

gravitation in the properties of an aethereal medium diffused over the universe.

"It appears, from his letters to Boyle, that this was his opinion early, and if he did not publish it sooner it proceeded from hence only, that he found he was not able, from experiment and observation, to give a satisfactory account of this medium and the manner of its operation in producing the chief phenomena of nature."¹

In his *Optical Queries*, indeed, he shows that if the pressure of this medium is less in the neighbourhood of dense bodies than at great distances from them, dense bodies will be drawn towards each other, and that if the diminution of pressure is inversely as the distance from the dense body the law will be that of gravitation. The next step, as he points out, is to account for this inequality of pressure in the medium; and as he was not able to do this, he left the explanation of the cause of gravity as a problem to succeeding ages. As regards gravitation the progress made towards the solution of the problem since the time of Newton has been almost imperceptible. Faraday showed that the transmission of electric and magnetic forces is accompanied by phenomena occurring in every part of the intervening medium. He traced the lines of force through the medium; and he ascribed to them a tendency to shorten themselves and to separate from their neighbours, thus introducing the idea of stress in the medium in a different form from that suggested by Newton; for, whereas Newton's stress was a hydrostatic pressure in every direction, Faraday's is a tension along the lines of force, combined with a pressure in all normal directions. By showing that the plane of polarisation of a ray of light passing through a transparent medium in the direction of the magnetic force is made to rotate, Faraday not only demonstrated the action of magnetism on light, but by using light to reveal the state of magnetisation of the medium, he "illuminated," to use his own phrase, "the lines of magnetic force."

From this phenomenon Thomson afterwards proved, by strict dynamical reasoning, that the transmission of magnetic force is associated with a rotatory motion of the small parts of the medium. He showed, at the same time, how the centrifugal force due to this motion would account for magnetic attraction.

A theory of this kind is worked out in greater detail in Clerk Maxwell's *Treatise on Electricity and Magnetism*. It is there shown that, if we assume that the medium is in a state of stress, consisting of tension along the lines of force; and pressure in all directions at right angles to the lines of force, the tension and the pressure being equal in numerical value and proportional to the square of the intensity of the field at the given point, the observed electrostatic and electromagnetic forces will be completely accounted for.

The next step is to account for this state of stress in the medium. In the case of electromagnetic force we avail ourselves of Thomson's deduction from Faraday's discovery stated above.² We assume that the small parts of the medium are rotating about axes parallel to the lines of force. The centrifugal force due to this rotation produces the excess of pressure perpendicular to the lines of force. The explanation of electrostatic stress is less satisfactory, but there can be no doubt that a path is now open by which we may trace to the action of a medium all forces which, like the electric and magnetic forces, vary inversely as the square of the distance, and are attractive between bodies of different names, and repulsive between bodies of the same names.

The force of gravitation is also inversely as the square of the distance, but it differs from the electric and magnetic forces in this respect, that the bodies between

¹Maclaurin's account of Sir Isaac Newton's discoveries.

which it acts cannot be divided into two opposite kinds, one positive and the other negative, but are in respect of gravitation all of the same kind, and that the force between them is in every case attractive. To account for such a force by means of stress in an intervening medium, on the plan adopted for electric and magnetic forces, we must assume a stress of an opposite kind from that already mentioned. We must suppose that there is a pressure in the direction of the lines of force, combined with a tension in all directions at right angles to the lines of force. Such a state of stress would, no doubt, account for the observed effects of gravitation. We have not, however, been able hitherto to imagine any physical cause for such a state of stress. It is easy to calculate the amount of this stress which would be required to account for the actual effects of gravity at the surface of the earth. It would require a pressure of 37,000 tons' weight on the square inch in a vertical direction, combined with a tension of the same numerical value in all horizontal directions. The state of stress, therefore, which we must suppose to exist in the invisible medium, is 3000 times greater than that which the strongest steel could support.

Another theory of the mechanism of gravitation, that of Le Sage, who attributes it to the impact of "ultramundane corpuscles," has been already discussed in the article *ATOM*, *supra*, p. 46.

Sir William Thomson² has shown that if we suppose all space filled with a uniform incompressible fluid, and if we further suppose either that material bodies are always generating and emitting this fluid at a constant rate, the fluid flowing off to infinity, or that material bodies are always absorbing and annihilating the fluid, the deficiency flowing in from infinite space, then, in either of these cases, there would be an attraction between any two bodies inversely as the square of the distance. If, however, one of the bodies were a generator of the fluid and the other an absorber of it, the bodies would repel each other.

Here, then, we have a hydrodynamical illustration of action at a distance, which is so far promising that it shows how bodies of the same kind may attract each other. But the conception of a fluid constantly flowing out of a body without any supply from without, or flowing into it without any way of escape, is so contradictory to all our experience, that an hypothesis, of which it is an essential part, cannot be called an *explanation* of the phenomenon of gravitation.

Dr Robert Hooke, a man of singular inventive power, in 1671 endeavoured to trace the cause of gravitation to waves propagated in a medium. He found that bodies floating on water agitated by waves were drawn towards the centre of agitation.³ He does not appear, however, to have followed up this observation in such a way as to determine completely the action of waves on an immersed body.

Professor Challis has investigated the mathematical theory of the effect of waves of condensation and rarefaction in an elastic fluid on bodies immersed in the fluid. He found the difficulties of the investigation to be so great that he has not been able to arrive at numerical results. He concludes, however, that the effect of such waves would be to attract the body towards the centre of agitation, or to repel it from that centre, according as the wave's length is very large or very small compared with the dimensions of the body. Practical illustrations of the effect of such waves have been given by Guyot, Schellbach, Guthrie, and Thomson.⁴

A tuning-fork is set in vibration, and brought near a delicately suspended light body. The body is immediately

²*Proceedings of the Royal Society of Edinburgh*, 7th Feb. 1870.

³*Posthumous Works*, edited by R. Waller, pp. xiv and 184.

⁴*Philosophical Magazine*, June 1871.

attracted towards the tuning-fork. If the tuning-fork is itself suspended, it is seen to be attracted towards any body placed near it.

Sir W. Thomson has shown that this action can in all cases be explained by the general principle that in fluid motion the average pressure is least where the average energy of motion is greatest. Now, the wave motion is greatest nearest the tuning-fork, the pressure is therefore least there; and the suspended body being pressed unequally on opposite sides, moves from the side of greater pressure to the side of less pressure, that is towards the tuning-fork. He has also succeeded in producing repulsion in the case of a small body lighter than the surrounding medium.

It is remarkable that of the three hypotheses, which go some way towards a physical explanation of gravitation, every one involves a constant expenditure of work. Le Sage's hypothesis of ultramundane corpuscles does so, as we have shown in the article *ATOM*. That of the generation or absorption of fluid requires, not only constant expenditure of work in emitting fluid under pressure, but actual creation and destruction of matter. That of waves requires some agent in a remote part of the universe capable of generating the waves.

According to such hypotheses we must regard the processes of nature not as illustrations of the great principle of the conservation of energy, but as instances in which, by a nice adjustment of powerful agencies not subject to this principle, an apparent conservation of energy is maintained. Hence, we are forced to conclude that the explanation of the cause of gravitation is not to be found in any of these hypotheses.

For the mathematical theory of attraction and attraction of ellipsoids, see *POTENTIAL*; for attraction of gravitation, capillary attraction, and attraction of cohesion, see respectively *GRAVITATION*, *CAPILLARY ATTRACTION*, and *CONSTITUTION OF BODIES*. (J. C. M.)

ATTWOOD, THOMAS, musical composer, was born in London in 1767. As one of the boy choristers in the chapel royal he received his early instruction in music from Nares and Ayrton. In 1783 he was sent to study abroad at the expense of the Prince of Wales, who had been favourably impressed by his skill as a performer on the harpsichord. After spending two years at Naples, Attwood proceeded to Vienna, where he became a favourite pupil of Mozart. On his return to London he held for a short time an appointment as one of the chamber musicians to the prince of Wales. In 1795 he was chosen organist of St. Paul's, and in the following year he succeeded Dr Dupuis as composer to the chapels royal. His court connection was further confirmed by his appointment as musical instructor to the duchess of York and afterwards to the princess of Wales. For the coronation of George IV. he composed the anthem, *The King shall Rejoice*, a work of high merit. The king, who had neglected him for some years on account of his connection with the princess of Wales, now restored him to favour, and in 1821 appointed him organist to his private chapel at Brighton. Soon after the institution of the Royal Academy of Music, Attwood was chosen one of the professors. He wrote the anthem, *O Lord, grant the King a Long Life*, which was performed at the coronation of William IV., and he was composing a similar work for the coronation of Queen Victoria when he died (March 24, 1838). Attwood's compositions are favourable specimens of the English school. His services and anthems were published in a collected form after his death by his pupil Walmsley, and are frequently used in cathedral worship. Of his secular compositions several songs and glees are well known and popular. The operas which he composed in early life are now almost

forgotten, belonging, as they do, to a period when English music was at its lowest ebb.

ATWOOD, GEORGE, an author celebrated for the accuracy of his mathematical and mechanical investigations, and considered particularly happy in the clearness of his explanations, and the elegance of his experimental illustrations, was born in the early part of the year 1746. He was educated at Westminster school, to which he was admitted in 1759. Six years afterwards he was elected off to Trinity College, Cambridge. He took his degree of Bachelor of Arts in 1769, with the rank of third wrangler and first Smith's prizeman. These distinctions were amply sufficient to give him a claim to further advancement in his own college. In due time he obtained a fellowship, and was afterwards one of the tutors of the college. He became Master of Arts in 1772, and in 1776 was elected a fellow of the Royal Society of London. In the year 1784 he ceased to reside at Cambridge, and soon afterwards received from Mr Pitt a patent office, which required but little of his attendance, and enabled him still to devote a considerable portion of his time to his special studies. He died in 1807. Atwood's published works, exclusive of papers contributed to the *Philosophical Transactions*, for one of which he obtained the Copley medal, are as follows:—(1.) *Analysis of a Course of Lectures on the Principles of Natural Philosophy*, Cambridge, 1784. (2.) *Treatise on the Rectilinear Motion and Rotation of Bodies*, Cambridge, 1784, which contains a good account of the elementary principles of mechanics, though it is deficient in the application of higher mathematical analysis. It also gives some interesting experiments, by means of which mechanical truths can be ocularily exhibited and demonstrated, and describes the machine, since called by Atwood's name, for verifying experimentally the laws of simple acceleration of motion. (3.) *Review of the Statutes and Ordinances of Assize which have been established in England from the 4th year of King John, 1202, to the 37th of his present Majesty*, London, 1801, a work of some historical research. (4.) *Dissertation on the Construction and Properties of Arches*, London, 1801, with supplement, pt. i. 1801, pt. ii. 1804, an elaborate and, in its time, valuable work, though it is now completely superseded.

ATYS, ATTIS, or ATTES, in the *Phrygian and Lydian Mythology*, a youth beloved for his beauty by the goddess Rhea, there called Agdistis. Like Adonis, he was a personification of the changes in nature, from the beauty of spring and summer to the severity and darkness of winter. The story, as told at Pessinus, the centre of the worship of the goddess, was that she had born to Zeus a being both male and female; that the gods, displeased, had transformed this being into a tree, from the fruit of which the daughter of the river-god Sangarius bore a boy, who grew up among herdsmen marvellous in his beauty, so as to win the love of Agdistis. This was Atys, and he was about to be married to the king's daughter of Pessinus, when the goddess appeared among the guests, terrified them, and caused Atys to run to the woods, where he maimed himself and was transformed into a pine tree; from his blood sprang violets. Agdistis begged Zeus to restore him, but he could only assure her that the youth would never decay, and that his hair would always grow. She conveyed the pine to her cave at Pessinus, and gave herself up to grief.

AUBAGNE, a town of France, in the department of Bouches-du-Rhône, with a population of 7408, who carry on the manufacture of wine, pottery, leather, coarse cloth, &c. The only remarkable monument is a fountain to the memory of the Abbé Barthélemy, whose family was long connected with the town.

AUBE, a department of France, bounded on the N. by the department of Marne, N.W. by Seine-et-Marne, W.

by Yonne, S. by Cote-d'Or, and E. by Haute-Marne. It consists of a portion of Champagne and Vallage, with a small part of Burgundy, and has an area of 2317 square miles. Its general inclination from S.E. to N.W. presents little variety of surface, the only elevations being a double line of hills along the course of the Seine, never exceeding 1150 feet in height. The department belongs to the Seine basin, and is watered by that river and its tributaries, the Ource, the Sarce, the Melda, and the Aube, &c. The climate is comparatively mild, but damp. Heavy rains fall at the beginning of winter. In the N. and N.W. the soil is dry and sterile; but the S. and E. districts are very fertile, particularly the valleys, which are admirably adapted for the cultivation of the vine. About two-thirds of the surface consists of arable land, and the agricultural condition of the country is improving. The principal productions are wheat, rye, oats, potatoes, and wine, of which last about one-half is exported. In minerals Aube is one of the poorest departments in France; a few iron mines have been worked, but with insignificant results. Chalk and clay are abundant; and there are also quarries of marble, lithographic stone, and building stone. The principal manufacture is hosiery; but the department also produces glass, earthenware, paper, sugar, and ropes, and has a large number of distilleries, tile-works, and dye-works, and an oil factory. Among the celebrated men connected with Aube are Villehardouin, Pope Urban IV., Mignard, Danton, Beugnot, and Ulbach. The capital is Troyes, and the arrondissements are Troyes, Arcis-sur-Aube, Nogent-sur-Seine, Bar-sur-Aube, and Bar-sur-Seine. Population in 1872, 255,687.

AUBENAS, a town of France, department of Ardèche, near the river of that name, 14 miles S.W. of Privas. It is beautifully situated on the slope of a hill, but its streets generally are crooked and narrow. It is surrounded by a ruinous wall flanked with towers, and has an old Gothic castle, now occupied by the municipal authorities. As the centre of the silk trade of the surrounding district, it is a place of considerable traffic, and there is besides a large local manufacture of silk and woollen goods. Population, 7694.

AUBER, DANIEL FRANÇOIS ESTRIT, musical composer, the chief representative of the French school, was the son of a Paris printseller. He was born at Caen, in Normandy, on the 29th January 1782, while his mother was on a visit to that town. Destined by his father to the pursuits of trade, he was allowed, nevertheless, to indulge his fondness for music, and learnt to play at an early age on several instruments, his first teacher being the Tyrolean composer, Ladurner. Sent at the age of twenty to London to complete his business training, he returned after the rupture of the peace of Amiens. He had already attempted musical composition, and at this period produced several *concertos pour basse*, in the manner of the violoncellist, Lanare, in whose name they were published. The praise given to his concerto for the violin, which was played at the Conservatoire by Mazas, encouraged him to undertake the resetting of the old comic opera, *Julie*. Conscious by this time of the need of regular study of his chosen art, he placed himself under the severe training of Cherubini, by which the special qualities of the young composer were admirably developed. In 1813 he made his *début* in an opera in one act, the *Séjour Militaire*, the unfavourable reception of which put an end for some years to his attempts as composer. But the failure in business and death of his father, in 1819, compelled him once more to turn to music, and to make that which had been his pastime the serious employment of his life. He produced another opera, the *Testament et les Billets-doux*, which was no better received than the former. But he persevered, and the next year was rewarded by the complete success

of his *Bergère Châtelaine*, an opera in three acts. This was the first in a long series of brilliant successes, terminating only in the eighty-sixth year of his age. In 1822 began his long association with M. Scribe, who shared with him, as librettist, the success and growing popularity of his compositions. The opera of *Leicester*, in which they first worked together (1823), is remarkable also as showing the first evidences of the influence of Rossini on Auber's style. This style was, however, distinctly original, and was easily recognisable. A phrase of Auber, said his friend Théodore Gautier, is not the phrase of any one else. His characteristics are lightness and facility, sparkling vivacity, grace and elegance, clear and piquant melodiousness,—these marking him out as a true son of France, and making him her darling singer. Depth of thought, elevation of sentiment, intensity of passion, inspiration which grasps the sublime and the infinite—these are not in Auber.

Devoted by preference to the comic opera, as the most fitting field for his talents, he ventured on more than one occasion to pass into the field of grand opera, and in his *La Muette de Portici*, familiarly known as *Masanello*, he achieved his greatest musical triumph. Produced at Paris in 1828, it rapidly became a European favourite, and its overture, songs, and choruses were everywhere heard. The diut, *Amour sacré de la patrie* was welcomed like a new *Marseillaise*; sung by Nourrit at Brussels in 1830, it became the signal for the revolution which broke out there. Among his other works, about fifty in all, the more important are—*Fra Diavolo* (1830), *Lestocq* (1834), *L'Ambassadrice* (1836), *Le Domino Noir* (1837), *Le Lac des Fées* (1839), *Les Diamants de la Couronne* (1841), *Haydée* (1847), *Marco Spada* (1853), and *La Fiancée du roi de Garbe* (1864). Official and other dignities testified the public appreciation of Auber's works. In 1829 he was elected member of the Institute, in 1830 he was named director of the court concerts, and in 1842 he succeeded Cherubini as director of the Conservatoire. He was also a member of the Legion of Honour from 1825, and attained the rank of commander in 1847. One of Auber's latest compositions was a march, written for the opening of the International Exhibition in London in 1862. His fascinating manners, his witty sayings, and his ever ready kindness and beneficence won for him a secure place in the respect and love of his fellow-citizens. He remained in his old home during the German siege of Paris, 1870-71, but the miseries of the Communist war which followed sickened his heart, and he at last refused to touch his beloved instrument, or to take food. He died May 13, 1871. (W.L.R.C.)

AUBIN, a town of France, in the department of Aveyron and arrondissement of Villefranche, principally remarkable for its extensive mines of coal, sulphur, and alum. It also carries on an active trade in sheep, iron goods, &c. A church of the 12th century, with some remarkable sculpture, and the ruins of the castle of the counts of Rouergue, are still in existence. Population, 8863.

The name Aubin, or St Aubin, is one of the most frequent in France, being borne by upwards of fifty villages from the Pyrenees to Jersey.

AUBURN, the capital of Cayuga county, in the state of New York, on the railway between Albany and Buffalo, 174 miles W. of the former. The irregularity of the surface on which the city is built has prevented the complete carrying out of the rectangular arrangement of streets, which is so much in favour in the United States, but the thoroughfares are wide and lined with trees, and the houses for the most part well built. The principal public buildings are in Genesee Street. The most remarkable of the institutions is the state prison, founded in 1816, which is conducted on the "silent system," and usually contains upwards of 1000 prisoners, who are employed each in

the work to which he has been trained. Auburn also possesses a Presbyterian theological seminary, founded in 1821, an academy, five public free schools, sixteen churches, an orphan asylum, two opera houses, and several newspaper offices. The water-power supplied by the outlet of the neighbouring lake of Owasco is utilised in a number of manufactories. Cotton and woollen goods, carpets, agricultural implements and other tools, paper, flour, and beer are the principal products.

AUBUSSON, a town of France, situated in a picturesque valley on the banks of the Creuse, in the department to which that river gives its name. It is said to have owed its origin to a number of Saracens, who, having escaped from the battle in which their nation was defeated by Charles Martel, were enticed by the beauty and convenience of the spot to establish themselves permanently there. It has long been famous for its carpets and tapestry, the art of weaving which was probably derived from those Eastern settlers, and it also manufactures common cotton and woollen goods, leather, tobacco, &c. Population, 6625.

AUCH, the ancient *Climberrum* or *Augusta Auscorum*, one of the most ancient cities of France, capital of the department of Gers. In Cæsar's time this was the chief town of the Ausci. In the 8th century it became the capital of Gascony; and when that district was divided into countships, was the capital of Armagnac. The site of the modern town does not exactly coincide with that of the ancient, being on the opposite (the left) bank of the river Gers. Auch was probably destroyed by the Saracens about 724 A.D., and was afterwards rebuilt in its present picturesque situation on the slope of a hill. On the opposite side of the river, and occupying the site of the ancient city, is a considerable suburb, which is connected with the town by a bridge; and communication between the lower and the upper town is afforded by long flights of steps. The streets, though narrow, are generally well built, and a fine promenade in the upper part of the town gives a magnificent view of the surrounding country. Auch is the seat of an archbishopric, which was founded in the 4th century, and gave, till the Revolution, the title of Primate of Aquitania to the holder of the see. It has tribunals of commerce and primary jurisdiction, a royal college, an agricultural society, a theological seminary, with a museum and an extensive library, a theatre, &c. The cathedral of St Mary, one of the most magnificent in France, was commenced in the reign of Charles VIII. (1489), and finished in that of Louis XV. It exhibits several styles of architecture, contains many elegant monuments, and is adorned with fine stained-glass windows and carved woodwork. The *préfecture*, formerly the archiepiscopal palace, is a vast and noble edifice. The principal manufactures are hats, various kinds of linen and cotton stuffs, leather, &c., and there is a considerable trade, especially in the brandies of Armagnac. Population in 1872, 13,087.

AUCHTERARDER, a town and parish of Scotland, county of Perth, 15 miles W.S.W. of Perth. The town consists of a single street about a mile in length. It was formerly a royal burgh, but is now disfranchised. Near it is an ancient castle, said to have been a hunting-seat of Malcolm Canmore. It was in connection with this parish that the ecclesiastical dispute arose which led to the Disruption in the Church of Scotland in 1843. Population of town in 1871, 2599.

AUOHTERMUCHTY, a royal burgh and parish of Scotland, county of Fife, 8 miles W.S.W. of Cupar. The town is irregularly built on an elevated site, and is divided by the Leverspool, a rapid streamlet which runs down its centre. The manufacture of linen is carried on. Population of burgh in 1871, 1082.

AUCKLAND, a province of New Zealand, consisting of the northern portion of North Island, and bounded for the most part on the S. by the 39th parallel of latitude. In the N.W. it runs out into a peninsula between 200 and 300 miles in length, with a very irregular coast-line, especially on the eastern side. The total area of the province is about 17,000,000 acres, of which nearly 11,275,000 are still in possession of the Maoris, who are, however, continually disposing of their claims to the Government. The surface of the province is of a very varied character, presenting wide and fertile plains, stretches of fern-heath and swamp, mountain ranges and isolated peaks, tracts of richly-wooded jungle, rocky plateaus, and districts of strange volcanic activity. All round the coast there are a large number of natural harbours, and the most of the interior is traversed by navigable streams. The principal river-system is that of the Waikato (or Rushing Water), which rises in the Taupo Lake, in the south of the province, forces its way through an extensive rocky table-land, flows on wards for about 35 miles through a rich but marshy basin, joins its waters with the Waipa (or Peaceful Water), its largest tributary, cuts a passage through the Taupiri range, and after traversing the fertile expanse of its lower basin, turns abruptly to the W. and falls into the sea about 35 miles S. of the city of Auckland. The value of the Waikato as a commercial highway is greatly lessened by its mouth being encumbered with sandbanks, that prevent the entrance of ships. To the E. of this river lies the valley of the Thames, fertile and well watered by several streams, and still further eastward extends the versant of the Bay of Plenty. The course of settlement has hitherto advanced for the most part along the valleys of the Waikato and the Thames,—Cambridge, about 104 miles S. of the city of Auckland, being the frontier station in the former, and Tapapa, a little further to the S. in the latter. Nearly the whole of the N.W. peninsula is occupied by a scattered population, and various flourishing townships are situated along the coast on all sides. In 1873 there were 3842 holdings in the province, and about 225,000 acres had been broken up. Hitherto the cultivation of the cereals has not proved sufficiently remunerative, though climate and soil are equally favourable, and the attention of the farmer has principally been turned to the rearing of the various descriptions of live stock, more especially sheep. The natural wealth of the province consists principally in its gold and timber. Coal has been found in several districts, and a few mines have been successfully worked, as Kawakawa (at the Bay of Islands), Drury, and Whangarei; but the most important deposits are comparatively undisturbed. It is believed that iron may eventually be found in considerable quantities, and various minerals have been pointed out in the interior by scientific travellers. The chief seats of the gold-diggings are the Coromandel peninsula and the Thames valley. The quantity exported in 1871 was valued at £1,888,708. The most important timber tree is the kauri-pine, which is peculiar to Auckland, and does not grow further south than 37° 30'. It is of magnificent dimensions, and valuable, not only as the most extensively used building material, but on account of the fossil gum which is found wherever the kauri forest has been. This gum forms one of the chief articles of export, about 14,277 tons being the amount in the three years 1870, 1871, and 1872. There are various other trees of considerable value, such as the rimu, the kahikatea, and the totara. The timber trade, both domestic and foreign, is increasing in importance, and shipbuilding is extensively carried on. There are large districts overgrown with the *phormium* or New Zealand flax, and the right to cut it on the waste lands is granted by the Government at a low price. In 1873 1497 tons

of the prepared fibre, valued at £27,783, were exported, besides a considerable quantity of manufactured rope. Those great necessities of commerce, roads and railways, are being constructed in various directions. A line is in course of formation from Auckland up the valley of the Waikato, as far as Newcastle, at the confluence of the Waipa, and a survey has been made for about 20 miles further. A road runs from Bowen, on the Bay of Plenty, across the country, through the wonderful lake district, with its boiling fountains, steam geysers, and mud-baths, round by the east coast of Taupo Lake, and over the highlands to Napier, in Hawke's Bay province. The history of Auckland was for long the history of New Zealand, and will be fully treated under that heading. (See *NEW ZEALAND*.)

For a descriptive account of a large part of the province, the reader is referred to Dr Hochstetter's valuable works, especially to his *New Zealand*, 1863. A very graphic sketch of some of the natural curiosities is furnished by Anthony Trollope in his *Australia and New Zealand*, vol. ii.

AUCKLAND, the capital of the above province, is finely situated on an isthmus in the N.W. peninsula, on the S. shore of the Waitemata harbour, which is formed by an inlet of the Hauraki Gulf. Lat. 36° 51' S., long. 174° 50'. On the other side of the isthmus lies the harbour and town of Manukau, which serves as a supplementary port to the city. Auckland was founded in 1840 by Governor Hobson, and became a burgh in 1851. It was till 1865 the seat of the Government, which is now situated at Wellington. The city has a fine appearance, especially from the harbour, and is surrounded by a number of flourishing suburban villages, with several of which it is connected by railway. Among the public buildings in the city and neighbourhood may be mentioned the governor's house, the cathedral, St John's Episcopal college, about 4 miles distant, the Auckland college and grammar school, the Episcopal grammar school, in the suburb of Parnell, the provincial hospital, the provincial lunatic asylum, and the orphanage at Parnell. A wharf, 1690 feet in length, has been built opposite the centre of the city, and affords excellent accommodation for the gradually increasing traffic of the harbour. In 1872, 170 non-colonial vessels, with a tonnage of 54,257 tons, entered the port, besides a large number of coasting ships. There are registered at Auckland 167 sailing vessels and 20 steamships, most of them of provincial build. The population, which was 7989 in 1862, had increased by 1871 to 12,937 (with the suburbs 18,000), and is now estimated at about 21,000.

AUCKLAND ISLANDS, a group discovered in 1806 by Captain Briscoe, of the English whaler "Ocean," about 180 miles S. of New Zealand, in lat. 50° 24', long. 166° 7' E. The islands, of volcanic origin, are very fertile, and are covered with forest. They were granted to the Messrs. (under) by the British Government as a whaling station, but the establishment was abandoned in 1852. (See *Raynal's Auckland Islands*, 1874.)

AUCKLAND, WILLIAM EDEN, BARON, an eminent diplomatist and politician, third son of Sir Robert Eden, Bart., of West Auckland, was born in 1744. He was educated at Eton and Oxford, and adopted the profession of the law. At the age of twenty-seven he resigned his practice at the bar, and engaged in political life as under-secretary to Lord Suffolk. By the favour of the duke of Marlborough, he obtained a seat for Woodstock, and soon gave proof of his ability in the House. He attached himself to Lord North's party, and after serving under Lord Carlisle on the unsuccessful commission to the colonists in America, acted as secretary to that nobleman, when he held the post of viceroy in Ireland. During this time he had obtained the offices of director and auditor of Greenwich Hospital, which

probably yielded him an income sufficient for carrying on his political career. In 1783 he took a leading part in negotiating the remarkable coalition between North and Fox, and was rewarded by being made vice-treasurer of Ireland. In 1784 he opposed Pitt's proposal for commercial reciprocity with Ireland, but in so doing contrived to separate himself to some extent from his own party, and shortly after accepted from Pitt the office of plenipotentiary at Paris. Here he successfully negotiated the important commercial treaty with France; and after his appointment as ambassador to Spain, he rendered valuable service in settling the dispute between the British and French Governments with regard to the affairs of Holland. In 1789 he was made an Irish peer, with the title of Baron Auckland, and in 1793 he was raised to the British peerage as Baron Auckland, of West Auckland, Durham. For three years, 1798-1801, he held office as postmaster-general. He died suddenly in 1814. In 1776 he married the sister of the first earl of Minto, by whom he had a large family. Besides numerous pamphlets on political matters of the day, Lord Auckland wrote a treatise on the *Principles of the Penal Law*, 1771. His political conduct has been frequently censured; he was a skilful diplomatist, and as a statesman was specially remarkable for his clear grasp of economic principles. His *Journal and Correspondence*, 4 vols. 1860-1862, published by his son, the bishop of Bath and Wells, throws considerable light on the political history of his time.

AUCKLAND, GEORGE EDEN, EARL OF, Governor-General of India, born 20th August 1784, was the second son of the subject of the preceding notice. He completed his education at Oxford, and was admitted to the bar in 1809. His elder brother was drowned in the Thames in the following year; and in 1814, on the death of his father, he took his seat in the House of Lords as Baron Auckland. He supported the Reform party steadily by his vote, and in 1830 was made president of the Board of Trade and master of the Mint. In 1834 he held office for a few months as first lord of the Admiralty, and in 1835 he was appointed Governor-General of India. He proved himself to be a painstaking and laborious legislator, and devoted himself specially to the improvement of native schools, and the expansion of the commercial industry of the nation committed to his care. These useful labours were interrupted in 1838 by the hostile movements of the Persians, which excited the fears not only of the Anglo-Indian Government but of the home authorities. Lord Auckland resolved to enter upon a war in Afghanistan, and on the 1st October 1838, published at Simla his famous manifesto. The early operations were crowned with success, and the Governor-General received the title of Earl of Auckland. But reverses followed quickly, and in the ensuing campaigns the British troops suffered the most severe disasters. Lord Auckland had the double mortification of seeing his policy a complete failure, and of being superseded before his errors could be rectified. In the autumn of 1841 he was succeeded in office by Lord Ellenborough, and returned to England in the following year. In 1846 he was made first lord of the Admiralty, which office he held until his death, 1st January 1849. He died unmarried, and the earldom became extinct.

AUCTION, a mode of selling property by offering it to the highest bidder in a public competition. By 3 Vict. c. 15, the uniform duty of £10 per annum is imposed on every licence to carry on the business of auctioneer, but duties on sales by auction are abolished. It is the duty of an auctioneer to sell for the best price he can obtain, and his authority cannot be delegated to another, unless by special permission of his employer. The auctioneer's name must be exhibited on some conspicuous place during the

sale, under a penalty of £20. Sales by auction usually take place under certain conditions, which it is the duty of the auctioneer to read to the bidders before the sale begins. To complete a sale by auction there must be a bidding by, or on behalf of, a person capable of making a contract, and an acceptance thereof by the auctioneer, and until the bidding is accepted both vendor and bidder are free, and may retract if they choose. If due notice is given, an agent may be employed to bid on behalf of the seller, but the employment of several bidders is improper, and if the sale is declared to be *without reserve*, any bidding on the behalf of the seller will vitiate the sale. *Puffing*, it has been said, is illegal, even if there be only one puffer. On the other hand, any hindrance to a free sale, either by a bidder deterring competitors from offering against him, or by an engagement among the competitors to refrain from bidding, in order to keep down the price of the goods and then share the profit, is a fraud upon the vendor. Two persons, however, may agree not to bid against each other. Auctioneers are entitled by their licence to act as appraisers also.

AUDÆUS, or AUDIUS, a reformer of the 4th century, by birth a Mesopotamian. He suffered much persecution from the Syrian clergy for his fearless censure of their irregular lives, and was expelled from the church. He was afterwards banished into Scythia, where he gained many followers and established the monastic system. He died there at an advanced age, about 370 A.D. The Audæans celebrated the feast of Easter on the same day as the Jewish Passover, and they were also charged with attributing to the Deity a human shape. They appear to have founded this opinion on Genesis i. 26.

AUDE, a southern department of France, forming part of the old province of Languedoc, bounded on the E. by the Mediterranean, N. by the departments of Hérault and Tarn, N.W. by Upper Garonne, W. by Ariège, and S. by that of Eastern Pyrenees. It lies between lat. 42° 40' and 34° 30' N., and is 80 miles in length from E. to W., and 60 miles in breadth from N. to S. Area, 2341 square miles. The department of Aude is traversed on its western boundary from S. to N. by a mountain range of medium height, which unites the Pyrenees with the Southern Cevennes; and its northern frontier is occupied by the Black Mountains, the most western part of the Cevennes chain. The Corbières, a branch of the Pyrenees, runs in a S.W. and N.E. direction along the southern district. The Aude, its principal river, has almost its entire course in the department. Its principal affluents on the left are the Fresquel, Orbiel, Argent-Double, and Cesse; on the right, the Guette, Salse, and Orbiel. The canal of Languedoc, which unites the Atlantic with the Mediterranean, traverses the department from E. to W. The lowness of the coast causes a series of large lagunes, the chief of which are those of Bages Sigean, Narbonne, Palme, and Leucate. The climate is variable, and often sudden in its alterations. The wind from the N.W., known as the *Cers*, blows with great violence, and the sea breeze is often laden with pestilential effluvia from the lagunes. Various kinds of wild animals, as the chamois, bear, wild boar, wolf, fox, and badger, inhabit the mountains and forests; game of all kinds is plentiful; and the coast and lagunes abound in fish. Mines of iron, copper, lead, manganese, cobalt, and antimony exist in the department; and, besides the beautiful marbles of Cascastel and Caunes, there are quarries of lithographic stone, gypsum, limestone, and slate. The coal mines are for the most part abandoned. The mountains contain many mineral springs, both cold and thermal. The agriculture of the department is in a very flourishing condition. The meadows are extensive and well watered, and are pastured by numerous flocks and herds. The grain

produce, consisting mainly of wheat, oats, rye, and Indian corn, considerably exceeds the consumption, and the vineyards yield an abundant supply of both white and red wines. Olives and almonds are also extensively cultivated, and the honey of Aude is much esteemed. Besides important manufactures of woollen and cotton cloths, combs, jet ornaments, and casks, there are paper-mills, distilleries, tanneries, and extensive iron and salt works. The chief town is Carcassonne, and the department is divided into the four arrondissements of Carcassonne, Limoux, Narbonne, and Castelnaudary. Population in 1872, 285,927.

AUDEBERT, JEAN BAPTISTE, a distinguished French naturalist and artist, was born at Rochefort in 1759. He studied painting and drawing at Paris, and gained considerable reputation as a miniature painter. In 1787 he was employed to make drawings of some objects in a natural history collection, and was also a contributor in the preparation of the plates for Olivier's *Histoire des Insectes*. He thus acquired a taste for the study of natural history, and devoted himself with great eagerness to the new pursuit. In 1800 appeared his first original work, *L'Histoire Naturelle des Singes, des Makis, et des Galéopitèques*, illustrated by 62 folio plates, drawn and engraved by himself. The colouring in these plates was unusually beautiful, and was laid on by a method devised by the author himself. Audébert died in 1800, but he had left complete materials for another great work, *Histoire des Colibris, des Oiseaux-Mouches, des Jacamares, et des Promerops*, which was published in 1802. 200 copies were printed in folio, 100 in large quarto, and 15 were printed with the whole text in letters of gold. Another work, left unfinished, was also published after the author's death, *L'Histoire des Grimpereaux, et des Oiseaux de Paradis*. The last two works also appeared together in two volumes with the title *Oiseaux dorés ou à reflets métalliques*, 1802.

AUDITOR, a person appointed to examine the accounts kept by the financial officers of the Crown, public corporations, or private persons, and to certify as to their accuracy. The multifarious statutes regulating the audit of public accounts have been superseded by the 29 and 30 Vict. c. 39, which gives power to the Queen to appoint a "comptroller and auditor-general" with the requisite staff to examine and verify the accounts prepared by the different departments of the public service. In examining accounts of the appropriation of the several supply grants, the comptroller and auditor-general "shall ascertain first whether the payments which the account department has charged to the grant are supported by vouchers or proofs of payments; and second, whether the money expended has been applied to the purpose or purposes for which such grant was intended to provide." The Treasury may also submit certain other accounts to the audit of the comptroller-general. All public moneys payable to the Exchequer are to be paid to the "account of Her Majesty's Exchequer" at the Bank of England, and daily returns of such payments must be forwarded to the comptroller. Quarterly accounts of the income and charge of the consolidated fund are to be prepared and transmitted to the comptroller, who, in case of any deficiency in the consolidated fund, may certify to the bank to make advances. The accounts of local boards, poor-law unions, &c., must be passed in a similar manner by an official auditor. It is the duty of the auditor to disallow all illegal payments, and surcharge them upon the person making or authorising them; but such disallowances may be removed by *certiorari* into the Court of Queen's Bench, or an appeal may be made to the local Government Board. In municipal corporations two burgesses must be chosen annually as auditors of the accounts.