strength, and held out successfully against sieges—in 1428 by the Hussites, in 1467 by King George of Bohemia, in 1645 by the Swedish general Torstenson, and in 1742 by the Prussians. In 1805 it was the headquarters of Napoleon before the battle of Austerlitz. Its population in 1869 was 73,771.

BRUNO, St, the founder of the Carthusian order of monks, was born at Cologne about the year 1030. He was educated at Cologne, and afterwards at Rheims, where he was appointed to superintend the studies in all the chief schools of the diocese. Many of his pupils afterwards became distinguished, and in the number was Pope Urban II. In 1084, after some disputes with Manasses, the archbishop of Rheims, he retired with six companions into the desert of Chartreuse, where he built an oratory, with cells at a little distance from each other. Six years afterwards he went to Rome, where Urban II. pressed him to accept the archbishopric of Reggio. He declined the honour, and withdrew into the solitudes of Calabra, where he died October 6, 1101. He wrote treatises on the Psalms and on some of the Epistles, but none of his works are extant. His canonization took place in 1514. (See Mrs Jameson's *Legends of the Monastic Orders*, 124–134; Butler's *Lives of the Saints*, vol. ii. 592.) This saint is not to be confounded with others of the same name,—the bishop and apostle of the Prussians (970–1008), and the great archbishop of Cologne (925–968).

BRUNO, Giordano, the most genial and interesting of the Italian philosophers of the Renaissance, was born at Nola about the year 1548. Little is known of the life of this knight-errant of philosophy; the very date of his birth rests in obscurity. What we do know is attractive enough to render it matter of regret that the materials should be so scanty. In his fifteenth year he entered the order of the Dominicans at Naples, and is said to have composed a treatise on the ark of Noah. Why he should have submitted to the bonds of a discipline palpably unsuited to his fiery and vehement spirit, we cannot tell. He soon found the restraints intolerable, and became an outcast from his church and a wanderer on the face of the earth. His opinions with regard to some of the Romish mysteries seem to have been too liberal to find toleration with so strict an order as that of St Dominic. He was accused of impiety, and after enduring persecution for some years, he fled from Rome about 1576, and wandered through various cities, reaching Geneva in 1577. The home of Calvinism was no resting-place for him, and he travelled on through Lyons, Toulouse, and Montpellier, arriving at Paris in 1579. Everywhere he bent his irrepressible energies to the exposition of the new thoughts which were beginning to effect a revolution in the thinking world. He had drunk deeply of the very spirit of the Renaissance, the determination to open his eyes and see for himself this noble universe, unclouded by the mists of authoritative philosophy and church tradition. The discoveries of Copernicus, which were unhinging men's minds and teaching them to look upon their little world in a new light, were eagerly accepted by him, and he used them as the lever by which to push aside the antiquated system that had come down from Aristotle, and which was loaded with the weight of that great thinker's name. For Aristotle, indeed, he had a perfect hatred. Like Bacon and Telesius he infinitely preferred the older Greek philosophers, who had looked at nature for themselves, and whose speculations had more of reality in them. He had read widely and deeply, and in his own writings we come across many expressions familiar to us in earlier systems. Yet his philosophy is no eclecticism. He owed something to Lucretius, something to the Stoic nature-pantheism, something to Anaxagoras, to Heraclitus, to the Pythagoreans, and to the Neoplatonists, who were partially known to him; above all, he had studied deeply and profoundly the great German thinker Nicolas of Cusa, who was indeed a speculative Copernicus. But his own system has a distinct unity and originality; it breathes throughout the fiery spirit of Bruno himself.

Bruno had been well received at Toulouse, where he had lectured on astronomy; even better fortune awaited him at Paris. He was offered a chair of philosophy, provided he would receive the Mass. He at once refused, but was permitted to deliver lectures. These seem to have been altogether devoted to expositions of a certain logical system which Bruno had taken up with great eagerness, the *Ars Magna* of Raymond Lully. With the exception of a comedy, *Il Candelajo*, all the works of this period are devoted to this logic. The most important of them is the treatise *De Umbris Idearum*. It has seemed to many a curious freak of Bruno's that he should have so eagerly adopted a view of thought like that of Lully, but in reality it is in strict accordance with the principles of his philosophy. Like the Arabian logicians, and some of the scholastics, who held that ideas existed in a threefold form,—*ante res*, *in rebus*, and *post res*,—he laid down the principle that the archetypal ideas existed metaphysically in the ultimate unity or intelligence, physically in the world of things, and logically in signs, symbols, or notions. These notions were the shadows of the ideas, and the *Ars Magna* furnished him with a general scheme, according to which their relations and correspondences should be exhibited. It supplied not only a *memoria technica*, but an *organon*, or method by which the genesis of all ideas from unity might be represented intelligibly and easily. It provided also a substitute for either the Aristotelian or the Ramist logic, which was an additional element in its favour.

In the train and under the protection of the French ambassador, Michel de Castelnau, Bruno passed over in 1583 to England, where he resided for about two years. He was much disgusted with the brutality of the English manners, which he paints in no flattering colours, and he found in Oxford pedantry and superstition as rampant as at Geneva. But he indulges in extravagant eulogies of Elizabeth, and he formed the acquaintance at London of Sir Philip Sidney, Fulke Greville, and other eminent Englishmen. At Oxford he was allowed to hold a disputation with some learned doctors on the rival merits of the Copernican and so-called Aristotelian systems of the universe, and, according to his own report, had an easy victory. The best of his works were written in the freedom of English social life. The *Cena de le Ceneri*, or Ash Wednesday conversation, devoted to an exposition of the Copernican theory, was printed in 1584. In the same year appeared his two great metaphysical works, *De la Causa, Principio, ed Uno*, and *De l'Infinito, Universo, e Mondi*; in the year following the *Eroici Furori* and *Cabala del Cavallo Pegaseo*. In 1584 also appeared the strange dialogue, *Spaccio della Bestia Trionfante*, or *Expulsion of the Triumphant Beast*, an allegory treating chiefly of moral philosophy, but giving at the same time the very essence and spirit of Bruno's philosophy. The gods are represented as resolving to banish from the heavens the constellations, which served to remind them of their evil deeds. In their places are put the moral virtues. The first of the three dialogues contains the substance of the allegory, which, under the disguise of an assault on heathen mythology, is a direct attack on all forms of anthropomorphic religion. But in a philosophical point of view the first part of the second dialogue is the most important. Among the moral virtues which take the place of the beasts are Truth, Prudence, Wisdom, Law, and Universal Judgment, and in the explanation of what these mean Bruno unfolds the very inner essence of his system. Truth is the unity and substance which underlies all things; Prudence or providence is the regulating power of truth, and comprehends both liberty and necessity; Wisdom is providence itself in its supersensible aspect —in man it is reason which grasps the truth of things; Law results from wisdom, for no good law is irrational, and its sole end and aim is the good of mankind; Universal Judgment is the principle whereby men are judged according to their deeds, and not according to their belief in this or that catechism. Mingled with his allegorical philosophy are the most vehement attacks upon the established religion. The monks are stigmatized as pedants who would destroy the joy of life on earth, who are avaricious, dissolute, and the breeders of eternal dissensions and squabbles. The mysteries of faith are scoffed at. The Jewish records are put on a level with the Greek myths, and miracles are laughed at as magical tricks. Through all this runs the train of thought resulting naturally from Bruno's fundamental principles, and familiar in modern philosophy as Spinozism, the denial of particular providence, the doctrine of the uselessness of prayer, the identification in a sense of liberty and necessity, and the peculiar definition of good and evil. Altogether the *Spaccio*, as it is the most popular, is the most characteristic of Bruno's works.

In 1586 he returned to Paris with Castelnau, but was soon driven from his refuge, and we next find him at Marburg and Wittenberg, the headquarters of Lutheranism. There is a tradition that here or in England he embraced the Protestant faith; nothing in his writings would lead one to suppose so. Several works, chiefly logical, appeared during his stay at Wittenberg. In 1588 he went to Prague, then to Helmstadt. In 1591 he was at Frankfort, and published three important metaphysical works, *De Triplici Minimo et Mensura; De Monade, Numero, et Figura; De Immenso et Innumerabilibus*. He did not stay long at Prague, and we find him next at Zurich, whence he accepted an invitation to Venice. It was a rash step. The emissaries of the Inquisition were on his track; he was thrown into prison, and in 1593 was brought to Rome. Seven years were spent in confinement. On the 9th February 1600 he was excommunicated, and on the 17th was burned at the stake.

As has been said, for an estimation of Bruno's philosophy, the most important works are the two Italian dialogues and the three last-mentioned Latin treatises. It is not an easy matter to put his opinions into small compass, for the general form of exposition adopted by him, the dialogue, imposes a certain looseness on his own mode of thinking.

To Bruno as to all other great thinkers, the end of philosophy is the search for unity. Amid all the varying and contradictory phenomena of the universe there is something which gives coherence and intelligibility to them. Nor can this unity be something apart from the things; it must contain in itself the universe, which develops from it; it must be at once all and one. This unity is God, the universal substance,—the one and only principle, or *causa immanens*,—that which is in things and yet is distinct from them as the universal is distinct from the particular. He is the efficient and final cause of all, the beginning, middle, and end, eternal and infinite. By his action the world is produced, and his action is the law of his nature, his necessity is true freedom. He is living, active intelligence, the principle of motion and creation, realizing himself in the infinitely various forms of activity that constitute individual things. To the infinitely actual there is necessary the possible; that which determines involves somewhat in which its determinations can have existence. This other of God, which is in truth one with him, is matter. The universe, then, is a living cosmos, an infinitely animated system, whose end is the perfect realization of the variously graduated forms.

The unity which sunders itself into the multiplicity of things may be called the *monas monadum*, each thing being a *monas* or self-existent, living being, a universe in itself. Of these monads the number is infinite. The soul of man is a thinking monad, and stands mid-way between the divine intelligence and the world of external things. As a portion of the divine life, the soul is immortal. Its highest function is the contemplation of the divine unity, discoverable under the manifold of objects.

Such is a brief summary of the principal positions of Bruno's philosophy. It seems quite clear that in the earlier works, particularly the two Italian dialogues, he approached more nearly to the pantheistic view of things than in his later Latin treatises. The unity expounded at first is simply an *anima mundi*, a living universe, but not intelligent. There is a distinct development traceable towards the later and final form of his doctrine, in which the universe appears as the realization of the divine mind.

The Italian works of Bruno, formerly exceedingly rare, have been collected and published in two volumes, by A. Wagner, 1830. An edition of the Latin works was begun by Gfrörer in 1834, but has not been completed. The most complete monograph on him is that by C. Bartholmess, 2 vols. 1846–47; the most recent life is that by Domenico Berti, 1868. The best systematic account of his philosophy is that by Carriere, *Philosophische Weltanschauung der Reformationszeit*, 1847, pp. 411–494. The relations between his philosophy and that of Cusanus are treated in Clemens, *G. Bruno und Nicolaus von Cusa*, 1847. An English translation by Morehead (not, as is generally supposed, by Toland) of the *Spaccio* is dated 1713. It was probably printed before that time, and it is now excessively rare. Toland translated the preface to *De l'Infinito*; it is found in his *Posthumous Works*. There is a French translation of part of the *Spaccio, Le Ciel Reformé*, 1750. Lasson has translated *De la Causa* into German, 1872, with introduction and notes.

The earlier literature with regard to Bruno is copious; it will be found in Bayle, Buhle, and Tennemann. (R. AD.)

BRUNSWICK (German Braunschweig), a duchy and state of Northern Germany, forming part of the new German Empire, and included in the Prusso-German Zollverein. It consists of three larger and five smaller portions of territory lying mainly between 51° 38′ and 52° 28′ N. lat., and between 9° 20′ and 11° 30′ E. long. The principal part, containing the cities of Brunswick, Wolfenbüttel, and Helmstedt, is situated between Hanover and Prussia, to the S.E. of the former, and has its surface diversified by hill and plain. The part containing Holzminden and Gandersheim extends eastward from the Weser to Goslar, and is intersected by branches of the Hartz Mountains. The Blankenburg portion lies to the S.E. of the two former, between Prussia, Anhalt, and Hanover, and is traversed by the Hartz. Of the smaller portions some form *enclaves* in Hanover and others in Prussia.

Brunswick has an area of 1424 English square miles, and is divided into six circles, comprehending thirteen cities, and between four and five hundred smaller towns and villages. Besides the cities already mentioned the most important are Schöningen, Seesen, and Schöppenstedt. The population was in 1812, 209,527; in 1852, 271,208; in 1861, 281,708; and in 1871, 311,175. Of the last number 302,989 were Protestants, 7030 Roman Catholics, and 1171 Jews. The proportions in the political divisions were as follows:—

Circles.	Extent in square miles.	Inhabitants.		
		1834.	1867	1871.
Brunswick	209	61,232	82,828	90,845
Wolfenbüttel	294	50,423	59,454	60,739
Helmstedt	304	41,155	52,023	53,705
Holzminden	221	41,290	42,129	41,581
Gandersheim	212	39,277	43,430	42,322
Blankenburg	184	19,855	22,928	22,523
	1424	253,232	302,792	311,715

Brunswick also possesses in Prussian Silesia the principality of Oels, which from 1647 to 1792 belonged to Würtemberg. A portion of the Hartz Mountains is common to Brunswick and Hanover, and is consequently known as the Communion-Hartz. Various minor arrangements have been made with Prussia for the more convenient organization of this district since the formation of the new German empire. The highest point of the mountains in the Brunswick territory is the Wormberg, 3230 feet in height. The principal rivers by which the duchy is watered are the Ocker, the Weser, the Aller, and the Leine. The lower parts of the country are generally fertile and well cultivated; the higher are mostly covered with forests of fir, oak, and beech. A very extensive improvement has been effected in the circle of Helmstedt by the draining of the Drömling swamp, and the rectification of the courses of the Aller and the Ohre. Of the whole duchy 32·7 per cent. is arable, 27·3 consists of meadow and pasture, and 31·8 is under wood. Agricultural and pastoral pursuits constitute the principal employment of the inhabitants; and the peasant class are usually well to do. The principal articles of cultivation are grain, potatoes, beetroot, flax, hops, and fruits. The growing of tobacco, which was formerly of great importance, is now very limited. In 1870 there were in the duchy 25,344 horses, 83,558 head of cattle, 386,757 sheep, 75,616 swine, 39,167 goats, 55,829 geese, and 8385 bee stocks. The mineral wealth of the country, which is chiefly derived from the Hartz Mountains, consists of copper, lead, iron, gold, silver, sulphur, coal, salt, and alum. In 1867 the total yield of coal was 219,400 tons, of iron ore 58,400, of pig-iron 143,000, of cast-iron 1584; the copper amounted to 383 tons; the lead to 710, and the vitriol to 1339. The manufactures, which are comparatively small, comprise (besides the preparation of the ores) spinning, weaving, and brewing. The principal iron-works are at Rübeland, Wieda, Delligsen, and Oker; and the chief centres of general industry are Brunswick and Schöningen. An active trade is carried on by means of the extensive railway communication with the rest of Germany.

The educational institutions comprise two ecclesiastical seminaries, an anatomical and surgical college, an architectural school at Holzminden, an agricultural school at Schöppenstedt, 5 gymnasiums, 25 burgher schools, and upwards of 400 village schools, besides several important establishments in the capital (see below). There is an extensive lunatic asylum at Königslutter, opened in 1865.

According to the constitution of 1832, which has been frequently modified, the Government is an hereditary monarchy, with a legislative assembly of representatives. These are chosen, by the law of 1851, twenty-one by those citizens who pay the largest amount of taxes, ten by the towns, three by the clergy, and a certain number by the communes. They hold office for six years, one-half going out triennially; and when they are not in session, they are represented by a standing committee of seven members. In the federal council the duchy has two votes, and it sends three deputies to the imperial diet. The ducal contingent, which still wears its famous black uniform, forms part of the 10th federal army corps. The state is the proprietor not only of a large proportion of the mines and forests in the duchy, but also of its railways. From these sources it derives a considerable part of its revenue, which in recent years has been augmented by the farming out of lotteries. By the budget for the period 1873–5, the annual receipts were fixed at 7,429,400 marks, or £371,470. The total debt, which had been mainly incurred for the formation of the railways, amounted to 65,400,000 marks, or £3,270,000.

The people of Brunswick are, with comparatively few exceptions, of Saxon race. The country people speak dialects of Low German, while High German is employed by the educated classes in the cities.

The more immediate ancestor of the house of Brunswick was Henry the Lion, who, in the 12th century, held the united duchies of Bavaria and Saxony; but having refused to aid the Emperor Frederick Barbarossa in his wars with the Pope, he was, by decree of the diet in 1180, deprived of both duchies, and only left the possession of his allodial domains of Brunswick and Lüneburg. His grandson, Otho, was invested in 1235 with these domains as a fief of the empire, and thus became the first duke of Brunswick. The two principalities which had been severed were united by Ernest the Confessor, but on his death in 1546, they were again divided between his two sons; the elder (or rather his son Augustus) receiving Brunswick-Wolfenbüttel, or Brunswick, and the younger Brunswick-Lüneburg, or Hanover. The ducal residence, which had before been at Wolfenbüttel, was in 1754 removed to Brunswick by Duke Charles. His successor, Duke Charles William Ferdinand, married Augusta, daughter of George III. of England. He commanded the Prussian troops at Auerstädt in 1806, and soon after died of the wounds he had received in the battle. His possessions were immediately seized by Napoleon, and formed part of the kingdom of Westphalia till after the battle of Leipsic, when the duchy was restored to its rightful possessor, Frederick William, youngest son of the preceding duke. This prince fell at the head of his troops at Quatre Bras, and was succeeded by Charles Frederick, the elder of his two sons, who, being at that time a minor, was placed under the tutelage of George IV. of England, then prince-regent. The duke entered on the exercise of his authority in October 1823, but in consequence of a revolution in 1830 was obliged to abdicate in 1831 in favour of his brother William, the present duke. During the long reign of duke William many important changes have taken place in the internal organization of the duchy, and most of them have been in the direction of greater civil liberty. Of great moment was the establishment of a new criminal code in 1840; and publicity of parliamentary discussion, the freedom of the press, the introduction of jury-trials in criminal cases, and the legitimation of Christian-Jewish marriages were secured in 1849. In 1851 military service was recognized as binding on all, and the election of members of parliament was placed more directly in the hands of the people. In 1864 the *Stolgebühren*, or taxes paid to the established clergy on the occasion of a baptism, a marriage, or a burial, were made no longer leviable on Jews, Roman Catholics, or other dissenters. The introduction of the German commercial code was effected in 1864, and freedom of trade was introduced in the same year. Treaties of mutual inheritance exist between the houses of Hanover and Brunswick; and should the present duke, who is still unmarried, die without issue, the duchy will pass to the house of Hanover. The ex-duke, to whose sons the right would first have descended, died childless at Geneva in August 1873. He had spent his life in pitiable devotion to certain hobbies, the most remarkable of which was the collection of valuable diamonds. His various treasures were bequeathed to the city of Geneva, but the will is disputed by the present duke.

BRUNSWICK, the capital of the above duchy, is situated on the Ocker, 37 miles E.S.E. of Hanover by rail, and 52 W.N.W. of Magdeburg, in 52° 16′ N. lat. and 10° 32′ E. long. In spite of the numerous alterations effected during the present century, the city is still of an antiquated appearance, and is for the most part contained within the limits of its old fortifications. These, which were dismantled in 1797, have given place to a regular circle of gardens and promenades, which rank among the finest in Germany.

The ducal palace is a handsome modern structure, erected since 1865, when the most of the previous building, which only dated from 1831, was destroyed by fire. The famous Quadriga of Rietschel, which perished at the same time, has been replaced by a copy by Howald. Among the ten or twelve churches in the town the most important are the cathedral of St Blaise, built by Henry the Lion in 1173; St Magnus's, which is the oldest, dating from 1031; St Andreas, with a spire 318 feet high; and St Catherine's, a building of the 13th century. The educational and charitable institutions of Brunswick are numerous and important. Of the former may be mentioned the *Collegium Carolinum*, founded in 1745, the great United Gymnasiums (which include the former commercial gymnasium, the Martineum, and the Catherineum), the Medico-Chirurgical College, and the Academy of Forestry; while among the latter are a deaf and dumb institution, a blind asylum, an orphanage, and various hospitals and infirmaries. There are also two public libraries, a museum, a theatre, and several scientific societies. A monument, 60 feet high, to Duke Frederick William, who was slain at Quatre Bras, gives its name to Monuments-Platz, and another to the S.E. of the town perpetuates the memory of Schill and his companions. The trade of Brunswick, formerly restricted by obsolete legislation, is gradually increasing. The principal articles of manufacture are coarse cloth and leather; and, to a smaller extent, gloves, papier-maché, and paper wares. The town has long been famous for a special kind of beer, called Mumme, from the name of the Brunswick brewer who invented it in 1492. In 1867 the population amounted to 50,369, inhabiting 3487 houses, and divided into 10,850 families. In 1871 it had increased to 57,883.

Brunswick is said to have been founded about 861 by Bruno, duke of Saxony, from whom it was named *Brunonis Vicus*. Afterwards enlarged and fortified by Henry the Lion, it became one of the most important cities of Northern Germany. For a long time its constitution was rather peculiar, as it consisted of five separate townlets, each with its own walls and gates, its own council and Rathhaus,—a condition of which traces are still evident. In the 13th century it ranked among the first cities of the Hanseatic league, but it never succeeded in obtaining imperial freedom. After this, however, it declined, in consequence of the many divisions of territory among the branches of the reigning house, the jealousy of the neighbouring states, the Thirty Years' War, and more recently the French occupation. In 1830 it was the scene of a violent revolution, which led to the removal of the reigning duke.

BRUNSWICK, a town of the United States of America, in Cumberland County, Maine, 27 miles N.N.E. of Portland, on the right bank of the Androscoggin River, which, with a fall of about 50 feet in half-a-mile, supplies a large amount of water-power. Numerous industrial establishments have been erected, the most important being a cotton factory, flour-mills, and bleach-works. The lumber-trade, which was formerly of great extent, has been in great measure replaced by the building and owning of ships. Besides possessing an excellent system of graduated schools, Brunswick is the seat of Bowdoin College, founded in 1802, and of the Maine Medical School, which dates from 1820. The river is crossed by two bridges, one of which unites the town with Topsham, and the other belongs to the Kennebec and Portland railway. Population in 1850, 4927; in 1870, 4687, or including the neighbouring village, 6136.

BRUNTON, Mrs Mary (1778–1818), a novelist of the early part of the 19th century, was born on the 1st November 1778, in the island of Barra, Orkney. Her father, Colonel Balfour, was a man of importance in the island, and she received a very careful and excellent education. At the age of twenty she married the Rev. Mr Brunton, minister of Bolton in Haddingtonshire, who in 1803 received a call to a church in Edinburgh. In 1811 Mrs Brunton published anonymously her first novel, *Self-Control*. It at once became very popular; the first edition was sold off in a month, and a second and third quickly followed. The book was especially recommended by its high moral and religious tone; it was a novel with a purpose. As a work of art, it cannot take a high place; the plot is extravagant and improbable, and the characters have none of the charm of reality about them. The story is constructed after the model of *Clarissa*, and contains the usual virtuous heroine and vicious hero, with an unusual number of abductions and mysteries. Her second novel, *Discipline*, was published in 1814, and was received with equal favour. Mrs Brunton died on the 19th December 1818. An unfinished tale, *Emmeline*, was published after her death by her husband, with a notice of her life.

BRUSHES and BROOMS are implements composed of a solid basis in which a tuft or tufts of hair or of vegetable or other fibres are secured. They are mentioned by various ancient writers, as Homer, Sophocles, and Euripides. Perhaps the earliest notice is the figurative "besom of destruction" (Isa. xiv. 23). Brushes are of two kinds, simple and compound. The former consist of but one tuft, as hair pencils and painters' tools. The latter have more than one tuft. Brushes with the tufts placed side by side on flat boards, as plasterers' brushes, are called stock-brushes. The single tuft brushes, or pencils for artists, are made of the hair of the camel, badger, goat, and other animals for the smaller kind, and pig's bristles for the larger. The hairs for pencils are carefully arranged so as to form a point in the centre, and, when tied together, are passed into the wide end of the quill or metal tube and drawn out at the other end to the extent required. The small ends of the quills having been previously moistened, in drying contract and bind the hair. A similar effect is produced with metal tubes by compression. Compound brushes are—first, set or pan-work; second, drawn-work. Of the former, an example is the common house-broom, into the stock of which holes are drilled of the size wanted. The necessary quantity of bristles, hair, or fibre, to fill each hole is collected together, struck on the working bench at the thick ends, dipped into molten cement chiefly composed of pitch, bound round with thread, dipped again, and then set into a hole of the stock with a peculiar twisting motion only to be acquired by practice. In drawn-brushes, of which those for shoes, teeth, nails, and clothes are examples, the holes are more neatly bored, and have smaller ones at the top communicating with the back of the brush, through which a bight or loop of wire passes from the back of the stock. Half the number of hairs or fibres needed for the tufts to fill the holes are passed into the bight of the wire, which is then pulled smartly so as to double the hairs and force them into the loop-hole as far as possible. With all brushes, when the holes have been properly filled, the ends of the fibres outside are cut with shears, either to an even length or such form as may be desired. The backs are then covered with veneer or other material to conceal the wire and other crudities of the work. A process called trepanning is adopted with some small brushes. The drawholes come out at some inconspicuous part of the stock, and the hairs or fibres having been properly secured, the holes are plugged up in order to conceal them as much as possible.

The bristles used in this manufacture are imported chiefly from Russia and Poland, and are sorted into black, grey, yellow, white, and lilies. They vary in length, and are separated by the workman striking a quantity held in the hand smartly on a bench, the thick ends downwards. He then applies them to a gauge to ascertain the lengths of those that project, and, seizing them between his finger and thumb, draws them out of the bundle and places them with those of corresponding dimensions. They are sorted according to thickness by a process called "dragging,"

which consists in passing them through a kind of comb, which retains those that are too stout to go between the teeth. By repeating this with finer combs the bristles can be assorted to any number of sizes required. Various other substances are now used in place of bristles, and this was greatly stimulated by the scarcity of these during the Russian war. In 1808 whalebone fibres were patented in England for the purpose, and in 1810 twigs of broom, mallow, rushes, and other shrubs and plants. In 1842 the shafts of quills prepared and split up, and in 1872 horn and similar substances were used in the same way. The latter are softened by steeping them in an infusion of sage leaves or plants of that class, then flattened, rolled out, and extended and moulded so as to disintegrate them into threads. In 1844 a brush was patented made of stiff fibre and bristles, hard in one part and soft in another, so that the softer parts should follow the harder, and take up what the latter left. The same inventor also made tooth-brushes on the same principle. The hairs of the squirrel, horse, badger, bear, and other animals are also used for brushes, and those from the ears of cows and from the ichneumon, amongst others, for artists' pencils. When necessary the bristles are bleached by sulphur or other chemical agents. In the United States a kind of sorghum or broom-corn is extensively cultivated for the manufacture of brooms, and especially by the Shakers of New York State. The seed of the crop alone, it is stated, often pays the expense of cultivation, being, when mixed with other corn, good food for cattle and horses.

One of the most important purposes to which brushes have been applied is that of sweeping chimneys. So far back as 1789 John Elin patented an arrangement of brushes with this purpose in view. He was followed at intervals by others, and the use of these machines having been found practicable, the Acts 3 and 4 Vict. c. 85, and 27 and 28 Vict. c. 37, put an end to the cruelties previously practised, prohibiting the employment of children in sweeping chimneys.

Revolving brushes for cleaning rooms were patented in 1811, and others have followed. In 1825 they were constructed to take the place of teazles for raising the wool or pile of woollen and other cloths, and they are now used for polishing and other purposes in various manufactures. The first patent in which they were applied to hair-dressing appears in 1862. The patented invention for sweeping and cleaning roads by means of revolving brushes and other contrivances are very numerous. The first appears in 1699. It is that of Edmund Henning for "a new engine for sweeping the streets of London, or any city or town." No specification was enrolled, but the invention included the loading and removal of the refuse "with great ease and quickness." A long interval elapsed before anything further was done in this direction, the next patent being that of W. Ranyard, on 1st November 1825, which consisted of a number of brushes mounted upon two rims or placed upon an axis, which was raised on a vehicle or barrow. Boase and Smith's followed in 1828, including scraping, sweeping, and watering. From 1836 a succession of inventors follow each other rapidly, amongst whom frequently appears "Joseph Whitworth." Some of the most recent patents are Greenwood's, 17th February 1873; Robinson's, 4th April 1874; Sinclair and Clayton's, 20th February 1875; Kitson's, 21st April 1875. Many of these inventions include the removal of the refuse, as well as scraping. Some propose watering in addition; but the simplest and most easily managed is that most commonly used, which scrapes or sweeps the mud and rubbish to the sides of the road. A particular point in Mr Kitson's invention seems to be to clear out the dust and mud from between the joints of the paving stones

An improvement in brushmaking was patented in 1830 by Timothy Mason, which consisted in cutting grooves in the stocks or bases of brushes instead of boring holes, the grooves increasing in width from the outer surface. The hairs or bristles are tied up into tufts or knots, dipped in cement, placed in the grooves, and wedged tightly by the use of a blunt tool, which operation causes the tufts to expand and hold firmly in the enlarged recess. Various contrivances have been patented by which brushes might be self-supplied with water, soap, paste, paint, and the like, when in use, by means of receptacles or pipes being attached to them for the purpose.

One of the greatest advances in the brushmaking of the present day is the Woodbury machine, an American invention for bunching, wiring, and inserting bristles in the stock. In this machine a metal comb of uniform thickness is filled with bristles, holding them by the middle, so that one-half of the bristles appear above the surface of the comb, the other underneath. The comb thus charged moves in guideways, and discharges the bristles from each division successively into a channel in which, by an ingenious contrivance, they are brought gradually into a horizontal position and a proper quantity taken up to form a tuft, which is moved along an incline. At the bottom of this is a hollow cylinder that does not enter, but is placed firmly against the tuft hole in the brush stock. A plunger now acts upon the bristles. The end of the plunger is slotted crossways; one slot receives the bristles, the other a piece of wire. The plunger is made to descend and double the bristles into a loop at the middle. Other mechanism unwinds the binding wire from a reel, straightens the wire, and passes the proper quantity through the enlarged upper portion of the slot, and at the same time cuts off the length required. The plunger now descends further, receiving a rotatory motion on its vertical axis, winds the wire by forcing it into the thread of a nut at the lower portion of the cylinder, and fastens it round the double end of the bunch. The end of the wire now acts as a tap, cutting a female screw in the end of the block, whilst the upper end of the wire thread, by expanding, acts as a pawl, and prevents the unscrewing of the tuft. This machine is described in the *Scientific American*, 1872, p. 31, with illustrations.

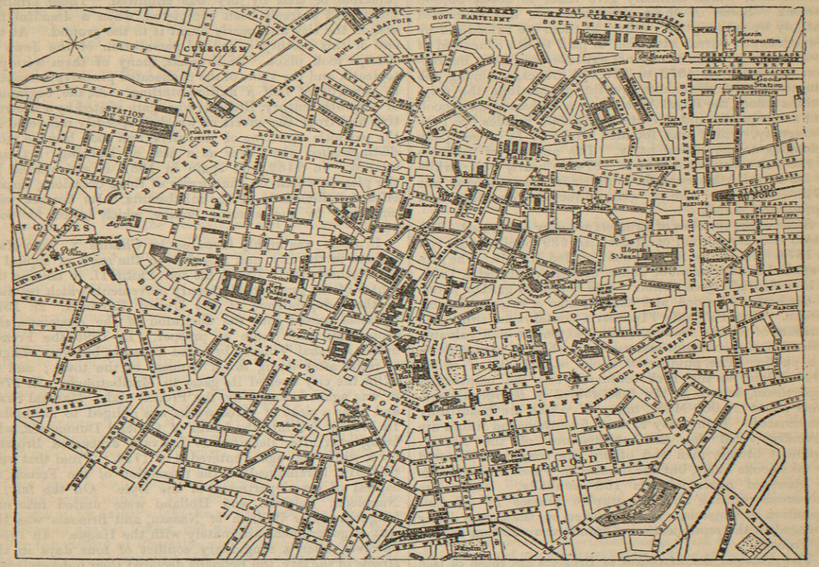
For further information on the subject of brushes, the reader will find the abridgement of specifications relating to brushing and sweeping, published at the Patent Office, a most useful manual.

(J. J. L.)

BRUSSELS (French, *Bruxelles*; Flemish, *Brussel*; German, *Brüssel*), capital of Belgium and of the province of South Brabant, is situated on the small River Senne, about 50 miles from the sea, in 50° 51′ N. lat., 4° 22′ E. long. It lies in the midst of a beautiful and fertile country, and is picturesquely built on the top and sides of a hill, which slopes down to the Senne. The general contour of the old town of Brussels is pentagonal, and is well defined by the boulevards, which occupy the site of the old fortifications; but extensive additions have been made, especially to the east and south, and present a very irregular outline

Brussels may be considered to consist of two parts, each presenting characteristics peculiar to itself. The New Town or upper part of the city is dry and healthy, and contains a very large number of handsome buildings, both public and private. The lower part is the more ancient and interesting of the two, but is damp, and in summer unhealthy, from the exhalations of the river and the numerous canals. In the former are situated nearly all the public offices, the royal palace, the chamber of deputies, the residence of the foreign representatives, and the principal hotels. The latter contains the Hôtel de Ville and

some of the best remains of the old Gothic architecture, and is the seat of nearly all the trade and commerce of the town. The facilities for commerce are very considerable. Though the Senne is not navigable itself, and is in fact now (1876) in process of being arched over to afford room for a new boulevard, it supplies water to some of the canals that intersect the lower portion of the city. By these canals Brussels communicates with the great Belgian cities, Mechlin, Ghent, Bruges, and Antwerp on the north, and Charleroi on the south. It further enjoys the advantage of railway communication with France and Germany, and the chief towns of the Belgian dominions. The streets are for the most part well paved, well lighted, and abundantly supplied with excellent water. There are



Plan of Brussels.

largest are the Place du Grand Sablon, the Place Royale, and the Grande Place before the Hôtel de Ville. In the last-named square, surrounded for the most part with houses that date from the time of the Spanish possession, the Counts Egmont and Horn were beheaded in 1568, by order of the duke of Alva, who surveyed the scene from the windows of the Brood-Huys (otherwise Maison du Roi), a remarkable specimen of Gothic architecture still extant. In the Place de la Monnaie are the mint, the exchange, and the great theatre. In the Place des Martyrs, the heroes who fell in the Revolution of 1830 are interred. In front of the palace is the Public Park, a fashionable summer promenade, which covers an area of about 14 acres. It is beautifully laid out with walks, adorned at moderate distances with groups of sculpture; and as it is planted with trees which shade it from the sun, the grass is always fresh and green. In the lower town is the Allée Verte, an equally fashionable promenade, which runs parallel with the Mechlin canal, having a triple row of linden trees on each side, and leads towards the village of Lacken, where, since 1815, the king has had a suburban castle.

in the town innumerable fountains, some of which are handsomely ornamented with sculptures in stone and bronze. Of these the best are *Les Fontaines des Fleuves* in the Hôtel de Ville, *La Fontaine de Minerve* in one of the great squares, and the *Mannekin-pis* behind the Hôtel de Ville. Some of the streets are macadamized, but the majority of them are causewayed, while the *trottoirs* are either flagged or paved with flint-stones. In the new town some of the streets are remarkably handsome; they contain a considerable number of shops and cafés similar to those of Paris, and form the chief promenades of the inhabitants. In the old town they are for the most part narrow and sombre. There are fourteen squares in Brussels, many of which are used as market-places. Of these the

Of the public buildings of Brussels the most remarkable are the cathedral church of St Michel et Ste Gudule, the Hôtel de Ville, and the Palace of Justice, a modern erection. The cathedral was built in 1010, and in it was held the first chapter of the order of the Golden Fleece in 1535. It contains a remarkable pulpit, and some splendid specimens of stained glass. From its towers a fine view of the surrounding country may be obtained. The Hôtel de Ville, built in 1400, is profusely ornamented; it has a tower 360 feet in height. The other public buildings of Brussels are for the most part handsome, but are quite