Inactive.

Air, &c., in which electrical discharge has ceased for about ten seconds.

Smoke without fire.
Bottled phosphorus fumes.
Ammonia.
Ozone.
Steam.
Alcohol vapour.
Formic acid vapour.
Sulphurous acid.

It seems that we have here a pretty little problem which might, perhaps, be solved without much difficulty by a competent chemist, but which quite baffles me.[1] Is it possible that the condensing vapours may contain dissociated atoms?

To return to the electrical effect. There are only two kinds of chemical change that I know of which could be brought about in air by an electrical discharge. Either some of the oxygen might be converted into ozone, or the oxygen and nitrogen of the air might be caused to combine, forming nitric acid or some such compound. The former of these would not account for the action of the air upon the jet, because, as we have seen, ozone is inoperative; the latter might. But if the activity of the air is due to the presence in it of a compound of oxygen and nitrogen, then it is clear that an electrical discharge in either nitrogen or oxygen separately would fail to render those gases active.

I arranged a spark bottle, inside which an induction-coil discharge could be made to take place; two bent tubes were passed through the cork, one reaching nearly to the bottom for the ingress of the gas to be tested, the other, a shorter one, for its egress. The open end of the egress tube was fixed near the steam jet, and first common air, then oxygen and then nitrogen were successively forced through the bottle while the coil discharge was going on. All produced dense condensation, but I thought that oxygen appeared to be a little more efficient than common air, and nitrogen a little less.

This last experiment points to a conclusion to which at present I see no alternative. It is that the action on the jet of an electrical discharge is due in some way or other to dissociated atoms of oxygen and nitrogen. There is nothing else left to which it *can* be due.

So far as Robert Holmholtz's explanation coincides with this conclusion, I think it must be accepted as correct. As to the precise manner in which he supposed the dissociated atoms to act upon the jet, it is more difficult to agree with him. He thought that the abnormal condensation was a consequence of the molecular shock caused by the violent recombination of the dissociated atoms in the supersaturated air of the jet, the action being analogous to that which occurs when a supersaturated solution of sulphate of soda, for example, is instantly crystallised by a mechanical shock.

To me this hypothesis, ingenious as it is, seems to be more fanciful than probable, but I can only hint very diffidently at an alternative one. To many chemical processes the presence of water is favourable or even essential. Is it possible that the recombination of free atoms may be assisted by water? And is it possible that dissociated atoms in an atmosphere of aqueous vapour may obtain the water needed for their union by condensing it from the vapour?

According to Holmholtz, flames and incandescent substances generally cause dissociation of the molecules of oxygen and nitrogen in the surrounding air. This, I believe, is generally admitted. I do not know whether slowly oxidising phosphorus has the same effect.

If it is conceded that the atmospheric gases are dissociated by electrical discharges, and that the presence of such dissociated gases somehow brings about the dense condensation of water vapour, we may still regard the electrified steam jet as affording an illustration of the abnormal darkness of thunder-clouds.

Perhaps another source of dissociated atoms is to be found in the ozone which is generated by lightning flashes. A molecule of ozone consists of three atoms of atomic oxygen, while one of ordinary oxygen contains only two. Ozone is an unstable kind of material, and gradually relapses into ordinary oxygen, the process being that one atom is dropped from the three-atom molecules of ozone, these detached atoms in course of time uniting with one another to form pairs. Thus two molecules of ozone are transformed into three of oxygen. A body of ozone is therefore always attended by a number of dissociated atoms which are looking for partners.

In the steam jet experiment there is not time for the disengagement of a sufficient number of isolated atoms from a blast of ozone to produce any sensible effect. But the case is otherwise when the vapour is confined in a closed vessel, as in Mascart's experiment, or when it occurs in the clouds, where the movement of air and vapour is comparatively slow.

Ozone, it will be remembered, was found by Mascart to produce dense condensation in a closed vessel even after being filtered through cotton wool. Similar filtration seems to entirely deprive the so-called products of combustion of their active property, a fact which has been adduced as affording overwhelming evidence in favour of the dust nucleus theory. Coulier himself, however, detected a weak point in this argument. He produced a flame which could not possibly have contained any products of combustion except steam, by burning pure filtered hydrogen in filtered air; yet this product was found to be perfectly capable of causing dense condensation, and, as in his former experiments, filtration through cotton wool deprived it of its activity.

These anomalies may, I think, be to a great extent cleared up if we assume that the effect of the cotton wool depends, not upon the mere mechanical obstruction it offers to the passage of particles of matter, but upon the moisture which it certainly contains, and which may act by attracting and facilitating the reunion of dissociated atoms before they reach the air inside the vessel. According to this view ozone would remain an active condenser in spite of its filtration, because free atoms would continue to be given off by it after it had passed the cotton wool. The filtration experiment should be tried with perfectly dry cotton wool, which, however, will not be easily procured, and if my suggestion is right, dry wool will be found not to deprive ordinary products of combustion of their condensing power.

To sum up. I think my recent experiments show conclusively that the dense condensation of the steam jet is not due directly either to electrical action or to dust nuclei. The immediate cause is probably to be found in dissociated atoms of atmospheric gases, though as to how these act we can only form a vague guess.

SHELFORD BIDWELL.

[1] Two chemists of the highest eminence have been good enough to consider the problem for me, but they are unable to throw any light upon it.

SCIENTIFIC SERIALS.

American Journal of Science, December.—An apparent time-break between the eocene and Chattahoochee miocene in south-western Georgia, by Raphael Pumpelly. The Red Clay Hill region, a plateau extending through the south-western part of Georgia and adjacent northern Florida, has a maximum altitude of 300 feet, is sharply limited on the north by a declivity facing the eocene flat-land country, and consists of miocence deposits resting on eocene, both of which dip about 13 feet per mile to the south. The base of the plateau is formed by the white calcareous beds of the Chattahoochee group. A time-break between the latter and the eocene is evidenced by the almost general presence of a limestone conglomerate at the base of the Chattahoochee, immediately overlying eocene fossils, and the irregularity of the surface of demarcation. It seems possible that during miocene time the present plateau of southern Georgia was outlined by submerged islands of the eocene limestone. The Gulf Stream, after the creation of the central American barrier, found its way back to the Atlantic sweeping over southern Georgia and northern Florida, and supplying the food needed to build up the great organic beds of the Chattahoochee and Chipola. The lower flat-land country of central Georgia may represent the contemporaneous course of the cold current carrying less pure water and less nutriment.—The rise of the mammalia in North America, by H. F. Osborn. This second part deals with ancient and modern placental differentiation, the succession of the perissodactyls and the artiodactyls, a discussion of the factors of evolution, and a diagram illustrating the supposed descent of the mammalia from their jurassic prototypes.—On the thoracic legs of Triarthrus, by C. E. Beecher. Some very perfect specimens of *Triarthrus Becki*, Green, in which nearly the entire calcareous and chitinous portions are represented by a thin film of iron pyrites, show, besides the antennæ already noticed, a complete series of thor-

©1893 Nature Publishing Group

acic legs becoming shorter towards the pygridium, but without any essential differences amongst each other. Each limb consists of two nearly equal members, one of which was evidently used for crawling, and the other for swimming. These two members and their joints may be correlated with certain typical forms of Crustacean legs among the *Schizopoda*, *Cumacea*, and *Decapoda*, and may be described in the same terms.—On the diamond in the Cañon Diablo meteoric iron and on the hardness of carborundum, by George F. Kunz and Oliver W. Huntingdon. The carborundum made by Mr. Acheson, of Pittsburg, is capable of scratching most varieties of corundum, but not the diamond.

SOCIETIES AND ACADEMIES.

LONDON.

Anthropological Institute, December 12.—Prof. A. Macalister, F.R.S., President, in the chair.—Mr. Cuthbert E. Peek exhibited some specimens of fishing-line made of human hair, some needles constructed from ribs of feather, and two message-sticks from the extreme north of Queensland.—Mr. W. L. Duckworth read a paper on the collection of skulls of Aboriginal Australians in the Cambridge University Museum, and the following papers were also read:—On an unusual form of rush basket from the northern territory of South Australia, by Mr. R. Etheridge, jun.—On a modification of the Australian Aboriginal weapon, termed the leonile, langeel, bendi or buccan, by Mr. R. Etheridge, jun.—An Australian Aboriginal musical instrument, by Mr. R. Etheridge, jun.—The Aborigines of North-West Australia, by Mr. P. W. Bassett-Smith.—Rites and customs of Australian Aborigines, by Mr. H. B. Purcell.—Japanese onomatopes and the origin of language, by Mr. W. G. Aston.

Mathematical Society, December 14.—A. B. Kempe, F.R.S., President, in the chair.—On the stability of a deformed elastic wire, by A. B. Basset, F.R.S.—This paper commences with a discussion of the different methods of determining the stability of a deformed elastic wire which is in equilibrium, and then proceeds to discuss two special problems. When a naturally straight wire is deformed into a helix having m convolutions, the helical form is unstable unless its pitch is greater than $\sec^{-1} 2m$. This result shows that it is impossible to deform the wire into a helix of *small* pitch and having a great many convolutions, such as the spring of an ordinary spring-balance, unless the wire is given a permanent set. The two special cases in which the terminal stresses consist, (1) of a thrust and a flexural couple, (2) of a couple alone, are also noticed; and in the latter case the helix is unstable when the length of the wire exceeds half a convolution. When the natural form of the wire is a circular coil, which is unrolled and the ends joined together without twist, so that the wire forms a circular ring, the ring will be unstable when the length of the wire is greater than about one and a half convolutions. The ring is stable from displacements in its plane, and consequently will not collapse like a boiler flue; but it is unstable for displacements perpendicular to its plane, which involve torsion as well as flexion. The stable figure will consequently consist of a closed tortuous curve.—Papers were also read by R. J. Dallas, on the linear automorphic transformations of certain quantics; and by Dr. Hobson, F.R.S., on Bessel's functions and relations connecting them with spherical and hyperspherical harmonics.—Messrs. Love, Greenhill, Macmahon, and the President spoke on the subject of the communications.—The following papers were taken as read:—A theorem of Liouville's, by Prof. G. B. Mathews; note on non-Euclidian geometry, by H. F. Baker; note on an identity in elliptic functions, by Prof. L. J. Rogers; and note on a variable seven-points circle analogous to the Brocard circle of a plane triangle, by J. Griffiths.

Royal Meteorological Society, December 20.—Dr. C. Theodore Williams, President, in the chair.—Mr. C. Harding gave an account of the great storm of November 16 to 20, 1893. This storm was the most violent of recent years, and, so far as anemometrical records are concerned, the wind attained a greater velocity than has previously been recorded in the British Islands. The velocity of the wind was 96 miles in the hour from 8.30 to 9.30 p.m. on November 16 in the Orkneys, where the hurricane burst with such suddenness that it is described as like the shot of a gun, and the wind afterwards attained the very high rate of 90 miles and upwards, in the hour, for 5 consecutive hours. At Holyhead the storm was terrific; the anemometer recorded a wind velocity of 89 miles in the hour, and it was 80 miles or above for 11 hours, while the force of a whole gale, 65 miles an hour and upwards, was maintained for 31 hours, and for 4½ days the mean hourly velocity was 54 miles. Many of the gusts were at the rate of 115 miles an hour, and at Fleetwood a squall occurred with the wind at the rate of 120 miles in the hour. The storm was felt over the entire area of the United Kingdom, and the wreck returns show that disasters occurred with almost equal frequency on all coasts. Four weeks after the storm the official records gave the total loss of life on our coasts as 335, while there were 140 vessels which had been abandoned, or had foundered, stranded, or met with other severe casualty, involving either loss of life, or saving of life by some extraneous assistance. There were 600 lives saved on our coasts by aid of the Lifeboat Institution and other means. The author has tracked the storm from the neighbourhood of the Bahamas on November 7, acress the Atlantic and over the British Islands to Central Europe on November 20.—The other papers read were on rainfull and evaporation observations at the Bombay Waterworks, by Mr. S. Tomlinson; and on changes in the character of certain months, by Mr. A. E. Watson.

DUBLIN.

Royal Dublin Society, November 22.—Prof. W. N. Hartley, F.R.S., in the chair.—Prof. T. Johnson communicated a paper on the systematic position of the Bangiaceæ. The author, with Berthold and others, regards the group as true Florideæ, and discusses in his paper the views expressed by Schmitz, in a recent number of *La Nuova Notarisia*, against their Floridean nature—Mr. Thomas Preston gave an elementary explanation of the system of waves attending a bullet moving at a high speed through the atmosphere.—Mr. W. E. Adeney read a note on the present condition of the water in the Vartry reservoir at Roundwood, co. Wicklow, and Mr. Richard J. Moss gave the results of an examination of the Vartry water as at present supplied to Dublin.

PARIS.

Academy of Sciences, Annual Public Meeting, December 18.—M. de Lacaze-Duthiers in the chair.—After some commemorative words on the deaths of Sir Richard Owen, Kummer, and de Candolle, Foreign Associates, and those of Chambrelent, Admiral Pâris and Charcot, Members of the Academy, by the President, M. Bertrand, one of the Secretaries, announced the names of those to whom prizes had been awarded. In *Geometry*, the Prix Francœur was awarded to M. G. Robin for mathematical physics, and the Prix Poncelet to M. G. Kœnigs, for geometrical and mechanical work.—*Mechanics:* The extraordinary prize of 6000 francs offered by the Département de la Marine for contrivances increasing the efficiency of the Navy, was distributed among M. Bourdelles (for lighthouse illumination), M. Lephay (compass with luminous index), and M. de Fraysseix (system of optical pointing); the Prix Montyon of 700 francs to M. Flamant (hydraulics), the Prix Plumey of 2500 francs to M. Lebasteur (steam engine appliances); the Prix Fourneyron of 500 francs, to M. Brousset (fly-wheels).—*Astronomy:* The Prix Lalande of 540 francs, to M. Schulhof (Comets); the Prix Valz of 460 francs, to N. Berberich (Minor Planets). The Prix Janssen of a gold medal, to Mr. Samuel Langley (Astronomical Physics).—*Physics:* The Prix La Caze of 10,000 fr., to M. E. H. Amagat (gases and liquids).—*Statistics:* The Prix Montyon of 500 fr., to Dr. Marvand (diseases of soldiers).—*Chemistry:* The Prix Jecker of 10,000 fr., to M. D. Forcrand and M. Griner in equal parts, with a special prize to M. Gautier.—The Prix La Caze of 10,000 fr., to M. Lemoine (Phosphorus Compounds).—*Mineralogie and Geology:* The Grand Prix, to M. Marcellin Boule (The Central Plateau of France). The Prix Bordin of 3000 fr. was distributed amongst MM. Bourgeois, Gorgen, Michel, and Duboin for their researches in mineral synthesis. The Prix Delesse of 1400 fr., to M. Fayol (Commentry Strata). The Prix Fontannes of 2000 fr., to M. R. Zeiller (Palæontology).—*Botany:* The Prix Desmazières of 1600 fr., to M. C. Sauvageau (Algæ). The Prix Montagne, to MM. Cardot (Mosses) and Gaillard (Fungi).—*Agriculture:* The Prix

©1893 Nature Publishing Group