hydrate of potassium, and of sulphuretted hydrogen on solution of bicarbonate of potassium. Equilibrium results when the pressures of the gases are in a certain ratio ; if the equilibrium is disturbed chemical action takes place in the direction which tends to restore the equilibrium by reproducing the ratio of pressures.

The apparatus devised by Deville for detecting and measuring dissociation illustrates his remarkable ingenuity. We shall instance only one example in addition to those already mentioned.

One of the great difficulties in observing dissociation depends on its reversible character. A compound may indeed decompose when raised to a high temperature ; but, if, as we cool it again, reunion occurs, it is not easy to prove that any chemical change took place, One of the ways in which Deville got over this difficulty was by the use of his “hot and cold tube.” Inside a porcelain tube he placed a metal tube of smaller diameter, so that their axes coincided, leaving an annular space between them. This annular space was closed at both ends, but, by means of side tubes near the ends, could be filled with any gas, or a current of gas could be passed through it. The porcelain tube was raised to a high temperature by being placed in a furnace, while the internal metal tube was kept cold by running water through it. By this means he proved the dissociation of carbonic acid gas, carbonic oxide, and sulphurous acid gas,—the carbon or sulphur being deposited on the outer wall of the cold internal tube, and thus kept at a temperature below that at which recombination could take place.

Deville’s observations on dissociation and his generalizations from them have a very direct bearing on the kinetic theory of gases, and it is a fact of interest in the history of science that Deville did not recognize the validity of that theory, Our estimate of the ingenuity, skill, and patience shown in his experimental work, and of the genius and sound judgment which directed his theoretical conclusions, is perhaps raised when we recollect that he was neither led in the first nor biassed in the second by ideas derived from the kinetic theory, and his hostile or at least neutral attitude towards it gives perhaps greater value to the evidence that his work has contributed to its soundness.

Deville’s works were published in the *Annales de Chimie et de Physique* and in the *Comptes Rendus.* He further published a volume, entitled *De l'Alumi­nium; ses Propriétés,* &c., Paris, 1859, and the lecture *On Dissociation* already referred to. (A. C. B.)

STE MARIE-AUX-MINES. See Markirch.

SAINTES, a town of France, the chef-lieu of an arron­dissement in the department of Charente-Inférieure, on the left bank of the Charente, 88 feet above the sea and 45 miles south-east of La Rochelle by the railway from Nantes to Bordeaux. It occupies a delightful position and is of interest for its Roman remains. Of these the best preserved is the triumphal arch of Germanicus, although it has been removed and rebuilt stone by stone. The amphitheatre is larger than those of Nîmes, Bordeaux, and Pompeii, and in area (.89 of an acre) is surpassed only by the Colosseum. The external ellipse was 436 feet long and 354 broad. Rubble embedded in cement is the material of the building, which dates probably from the close of the 1st or the beginning of the 2d century. Measures have been taken to keep the ruins, now made picturesque by trees, from further injury or decay. The capitol was destroyed after the capture of the town from the English by Charles of Alençon, brother of Philip of Valois, in 1330. An ancient hypogæum is still preserved, as well as numer­ous traces of the channels by which water was conveyed to private houses. The antiquarian museum contains 7000 medals and numerous sculptured pieces. Saintes was a bishop’s see till 1790; the cathedral of St Peter, rebuilt at the close of the 12th century, was almost destroyed by the Huguenots in 1568. As rebuilt between 1582 and 1585 the interior of the church has an unattractive appear­ance. The tower is 236 feet high. The church of St Eutropius (which was founded in the close of the 6th century, rebuilt in the 11th, and had its nave destroyed in the Wars of Religion) stands above a very interesting well- lighted crypt, the largest in France after that of Chartres, adorned with richly sculptured capitals and containing the tomb of St Eutropius (4th or 5th century). Notre Dame, a splendid example of the architecture of the 11th and 12th centuries, with a noble round clock-tower, is unfortu­nately occupied by the military authorities, who have divided and mutilated the interior. The town, which was

at one time at the head of the department, is still the seat of the courts of assize and has a court-house. Other public buildings are a town-house (Renaissance), a hospital, and a library. Small vessels ascend the river as far as Saintes, which has an advantageous situation between Angoulême and Cognac higher up and Taillebourg and Rochefort farther down, and is the seat of iron and copper foundries, factories for agricultural instruments, cooperages, and skin­dressing establishments. The population in 1881 was 13,341 (15,763 in the commune).

Saintes (Mediolanum or Mediolanium), the capital of the Santones, was a flourishing town before Cæsar’s conquest of Gaul. Christianity was introduced by St Eutropius, its first bishop, in the middle of the 3d century. Charlemagne rebuilt its cathedral. The Normans burned the town in 845 and 854. Richard Cœur de Lion fortified himself within its walls against his father Henry IL, who captured it after a destructive siege. It was not till the reign of Charles V. that Saintes was permanently recovered from the English. The Protestants did great damage during the Wars of Religion.

ST ÉTIENNE, an industrial and manufacturing town of France, chef-lieu of the department of Loire, 312 miles south-south-east of Paris and 36 miles south-south-west of Lyons by rail, with a branch line to Le Puy. The coal-field of St Étienne is the richest in France after that of Valenciennes and Pas de Calais, giving employment to 12,000 miners and 5000 workmen at the pit-heads. There are 64 concessions worked by 28 companies, extending over an area 20 miles long by 5 in width ; the mineral is of two kinds,—smelting coal (said to be the best in France) and gas coal ; the yearly output is between 3,000,000 and 4,000,000 tons, but with a tendency to decrease. In the metallurgic establishments of the arrondissement, which extend all the way along the railway from Firminy to Rive-de-Gier, 5540 workmen are employed, and in 1882 61,127 tons of cast metal, 58,445 tons of iron, 10,815 tons of sheet-iron, and 131,563 tons of steel of all kinds were manu­

factured. The last-

named industry,

carried on accord­

ing to the Besse­

mer and Martin

processes, yields

nearly a third of

the whole French

production of steel.

Military and naval

material, railway

plant, and articles

of general mer­

chandise are all

madeat St Étienne,

and its name is

especially associ­

ated with large

castings, bomb­

proof plates, ship-

armour, masts, and

pieces of machin­

ery. The national

gun-factory, under

the direction of artillery officers and employing 4300 workmen, is almost exclusively devoted to the produc­tion of rifles and revolvers for the army. A certain number of gun-makers not engaged in the factory turn out from 80,000 to 90,000 firearms (hunting-pieces, revolvers, &c.) per annum. Hardware is manufactured by 60 firms, employing 7000 workmen (who are not, how­ever, exclusively occupied with this department) ; leading articles are locks (known as Forez locks), common cutlery, files, nails, bolts, anvils, vices. Hemp cables for mines,