of this external sign and the mental faculty occurred to me. It was not, however, till some time afterwards, that, led on from observation to observation, and from reflection to reflection, I began to conceive that, since memory has its external sign, the other faculties may very well have theirs. From that moment every person remarkable for any talent, or for any quality, became the subject of attention, and all my thoughts were directed to a minute study of the form of their heads. Little by little, I ventured to flatter myself that I could perceive one constant shape in the head of every great painter, of every great musician, of every great mechanic, severally denoting a decided predisposition in the individual to one or other of these arts. In the meantime I had begun the study of medicine, in which I heard much of the functions of the muscles, the viscera, &c., but not a word about the functions of the brain. My former observations then recurred to me, and led me to suspect, what I afterwards proved, that the form of the skull is entirely due to the form of the viscus which is contained in it. From that instant I conceived the hope of one day being able to determine the moral and intellectual faculties of man, by means of his cerebral organization, and of establishing a physiology of the brain."

Of the efforts he afterwards made, together with those of his friend and pupil, Spurzheim, much has been said in dispraise. On one point, however, philosophers are generally agreed—that the brain is the instrument of the mind. Certain it is, too, that man has all the powers of which phrenology takes cognizance; and, therefore, the matter of doubt is, whether the brain has a corresponding division, each portion having the peculiar province assigned to it by this science. On this subject it becomes no one to decide without conclusive evidence; and whatever be the ultimate opinion of the value of phrenology, it must be admitted, that it has furnished an aggregate of important facts in reference to the brain, which, but for this, had remained unknown.

But this is not the only part of the human system to which attention has recently been given. Among the more special improvements which have been effected within the last forty years, is the elucidation of those fundamental questions in physiology which bear most directly on pathology; namely, those which illustrate the causes of sudden or violent death. The next important addition to the science of medicine has been furnished by the labours of those physiologists, who have recently done so much to determine the different purposes which are served by the different parts of the nervous system. The chemical analysis of the blood has also been carried to a high point of perfection; and important information has been obtained in regard to the functions of nutrition, secretion, excretion, and absorption.

The additions made to our knowledge of the nature and proper treatment of diseases may be chiefly traced to the extent and minuteness with which the study of morbid anatomy has latterly been cultivated. The example of Baillie in London—the lectures of the late Dr. Gregory in Edinburgh—the laborious researches of Abercrombie, and others—have had much influence in extending this study among British practitioners; but it is to the zeal of the profession in France, and to the opportunities afforded by the French hospitals, that we are chiefly indebted for the increased extent and precision of our knowledge of the changes of structure effected in the human body by disease.

To mention one modern improvement of great importance: Laennec, a native of France, early devoted himself to medicine. Under the guidance of his master, Corvisart, he became a zealous and successful investigator of chest-diseases, by means of percussion; and while he proved its full value, he soon became sensible of its imperfections, more especially in diseases of the heart. In cases of this kind, young Laennec, and several of his fellow-pupils, were accustomed, in imitation of Hippocrates, to apply the ear to the chest; but from these trials he derived little practical benefit. Still from them he was led to a discovery of the very greatest importance—that of mediate auscultation; of which he has given the following account:—

"In the year 1816 I was consulted by a young woman affected with the general symptoms of a diseased heart, and in whose case percussion, and the application of the hand, were of little avail, owing to her being extremely lusty. The immediate application of the ear being inadmissible, I happened to recollect a simple and well-known fact in acoustics, and fancied it might be turned to some use on the present occasion. The fact I allude to is the great distinctness with which we hear the scratch of a pin at one end of a piece of wood, on applying our ear to the other. Immediately on this suggestion, I rolled a quire of paper into a kind of cylinder, and applied one end of it to my patient's chest, and the other to my ear, and was not a little surprised and pleased to find that I could thereby perceive the action of the heart in a manner much more clear and distinct than I had ever been able to do by the immediate application of the ear. From this moment I imagined that means might be found to ascertain the character, not merely of the action of the heart, but of every species of sound produced by the motion of all the organs within the chest." The first object of Laennec, after his discovery, was to improve and perfect the rude instrument he had used in his primary explorations; and after many trials, he finally invented and adopted the instrument called the stethescope, of which intelligent medical practitioners are glad to make use.

At the close of the last century an association was formed, whose main design was to preserve the distinction between the apothecary and the druggist, which had so long prevailed, and which, without some special efforts, was in danger of being merged and lost. Not only in the metropolis, but in almost every town in Great Britain, men, utterly ignorant of the science of medicine, of the formulæ of prescription, of the theory and practice of chemistry, and not unfrequently ignorant even of the English language, obtained extensive business as druggists, and often connected with it the operations of bleeding, tooth-drawing, and bone-setting. In various instances country grocers had practised actively in these *kindred* departments, and, as may be easily conjectured, the mischief was immense.

In the village of Beckenham, near London, a man practised surgery and pharmacy, whose whole education consisted in having been *stable-boy* for two years to a surgeon in that neighbourhood. At Uckfield there were *three* "grocer-druggists" who prescribed; applying in difficult cases to their London drug-merchant for assistance. Others of the same order, at Marlow, substituted, for want of better knowledge, arsenic for cream of tartar, tinctures of opium and jalap for those of senna and rhubarb, and nitre for glauber's salts; thus ruining instead of restoring the healths of those who, unhappily, consulted them. A druggist at Croydon, after labouring hard to discover the meaning of the Latin words for *bleeding by the cupping instrument*, found at length, by the kind aid of an equally learned disciple of Esculapius, that they denoted *an electric shock.* A medical gentleman at Worcester prescribed for a patient—"Decoct. Cascarillæ ℥vij., Tinct. ejusdem ℥j." that is, a tincture of *the same*—a tincture of *cascarilla;* but the shopman of the druggist having sought in vain for a phial labelled Tinct. *ejusdem* sent to the shops of other druggists to procure it; and failing in this, the prescription was actually returned to the physician, with an earnest request that he would substitute some other ingredient for this scarce tincture—one not to be found in the city of Worcester. In the same city, another blunder was of serious consequence. Among the ingredients of a prescription for a boy of ten years old, was included a portion expressed as Tinct. Opii *Camp.;* but the shopman not knowing the new name for Paregoric Elixir, made it up with the quantity mentioned of Tinct. Opii, the Tincture of *Opium:* he advised the mother to give the child only *half* of the draught, but that was fatal.

One fact will place beyond all doubt the value of modern improvements in medicine. Sir William Petty (who died about 150 years since) states, that the proportion of deaths to cures in St. Bartholomew's and St. Thomas's Hospitals was, in his time, one to *seven;* while we know, by subsequent documents, that in St. Thomas's Hospital, during 1741, the mortality had diminished to one in *ten;* during 1780, to one in *fourteen;* during 1813, to one in *sixteen;* and that, during 1827, out of 12,494 patients treated, 259 only were buried, or one in *forty-eight.* "Such, indeed," says the Duke of Sussex, "is the advantage which has been already derived from the improvement of medical science in this line of study, that comparing the value of life as it is now calculated to what it was a hundred years ago, it has absolutely doubled. The most fatally malignant diseases have become comparatively mild in the hands of modern physicians. The entire half of the population were, at one time, destroyed by one disease alone, small-pox; the mortality of which, at the present time, is but fractional. Typhus fever was once accustomed to visit this country in annual epidemics, and to slay one out of every three whom it attacked; whereas, in the present day it is seldom seen as an epidemic, and its average mortality does not amount to one in sixteen. Measles, scarlet fever, hooping-cough, and consumption, are no longer regarded with the extreme terror in which they were once viewed. "From 1799 to 1808 the mortality of consumption amounted to about twenty-seven per cent.; of those who became ill from 1808 to 1813, it diminished to twenty-three; and from 1813 to 1822, it still further decreased to twenty-two per cent."

The extreme clumsiness and cruelty with which surgical operations were once performed could scarcely be credited, were there not extant some descriptions of them by those who operated. Thus Fabricius, the preceptor of the immortal Harvey, describes what he considered an improved and easy operation in the following terms:—"If it be a movable tumour, I cut it away with a red-hot knife that sears as it cuts; and if it be adherent to the chest, I cut it without bleeding or pain, with a wooden or horn knife soaked in aquafortis, with which, having cut the skin, I dig out the rest with my fingers." It is little more than fifty years since Mr. Sharpe, one of the most eminent surgeons of London at that time, denied the possibility of the thigh-bone being dislocated at the hip-joint,—an accident which occurs daily, and which the merest bone-setter in the kingdom can now detect. But it were a task equally difficult and unnecessary to enumerate one-tenth of the achievements of modern surgery ;—all of which should awaken our gratitude.

The most remarkable improvement in surgery of a recent date, is that of the Baron Heurteloup, in cases of calculus. Before this was made, the extraction of stone from the bladder involved a severe and perilous operation; a calculus may now be completely pulverized, and removed in a few minutes, with but little suffering, and no danger.

Some important institutions have lately arisen; among them are the British Association for the Advancement of Science, those for the promotion of Horticulture and of Zoology, and another, with which is connected a valuable improvement. Interesting as the solar microscope has long proved, the opportunities for employing it are limited, from the frequent absence of the bright rays of heaven. Messrs. Cooper and Cary have therefore supplied the deficiency by employing the beautiful and intense light obtained by the action of a stream of oxygen and hydrogen gases in a state of combustion, on a ball of lime; and they have so adjusted the instrument that it may be used at all seasons. The one .hibiting in the Gallery of Practical Science, has .iree sets of glasses: those of the first power magnifying 16,000 times; those of the second, 800,000 times; those of the third power, more than 3,000,000 times. As the objects thus presented are often changed, a frequent visit to the Gallery will yield an ample reward in the contemplation of nature, to say nothing of the numerous works of art, which, in their various departments, are both gratifying and instructive.

The British Museum has been of late greatly enriched by the acquisition of the matchless collection of Lord Elgin, by the addition of the Phygalian frieze, — a well-preserved series of very spirited high-reliefs, of the pure age of Grecian sculpture, and by purchases and gifts in other departments. The value of the library has been also much enhanced by the same means. These, together with the right of obtaining copies of all British publications entered at Stationers' Hall, and especially the Library formed by George III., lately presented to the nation by George IV., have rendered this part of the Museum a vast and noble depositary of every species of literature.

Cowper may be legitimately styled the father of the triumvirate—Southey, Wordsworth, and Coleridge, the eminent and adventurous revivers of English poetry, about thirty years ago; and with the names of Byron, Scott, Montgomery, Campbell, Rogers, and Crabbe, and those of the better sex, Mrs. Joanna Baillie, Mrs. Hemans, Miss Mitford, and Miss Landon, the reading portion of society are all familiar.

The prose works that have appeared since the commencement of the present century, amount to an incalculable number. Original treatises, which show the industry, talents, and acquirements of authors, are many, while compilations of probably every possible kind are also abundant. Works of history, voyages and travels, law, physic, and divinity, appear worthy of the age; and there are others which, so far as the credit of their authors and the advantage of the public are concerned, had better have been unpublished—and unwritten.

The commencement of the "Edinburgh Review" was the discovery of a new world in criticism; the "Quarterly Review," on the same scale, was started a few years after; and the rise and progress of such publications in the form in which they now appear could not have existed but in the most polished ages of literature: for without a constant supply of authors, and a refined spirit of criticism, they could not excite a perpetual interest among the lovers of literature. But, to quote Montgomery once more—"It is in the issues from the periodical press that the chief influence of literature, in the present day, consists. Newspapers alone, if no other evidence were to be adduced, would prove incontrovertibly the immense and hitherto unappreciated superiority, in point of mental culture, of the existing generation over all their forefathers, since Britain was invaded by Julius Cæsar."

The publication of the debates in parliament involves an extraordinary combination of talent and effort. For a large journal, at least twelve reporters are constantly attending the Houses of Commons and Lords; each in his turn retiring, after about an hour's work, to translate into ordinary writing the portion of the discussion he has just taken in short-hand. In the mean time, perhaps, fifty compositors are at work, some of whom have already set up the beginning, while others are committing to type the yet undried manuscript of the continuation of a speech, whose middle portion is on its way in the pocket of another reporter, and whose peroration has yet to be pronounced. Next morning, all that has been said, given with surprising accuracy, may be read at the breakfast table.

The idea of a machine for making paper originated in France; and between thirty and forty years ago, M. Leger Didot brought hither a rude and imperfect model, which at length became at once beautiful and efficacious. Mr. Dickenson has effected great improvements; one machine he has constructed converts a stream of pulp into a web of dry paper, completely finished and ready for the press, within a distance of about twenty-seven feet, and in about three minutes' time. The machinery by which this extraordinary result is effected is so ingeniously contrived and admirably adjusted, that the continuous sheet of paper, which in its first stage appears like a wet cobweb, hardly capable of cohesion, is drawn forward over various rollers, from one stage of the process to another, at the rate of thirty feet per minute.

So long since as the year 1725 William Ged, an inhabitant of Edinburgh, discovered the principle of casting metal plates, and carried it so far into practical operation as to be engaged by the University of Cambridge, to print Bibles and Prayer-

Books. The compositors, thinking this would injure their trade, united with the pressmen secretly to make so many errors, that the University relinquished this method. Fifty years afterwards, the art was revived by Mr. Tilloch, was subsequently practised by Didot of Paris, and was ultimately brought to nearly its present state by Earl Stanhope. So far has the process of stereotyping been carried, that the whole page, including not only the letters, but the wood-cuts, is now moulded, and appears in one plate.

Until a very recent period the printing presses commonly used in this country differed but little in their form and materials from those known in Europe soon after the invention of printing. The earliest signal improvement made in them was that of the nobleman just mentioned. The mode in which the ink was applied to the type continued unchanged for three centuries and a half. Twenty years ago two circular cushions, called balls, were employed for this purpose, and an enormous quantity of ink was in consequence wasted. The principle of inking the types by means of a roller, and that of taking impressions from them by a cylinder, had been discovered in this country so early as the year 1790: but the first maker of a printing machine was Mr. König, a native of Saxony; and the first sheet of paper printed by cylinders and by steam was the "Times" newspaper of the 28th of November, 1814, under the direction of that individual. Great improvements have since been made by Applegath and Cowper.

The art of engraving on iron or steel, for purposes of ornament, and even for printing in certain cases, is by no means a discovery of modern times; but the substitution of the latter material for copper, which has invited the superiority of the British burin to achievements hitherto unattempted by our artists, is entirely a modern practice. It originated with Mr. Jacob Perkins, an ingenious artist of New England; and though it was supposed it would prove injurious, it has increased tenfold the business of the engravers, and fiftyfold that of the copper-plate printers.

Lithographic printing, invented by Senefelder, in 1809, is another mode of producing copies in almost unlimited number. The original which supplies the copies is a drawing made on a stone of a slightly porous nature; the ink employed for tracing it is made of such greasy materials that when water is poured over the stone it shall not wet the lines of the drawing. When a roller covered with printing ink, which is of an oily nature, is passed over the stone previously wetted, the water prevents this ink from adhering to the uncovered portions; whilst the ink used in the drawing is of such a nature that the printing-ink adheres to it. In this state, if a sheet of paper be placed upon the stone, and then passed under a press, the printing-ink will be transferred to the paper, leaving the ink used in the drawing still adhering to the stone. But little progress was made in this country in the art till Mr. Hullmandel commenced his establishment, which formed a new era in lithography, and in many cases English printing is now equal, if not superior to that of the continent. In consequence of the latest improvements in this art, a completeness of effect can be given not heretofore attainable; each impression having the appearance of a drawing on tinted paper touched with white, the white lights being printed with the tints.

A singular instance of the advantage of rivalship and of free intercourse between different countries, appears in connexion with the silk manufacture. An obscure straw-hat manufacturer, who had never been engaged in automatic mechanics, saw, during the peace of Amiens, the offer of a reward by the Society of Arts in this country, to any one who should weave a net by machinery. Aroused by this he accomplished the object; but receiving no public encouragement from the state of his country, he threw it aside, and afterwards gave it to a friend as a matter of no consequence. The net, however, came to the hands of the public authorities; it was sent to Paris, and after a considerable time the prefect of the department sent for Jacquard, and mentioned the attention he had given to this manufacture. He did not immediately recollect it, but on seeing the net, every thing occurred to his mind. He was then desired by the prefect to make a machine which would produce such a result; and having done so in the course of three weeks, he requested the prefect to strike with his foot on a part of the machine, whereby a mesh was added to the net. On its being sent to Paris, he was ordered to be arrested by Napoleon, was afterwards placed in the Conservatoire des Arts, and required to make a machine in the presence of the inspectors.

When presented to Bonaparte, he was addressed in coarse and incredulous language; he then produced the machine, and showed its mode of operation. He was afterwards called to examine a loom on which from 20,000 to 30,000 francs had been expended, for making fabrics for Bonaparte's use. He undertook to do what was required by simple means, and produced the famous Jacquard-loom. He returned to his native town with a pension of 1000 crowns, but experienced the utmost difficulty in introducing his machine among the silk weavers, and was three times in great danger of assassination. The official conservators of the trade of Lyons broke up his loom in the public place, sold the iron and wood for old materials, and denounced him as an object of universal ignominy and hatred. When, however, the French people began to feel the force of foreign competition, they had recourse to this admirable invention, since which time they have found it to be the only real protection and prop of their trade. Here, too, its introduction has been attended by important results.

Improvements in the cotton manufacture are very numerous. To give merely one instance: from two to five cylinders may now be used at the same time in one press, each one having engraved on it a *different* portion of the pattern, and being supplied with a *different* colour. The piece passes over them successively, and receives almost at the same moment the entire pattern. The saving of labour is therefore immense. One of the cylinder printing machines, attended by a man and a boy, is capable of producing as much work as could be turned out, some years ago, by a hundred *block* printers and as many boys. Three-fourths of all the prints executed in this country are the work of the cylinder machine.

The advantages of this admirable invention have been still further increased. Instead of the pattern on the copper cylinder being executed by the graver, it is now transferred to it by means of pressure from a very small steel cylinder, which gives the pattern desired. Thus the most delicate designs, which would employ an engraver *many months* to produce, can be completed in a *few days*, and at a much less price. Another plan is also likely to prove of great benefit. The polished cylinder having been heated, is covered with a thin coat of varnish, and the pattern is then traced with a diamond-pointed instrument, by means of most ingenious and complicated machinery : the varnish being then removed from the figure, the cylinder is immersed in aquafortis, and the parts exposed become corroded or engraved. The tracing machinery, though not dependent on mere accident, is capable, like the kaleidescope, of producing an endless variety of patterns. So far, indeed, has it been perfected, that it will follow many designs by persons altogether unacquainted with its construction, and patterns may be produced by it which cannot be copied, or in many cases even imitated by other means.

In the production of cast-iron from the blast-furnace, a wonderful improvement has been effected by the introduction of heated instead of cold air. The temperature of heated air first applied in this manner was 300 degrees, and this has been raised to 600, which is sufficient to melt lead: this new process saves the necessity of converting coal into coke before being thrown into the furnaces, so that the iron-works are no longer enveloped in dense clouds of smoke. The coals are thrown into the furnace just as they come from the mine, and are converted into coke by the time they reach the blast; a great saving of coals is also effected. Eight tons of coals were formerly used in producing one ton of cast-iron; but by the new process only three are required for the same quantity.

Glass may now be brought into almost any form. Processions may sometimes be seen in which a number of artisans employed in glass houses appear, each one bearing in his hand a specimen of his art, remarkable either for its curious construction, or for its beauty and elegance. The hat of almost every one of them is decorated with a glass feather, while a glass star sparkles on his breast, and a chain or collar of variegated glass is suspended from the neck. Each one carries a staff, with a cross piece on the top, displaying one or more curious or beautiful specimens of this manufacture. These elevations afford a sight of a great variety of vessels—decanters, glasses, goblets, jugs, bowls, and dishes, with other staple articles of the trade, in an endless variety of shape and decoration. Sometimes there are elegant bird-cages, containing their little songsters; even a salute has been fired from a fort mounted with glass cannon, while a glass bugle has sounded the halts, and played several marches with much sweetness and correctness of time.

But a large volume might be occupied with a description of the various means employed in the different arts, and with their results; it must therefore suffice to observe, that even articles of little or no value are now turned to some account. The worn-out tin ware of our kitchens furnishes strips, to be punched with small holes, and covered with a coarse varnish, for the trunk-maker, that he may protect the edges and angles of his boxes; while the remainder, united with pyroligneous acid, becomes a black dye, which is used in calico printing. The hoofs of horses and cattle are used to make a beautiful yellow crystallized salt—the prussiate of potash; the skins employed in the beating of gold are produced from the offals of animals; and the pieces of broken bone, picked up from the streets by some ill-clad creature, produce, at the manufactory to which they are to be conveyed, lamp-black, Glauber's salts, and sal ammoniac.

Other instances are still more remarkable. Dry bones can even be a magazine of nutriment, capable of preservation for years, and ready to yield up their sustenance in the form best adapted to the support of life, on the application of that powerful instrument steam, which enters so largely into all our processes; or of an acid at once cheap and durable. Linen rags are capable of producing more than their own weight of sugar, by the simple agency of one of the cheapest and most abundant of acids—the sulphuric. Even saw-dust itself is susceptible of conversion into a substance bearing no remote analogy to bread; and though certainly less palateable than that of flour, yet in no way disagreeable, and still more, wholesome, digestible, and highly nutritive.

The honour of giving a new direction to taste, and of establishing the art of sculpture on true principles, is certainly due to Canova and Flaxman. The present is the sixty-eighth Exhibition of the Royal Academy, and it is generally considered of far higher merit than any for the last ten years. All the popular living artists are present in their works, and the result of their labours is truly gratifying. The Exhibition of the Society of Painters in Water Colours is no less creditable to its own branch of art, which is of recent date; while the pictures marked as sold give proof that faithful and exquisite delineations of natural objects readily find purchasers, while others of a different character are not so fortunate.

The offer of premiums for the best designs for the new Houses of Parliament, has presented a considerable portion of the architectural ability and taste of the country to view, in a very favourable and even imposing aspect. Mr. Barry, who in this case bears away the palm, is generally admitted to do so most worthily. He had already been successful in his Schools at Birmingham, which are ranked with the most classic adaptations of the pointed style in modern times; while his Traveller's Club House, in Pall Mall, is considered to be the best specimen of Italian palatial architecture in London. His plans for the Senate House will greatly increase his fame. The edifice he purposes to rear admirably combines with it the adjacent buildings, and that without apparent effort; provides, internally, what is required, and meets the eye of the spectator in its impressive unity and grandeur. It is massive without being heavy, and elegant in its own simplicity. Its ornaments are ample but not redundant, and it is, at the same time, sufficiently varied to escape every charge of monotony. It is truly worthy of England in the nineteenth century; and its architect, to whom so much praise has been awarded, need entertain no apprehensions of the censure of posterity.

Many proofs might be mentioned of regard to public convenience. The extraction of tar from pit-coal has already been mentioned,—a process which was carried on, with a commercial object, in the neighbourhood of Newcastle, by a Baron Van Hacke, who died in 1780. In the following year a patent was granted to the Earl of Dundonald for the same purpose. In these instances we have distillations of coal, made on a large scale, for almost every purpose, except the production of gas for illumination ; but in 1798 Mr. Murdoch constructed an apparatus at the Soho Foundry, which was applied during many nights to the lighting of the building; and in 1802, an illumination of the manufactory, in honour of the Peace, afforded an opportunity of making a public display of the result. The spectacle presented was as beautiful as new, and the numerous population of Birmingham came out to gaze with delight at such an extraordinary display of taste and brilliancy.

About two years after, the general nature of gas-light illumination was exhibited by a German, named Winsor, at the Lyceum Theatre in London; but the apparatus by means of which he obtained the coal-gas, and the mode of purification which he adopted, were kept secret. In 1807, Pall Mall was thus lighted, and it continued for some years to be the only street in London so illuminated. After this a Company was formed, and in the course of three or four years they began to realize the profitable effects of their exertions; the utility of gas was becoming daily more obvious, and the current of public opinion was turning rapidly in its favour. Applications were now made for private lights from various parts of the metropolis, and in many streets the oil-lamps were quite discarded. Its subsequent success is familiar to all.

Vast improvements, too, have taken place in travelling. In 1742, the Oxford stage-coach left London at seven o'clock in the morning, and reached

Uxbridge at mid-day: it arrived at High Wycombe at five in the evening, where it rested for the night, and proceeded at the same rate for the seat of learning on the morrow. Here then were ten hours consumed each day in travelling twenty-seven miles; and nearly two days in performing what is now done with the greatest ease under six hours. As to fast work: the Edinburgh mail runs the distance, 400 miles, in forty hours; and watches might be set by it at any point of the journey. Stoppages included, this approaches eleven miles in the hour; and much the greater part of it is done by lamp-light. The Exeter day-coach, the Herald, runs over her ground, 173 miles, in twenty-hours—an admirable performance, considering the natural unevenness of the country through which she has to pass. The horses kept for such work are very numerous; for example, from London to Shrewsbury is 158 miles, and the number kept for the Wonder coach is 150.

In one case a gentleman writes,—"I was out hunting last season on a *Monday*, near Brighton, and dined with my father in Merrion-square, Dublin, at six o'clock on the following *Wednesday*—distance four hundred miles!" It was done thus: he went from Brighton in an afternoon coach, that set him down in London in time for the Holyhead mail; and this mail, with the help of the steamer to cross the Channel, delivered him in Dublin at the time mentioned.

Conveyance by the means last mentioned belongs exclusively to the present century. The first attempt on record to apply steam to navigation was made by Jonathan Hulls, who obtained a patent for what may properly be called a steam-boat for towing vessels. The honour of other successful efforts towards steam navigation has had different claimants; but, in Britain, such vessels were first brought into use on the Clyde, in 1812. When launched, they were towed, at a very trifling expense, up the Clyde, to Glasgow, situated in the midst of inexhaustible mines of coal and iron; and where the number of practical engineers and artificers rendered the construction of the appropriate machinery easy, and the prices moderate. Since then, the number of persons who have found them a pleasant conveyance to various parts of the continent as well as of Britain is indeed immense. It was recently stated to a Committee of the House of Commons by Captain Rogers, that the vessel he commanded was capable of performing what no sailing vessel could do; and the extent to which steam navigation may yet be carried it is impossible to calculate.

Other means of transport have also been devised. Who, a few years since, could have credited the possibility of a ponderous engine of iron, loaded with several hundred passengers, in a train of carriages of corresponding magnitude, and with a large quantity of water and coal, taking flight from Manchester, and arriving at Liverpool, a distance of thirty miles, in little more than one hour? And yet this is a matter of daily, almost hourly occurrence. Neither is the road on which this wondrous performance is effected the most favourable which could be constructed for such machines; it is subject to undulations and acclivities, which reduce the rate of speed much more than similar inequalities affect the velocity on common roads. The rapidity of transport thus attained is not less wonderful than the weights transported. Its capabilities in this respect far transcend the exigencies even of the two greatest commercial marts in Great Britain. Loads, varying from 50 to 150 tons, are transmitted at the average rate of 15 miles an hour; but the engines in this case are loaded below their power; and, in one instance, a cargo of waggons, conveying merchandize to the amount of 230 tons gross, was transported from Liverpool to Manchester at the average rate of 12 miles an hour.

Here, then, our review of arts, literature, and science in England, must be brought to a close. Elevated, indeed, is the rank of our country. "Her career of glory, too," as Douglas remarks, "is already as long, and her measure of blessings as full, as hath ever been vouchsafed to any nation. She has enjoyed and abused greater mercies than were given to Israel of old. Her freedom has been as ample, and more lasting, than that of the ancient republics; and her commerce has taken a far wider range than that of the once-favoured cities of Tyre and Carthage, each, like her, for a season, the mistress of the sea. If her days, even now, were closed, she would excel all those ancient states, not only in her prosperity, but in her progeny. She would leave an empire of freemen behind, strong in all the fervour of youth, and ready to renovate those vast designs which Britain was unable to accomplish. The thoughts of moral supremacy and domination will not perish while the English language survives. The dreams of glory which were cherished for their country's line and language by the great minds of England, during its brightest periods of intellect, will at length become realities; and a new Rome will be re-edified in the West, whose mild and beneficent supremacy all nations will be happy to acknowledge."

# NOTES.

## Note A.—Page 7.

The practice of the mechanical arts was well understood by the ancients long before the theory and general laws of that department of physical science were discovered. Necessity, the mother of invention, prompted the Greeks at an early period of their history, as it had previously stimulated the Assyrians, Egyptians, and other oriental nations, to raise and transport large masses of matter by means not unlike those still in use. The true theory of mechanical philosophy dates no higher than the era of Archimedes, while the practice of it was very extensively adopted.

## Note B.—Page 19.

Abacus is the name of an ancient instrument for facilitating operations in arithmetic. The exhibition of numbers by counters seems happily fitted for unfolding the principles of calculation. Accordingly, in ancient Greece, the boys acquired the elements of knowledge by working on a smooth board with a narrow rim, and forming progressive rows of counters, which, stimulated by the wealth or fancy of the individual, consisted of small pebbles, of round bits of bone or ivory, or even of silver coins. Frequent allusions are made to this calculating board. The Romans borrowed their abacus from the Greeks, and by their means the instrument was diffused.

### Note C.—Page 48.

Anselm, a name familiar to every reader of English history, ranks high among those who received their education at Bec, under Lanfranc; and, like his preceptor, was remarkable for the application of dialectic rules to the most profound subjects of metaphysical research, and the minutest distinctions of polemic theology. A considerable change was effected by the public lectures and writings of Anselm, which has been thus characterised by an intelligent modern historian:—"Logic, which, agreeably to its primitive acceptation, denoted the art of just and solid reasoning, had degenerated into verbal controversies, the terms of which were unintelligible even to those who employed them. But Lanfranc and Anselm, by the greater purity of their style, and perspicuity of their reasonings, introduced an important change into the philosophy of their age, especially in the departments of logic and metaphysics." This celebrated ecclesiastic contributed more by his metaphysical abstractions towards the establishment of the scholastic philosophy than any of his contemporaries.

### Note D.—Page 57.

This contrivance is the method of *decimal notation*, or that by which each figure in the decimal scale is made to change its signification and power, as its position is changed, being increased in value tenfold for every place that it advances towards the left hand.

### Note E.—Page 59.

They reduced the resolution both of plain and spherical triangles to a small number of simple propositions; and by introducing the practice of measuring them by *sines*, instead of *double arcs*, rendered calculations, in themselves extremely complicated and difficult, perfectly simple and easy.

### Note F.—Page 67.

The Teutones were an ancient people of Germany, inhabiting chiefly the coast of the German Ocean. From them the name Teutonic is derived, as descriptive of themselves, or of something belonging to them.

## Note G.—Page 68.

Troubadours, a name given to the ancient poets of Provence, who wrote, set, and sang their own verses. Their poetry consisted in sonnets, pastorals, songs, syrientes, or satires, which were much to their taste; and in tensons, which were love disportes.

## Note H.—Page 162.

The *Portuguese;* long skilful in the art of confectionery.

## Note I.—Page 208.

A district in Yorkshire, of which Sheffield is a part.

## Note K.—Page 214.

How easily infatuated the subjects of Elizabeth were, and how prone to pry into futurity, through the medium of omens, auguries, and prognostications, may be learnt from the following passage in Scot:—"Amongst us there be manie women and effeminat men (manie papists alwaies, as by their superstition may appeare), that make great divinations upon the shedding of salt, wine, &c. and for the observation of daies and houres, use as great witchcraft as in anie thing. For if one chance to take a fall from a horse, either in a slipperie or stumbling waie, he will note the date and houre, and count that time unlucky for a journie. Otherwise he that receiveth a mischance, will consider whether he met not a cat, or a hare, when he went first out of his doores in the morning; or stumbled not at the threshold at his going out; or put not on his shirt the wrong side outwards; or his left shoo on his right foote." In the almanacs of Elizabeth's and James's reign, it was customary not only to mark the days supposed to have an influence over the weather, but to distinguish, likewise, those considered as lucky or unlucky for making bargains, or transacting business on; and, accordingly, Webster represents a character declaring—

> "By the almanack, I think
> To choose some days, and shun the critical."

### Note L.—Page 242.

The French algebraist, Vieta, was an illustrious man, and an excellent mathematician, remarkable both for industry and invention. To him is attributed the very important application of letters, in algebraic formula, to *known* as well as to *unknown* quantities. Among other benefits he conferred, is that of applying algebraic anlaysis to the solution of geometrical problems; thus showing more clearly the connexion between the two kindred sciences. In consequence of the improvements he suggested, the language of algebra acquired a regularity it had never before possessed, and became capable of expressing general truths: thus extended, it has become one of the most efficient instruments of investigation.

Girard, a Flemish mathematician, availing himself of these recent discoveries, brought them to bear successfully on other parts of algebraic science, and proved their extensive and almost universal application. Playfair concludes the account of his successful labours with the panegyric—"This is the greatest list of discoveries which the history of any algebraist could yet furnish."

### Note M.—Page 243.

To Harriott is attributed that important improvement in algebra which consists in transposing the terms, and changing the signs of equations, so as to arrange them on one side; and also the discovery of a method of ascertaining the nature of equations in general by successive multiplications of those of the first order.

### Note N.—Page 256.

Of the various methods of computing heights from barometrical measurements, that of Mr. Ivory has the advantage of combining accuracy with the greatest simplicity.

### Note O.—Page 283.

When the moon, or any planet, is at its nearest distance from the earth, it is said to be in *perigee*, and when at its furthest distance, in *apogee*. The nodes are the two opposite points where the orbit of a planet seems to intersect the ecliptic.

### Note P.—Page 296.

The word micrometer, derived from two Greek words, for *small* and *measure*, is the name of an instrument for measuring small angular distances in the heavens, or small rectilineal spaces of any kind.

### Note Q.—Page 297.

Geodesy is that part of geometry which contains the doctrine of measuring surfaces, and finding the contents of all plain figures.

### Note R.—Page 416.

The reference here is to the History of the Cotton Manufacture, by E. Baines, jun. Esq. a work containing a large mass of valuable information, and executed with great ability. To this the author is greatly indebted.

### Note S.—Page 448.

When this process was first introduced, the only practice was to put the pig metal into the puddling furnace, and there make it into malleable iron; but the experience of ten years showed that a previous operation was essential to perfecting the conversion. This is now termed preparing the metal, and is conducted as follows:—The fireplace is similar to a finery in dimensions and shape, and coke is used as the fuel; half a ton or more of metal pigs are broken up, and laid on the fire, and covered with coke; here the whole is melted down, and suffered to remain in the furnace about half an hour after fusion has taken place. It is then suffered to run out at a hole two inches square into a metal trough, by which it is formed into a plate half a yard square, and two inches thick. This, when cooled, is broken with a sledge hammer into pieces of about one hundred pounds' weight each, and thus they become ready for the puddling furnace.

The principal chemical change which the metal undergoes during this preparatory process, consists in its being deprived of its carbon; and the advantage gained over the puddling of pig is, in its having attained a greater degree of heat at the commencement of the conversion. The appearance of the metal is very materially changed; in the state of pig it is soft, open-grained, and of a dark grey; but in plate it is as hard as steel, close-grained, and nearly as white as silver: it is as much more difficult to melt than pig metal, and is not in the least malleable at any heat.

NOTE T.—Page 475.

Phlogiston was formerly used by chemists to express a principle which was supposed to enter into the composition of various bodies. Those which were thought to contain it in the largest quantity were the inflammable substances; and the property which they possess, of being susceptible of inflammation, was thought to depend on this principle: hence it was sometimes called the principle of *inflammability*. According to this doctrine, inflammation was the separation of this principle, or phlogiston, from the other matter which composed the combustible body; but its existence, as a chemical principle in the composition of bodies, is now fully proved to be false.

# INDEX.

FINIS.

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