pressed for taste and smell by Haycraft (*Proc.* Roy. Soc. Edin., 1883–1887).

But we now know gaseous bodies ranging over the whole domain of molecular weights appropriated by odorous and sapid substances, owing to Ramsay's well-known work on He, Ne, A, Kr and X, and to the discovery of SO_2F_2 and SF_6 by Moissan (*Comptes rendus*, cxxx. 1900, 865 and cxxxii. 1901, 374). These last two gases are of special importance because their want of taste and odour cannot be due to the fact that we have become inured to them. The molecular weights of these bodies are respectively 4, 20, 40, 81, 127, 102 and 146, with which may be compared vanillin, with a molecular weight of 152.

It was long ago pointed out by Liebig (see Klimont, "Die Synthetischen und Isolirten Aromatica," 1899) and by Graham (see Bain, *loc. cit.*) that odorous bodies are, as a rule, readily oxidised, and the notion of the chemical origin of the senses in question is much strengthened by the fact that all the new gases above mentioned are very inert. SO_2F_2, although soluble in ten parts of water, can only be decomposed by oxygen by sparking, and SF_6 is extraordinarily stable. It is recorded also by Graham that if an odoriferous principle is sniffed up in a current of CO_2 instead of air, the odour is much weakened.

There is another curious fact which might be accounted for by a chemical hypothesis. It has often been noticed that on purifying odorous or sapid substances, these properties tend to become less marked or to disappear. Thus acetylene, ammonia and acetamide have been described as odourless when pure, and it is said that ordinary sugar becomes less sweet the more it is purified. But it has been found in all carefully studied cases that stability increases very markedly with purity, and therefore on a chemical theory taste and smell would become correspondingly less.

In conclusion must be noted Prof. Ayrton's important contribution to this subject (Presid. Address to Section A. British Association, 1898), in which he definitely proves that the well-known metallic odours are not caused by the metals themselves (which are non-volatile), but by unstable decomposition products, probably unsaturated hydrocarbons.

Such a chemical explanation would not, of course, upset the vibration theory of Ramsay, but would merely mean that instead of these senses being directly stimulated by the ordinary vibrations of the molecules, they are only affected by agitations accompanying chemical change.

F. SOUTHERDEN.

Technical College, Finsbury, London, E.C., March 21.

Electricity and Matter.

IN view of the suggestive close of Sir Oliver Lodge's paper as given in NATURE of March 12, these more than century-old speculations of S. T. Coleridge may be found interesting.

E. H.

> "But properties are God: the naked mass
> (If mass there be, fantastic guess or ghost)
> Acts only by its inactivity.
> Here we pause humbly. Others boldlier think
> That as one body seems the aggregate
> Of atoms numberless, each organized;
> So by a strange and dim similitude
> Infinite myriads of self-conscious minds
> Are one all-conscious Spirit, which informs
> With absolute ubiquity of thought
> (His one eternal self-affirming act!)
> All his involved Monads, that yet seem
> With various province and apt agency
> Each to pursue its own self-centring end.

(From "The Destiny of Nations—A Vision," Juvenile Poems, S. T. Coleridge.)

Papaw-Trees and Mosquitoes.

Re Prof. Percy Groom's letter in NATURE (January 22, p. 271), I may mention that in Ceylon the papaw-tree gives no immunity against mosquitoes. In my garden here we usually take our afternoon tea under the shade of an old and much-branched example of the common papaw (*Carica papaia*), but far from being protected from mosquito bites in that situation, we are always terribly molested by the small striped mosquito (*Stegomyia scutellaris*). The stem of this tree is also haunted by various spiders and flies. I have not sufficiently studied the tree during the sunny part of the day to say whether flies settle on the leaves or not, but I propose to pay attention to this question shortly.

E. ERNEST GREEN.

Royal Botanic Gardens, Peradeniya, Ceylon, February 26.

A Remarkable Meteor.

WITH reference to the meteor a letter of mine concerning which you printed in your last issue (p. 464), I have received some details from Mr. G. S. Russell, of West Norwood, who saw it from the neighbourhood of the Crystal Palace. From the facts that he saw it E.N.E. (as I did) and saw the "wobbling" close to earth, it is seen that the meteor must have been a great distance off, probably falling a considerable distance out in the North Sea. He is convinced that it reached the earth's surface. Its great distance off would account for its apparently very slow movement. Owing to the steadiness of both its brilliancy and velocity it was probably of great size.

J. E. C. LIDDLE.

Fairfields, Basingstoke, Hants, March 23.

THE MOVEMENT OF AIR STUDIED BY CHRONOPHOTOGRAPHY.

THE investigation of stream lines has occupied the minds of several powerful workers, and great results have been obtained by the late W. Froude and Prof. O. Reynolds, and recently Prof. Hele Shaw has added some striking illustrations of the paths of the flow of liquids. Borda, in an almost forgotten, but remarkable paper (*Memoires de l'Académie Royal*, 1766), writes thus (when describing the conditions under which water flows by an opposing object):—"On imagine ensuit que les molécules du fluid, en s'approchant du corps, decrivent des lignes courbes, ou plutôt se meuvent dans les *petits canaux courbes.*" Borda goes on to show that theoretically the stream lines should flow round and again join in the rear of the object.

Thus the idea of stream lines and their behaviour was regarded as a matter of interest at an early date.

In a recent paper, in the *Bulletin des Séances de la Société Français de Physique*, 1902, M. Marey has added fresh information respecting the form of stream-lines, and by his new experimental methods he shows how air behaves as it flows by different shaped objects. In the first place he draws attention to his experiments on the movements of liquids in which he employed a stream of water, holding in suspension shining pearls of the same density as water; these were brightly illuminated by sunlight, a dark background being placed behind them; by means of a chronophotographic apparatus, a series of pictures of the illuminated parts was taken, their appearance in the picture being that of dotted lines. The direction and speed of the current which carried them along was by this means found.

When obstacles of different shapes were placed in the current the stream lines of the liquid were seen to bend in different ways and to form eddies. For example, in the case of water impinging against an inclined plane, the streams of liquid divide at a point, which appears to be the centre of pressure. In each case eddies form in the rear of the obstacle. The speed of the fluid, at any moment, could be recognised on the photograms by the degree of separation of the shining pearls, for photographed as they were, at equal times, they covered different distances in these equal intervals of time. A divided scale gave the lengths of these distances covered, while the rate of taking the successive pictures (ten per second) gave the speed of the current in its various positions.

By means of a method similar to this the direction and speed of the streams which form in a current of air were studied, and the changes which they underwent when they encountered obstacles.

The apparatus for investigating these movements in air was of simple character; it consisted of a chimney of prismatic form (side 0·50 m., height 0·75 m.). The front side was made of clear glass, and the posterior wall was covered with black velvet; the left wall was white and the right one was glazed.

In front of the apparatus a lantern was placed within which a magnesium flash could be fired. A draught was maintained through the chamber by an electric fan. The flow of air was rendered steady by being filtered through silk gauze of fine mesh, placed at the top and at the bottom of the prismatic chamber. By a beautiful method M. Marey rendered the direction of currents of air visible; he introduced minute streams of smoke, which were drawn in with the aspirated air, and remained parallel to each other during their passage through the chamber when not opposed by any obstacle. The smoke was obtained from the combustion of tinder and cotton in a closed furnace; from this furnace the smoke was conducted to a series of narrow tubes parallel to one another.

When an obstacle was placed within the chamber the stream lines were seen to bend against the obstacle and divide into two currents, one of which flowed up the slope of the inclined plane, the other down it (Fig. 1). The division appeared to take place at a point which corresponded with the centre of pressure against the inclined plane. This point of separation was found to be at the middle point of the plane when the plane was horizontal, and to approach its upper end

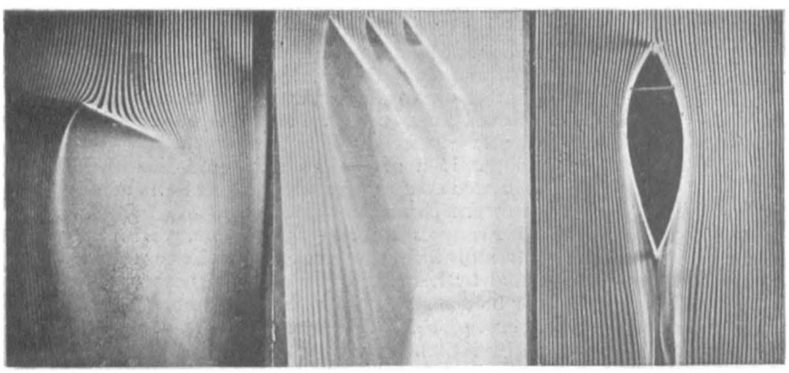

FIG. 1. FIG. 2. FIG. 3.

the more the plane was inclined. Behind the obstacle eddies were seen to form.

M. Marey found the velocity of the air streams, thus. By means of an electric vibrator he imparted vibrations to the smoke jet tubes, having a period of ten per second. The smoke streams then became sinusoidal in shape, the inflections being maintained during the whole length traversed by the smoke. The series of lateral inflections was measured by means of a divided scale placed in the same plane as the streams of smoke.

These inflections remained equidistant when the speed of the current remained constant, but when the speed was reduced the inflections were closer together, and farther apart when the speed of the streams was increased. M. Marey employed the magnesium flash to obtain his photograph; probably sharper pictures would have been obtained by using the electric spark from a charged Leyden jar as an illuminant.[1] M. Marey mentions that an important question to be answered in the science of aërial flight is, How do air currents behave when passing through adjacent parallel planes inclined at an angle to the stream? Fig. 2 answers the question clearly. The picture will suggest much to those engaged in the designing of kites of the *box* type, where the air strikes against more than one plane.

The conditions of stream line flow round different aquatic animals have received considerable attention, and we know that a blunt head and a pointed tail is a favourable arrangement. By immersing solid bodies having one end obtuse and the other pointed, it is observable that there is a great advantage in presenting the large end to the direction of motion; this minimises the motion of the air behind the body. The same phenomenon is to be seen in air. Fig. 3 shows that, with the large end facing the stream, the disturbance in the rear of the object is slight, only small eddies being set up. M. Marey's methods are applicable to an almost endless variety of similar experiments on the stream lines of air round differently shaped bodies. M. Marey's paper is short and condensed, but it contains matter of much importance, and is another example of the beautiful results obtained by this master of experimental methods in chronography.

F. J. J.-S.

[1] Spark photography of objects in rapid movement (smoke jets and smoke rings photographed in collision).—Junior Scientific Club, Oxford; NATURE, vol. xlvii. p. 119.

THE VENTILATION OF THE TUBES.

IN October, 1901, the London County Council determined to investigate the condition of the atmosphere in the tube of the Central London Railway, in order to ascertain how far the threatened multiplication of underground tubes might affect the public health. As the result of this, the chemist to the County Council, in conjunction with Dr. Andrewes, made a chemical and bacteriological examination of the condition of the atmosphere in the tunnels, stations, carriages, and lifts of the Central London Railway, as compared with the outside air under ordinary conditions. As might have been expected, it was shown by the experiments that the fluctuations in the amount of carbon dioxide and organic matter present in the tube were very great.

Examination in the early morning showed that the ventilation employed had produced a very fair condition of air, whilst during the hours of traffic the carbon dioxide rose to considerably higher limits than existed in the outer atmosphere. The County Council chemist considers that samples of air taken at any point on the railway should not contain more than double the amount which is found in the air of the streets, inasmuch as the additional carbon dioxide found in the air of the tunnels has been entirely produced by respiration, and is therefore accompanied by organic matter.

This report was submitted to the Council on February 17, but its reception was postponed, as it is clearly one of those cases in which extreme caution should be used in arriving at conclusions, and introducing rules and regulations which might hamper important developments in the relief of our over-congested traffic.

The normal quantity of carbon dioxide present in the air is a little under four volumes in ten thousand, and the sanitary limit, which is universally adopted for the atmosphere in our dwelling-houses, is six parts in ten thousand in rooms which are to be inhabited for any