that the balance of assimilation and nutrition, upon the proper maintenance of which the health of the whole organism immediately depends, hinges upon the integrity of such obscure structures; and it is the maintenance of this balance which constitutes health, its disturbance, disease. Nor, on the other hand, dare we, as the investigation of the attraction-particle has shown, afford to disregard the most minute detail of structure of the body.

> "All is concenter'd in a life intense,
> Where not a beam, nor air, nor leaf is lost,
> But hath a part of being."

PHYSICS AT THE BRITISH ASSOCIATION.

AFTER the President's address on Thursday morning, Lord Kelvin opened the proceedings in Section A with an account of some preliminary experiments made by himself and Mr. Maclean on the electrification of air by the subtraction of water from it. The subject is one in which Lord Kelvin has been for many years interested, and he commenced experimenting on it as far back as 1868. The nature of the results now obtained was illustrated by his insisting that the proper title of the paper was "Preliminary experiments *to find if* subtraction of water from air electrifies it" (and not as in the *Journal*—"Experiments *proving* the electrification of air"). In the present investigation a large U-tube was used. One branch of this was filled with pumice-stone soaked in sulphuric acid; the other was simply varnished inside and out. By means of a platinum wire touching the pumice, connection was made with a quadrant electrometer. A metal cylinder screened the tube from external influence. Air from an ordinary blow-pipe bellows was blown through the tube steadily for an hour; and the electrometer showed an electrification rising gradually to about nine volts positive. This shows that the passage of the air through the tube gave positive electricity to the acid, and therefore sent away the dried air electrified negatively. No such effect was observed when the pumice was moistened with water instead of sulphuric acid. The experiments are to be repeated with precautions to prevent any bubbling of the air through liquid in the tube; for it was observed that the strong positive electrification of the tube (when acid or calcium chloride was used) seemed to commence suddenly as soon as a gurgling sound, due to bubbling through free liquid, began to be heard. The authors have reversed the conditions, and have first dried air by passing it over sulphuric pumice, and then passed it through a tube containing moistened pumice. The tube became negatively electrified, but this may have been due to the negative electrification of the dry entering air. This experiment is to be repeated with dried and dis-electrified air. Lord Kelvin also described certain preliminary experiments made by himself and Mr. Galt with the object of comparing the discharge of a Leyden jar through different branches of a divided channel. The metallic part of the discharge channel was divided between two wires of conducting metal, each consisting in part of a test-wire. Each of the two test-wires consisted of 51 cm. of platinum wire of 0·006 cm. diameter and 12 ohms resistance stretched in a glass tube. One end was fixed to a solid brass mounting, and the other was attached to a fine spring carrying a light arm for multiplying the motion. The testing effect was the heat developed in the test-wire by the discharge, as shown by the elongation, the amount of which was measured by a tracing on sooted paper carried by a drum. The wires to be tested were generally of the same length. When they were of the same material but of different diameters, the testing elongation showed, as might be expected, that the test-wire in the branch containing the thicker wire was more heated than the other. With wires of various non-magnetic materials, of the same resistances but different lengths and diameters, the testing elongations were very nearly equal. In one experiment two equal copper wires were used, but one of them was coiled into a helix; the testing elongation in this branch was less than half of that in the straight branch. Lastly an iron wire was compared with a platinoid wire of equal resistance but greater diameter. The heating effect in the platinoid branch was nearly one-and-a-half times as great as in the iron branch. This is interesting in relation to Lodge's experiments on alternative paths, which were not decisive in showing any general superiority of copper over iron of the same steady ohmic resistance, but even showed a seeming superiority of the iron for efficiency in the discharge of a Leyden jar.

Prof. Oliver Lodge followed with a communication on "photo-electric leakage." It is known that a negative charge on an electrified surface escapes much more rapidly when the surface is illuminated with ultra-violet light (Hallwach's experiment). Prof. Lodge has investigated the rate of discharge for a number of substances under positive as well as negative electrification, and in hydrogen as well as air. He finds that when the inside of an electrified pewter-pot is illuminated, it does not leak; but when the edge is illuminated, it leaks rapidly. Thus the leakage appears to be a matter of surface-tension, and not of potential. In the discussion which followed, Prof. S. P. Thompson stated that he had verified the statement made by Elster and Geitl, that when the light is polarised the effect depends upon the plane of polarisation, the leakage being most rapid when the Fresnellian vibrations are in such a direction as to "chop into" the surface. He has found an analogous difference in the action on selenium cells.

Mr. G. H. Bryan presented the second part of his report on the present state of knowledge in thermodynamics. In a lengthy and valuable paper he discusses the limitations to the law of distribution of energy in the kinetic theory. He deals primarily with the so called Boltzmann-Maxwell law of distribution of energy among the molecules of a gas, which law forms the basis of the kinetic theory of gases. One of the main points kept in view has been to show, as far as possible, where to draw the line between dynamical systems which do, and dynamical systems which do not satisfy the law in question. A great advance in the subject is due to the extension of the use of generalised co-ordinates, by which greater generality has been given to results, and the analysis has been much simplified, as a comparison of Boltzmann's early papers with modern writings abundantly testifies. A further simplification has been effected by the extensive use of the Jacobian notation in this report. The report is divided into three sections. In Section I. the law is regarded in the aspect of a general dynamical theorem without reference to any particular applications, and without taking into account the effect of collisions. Section II. treats of its application to a system of bodies colliding with one another indiscriminately, and partaking of the nature of gas molecules. Section III. deals briefly with certain researches relating to the connection between the Boltzmann-Maxwell law and the Theory of Probability, the Virial Equation, and the Second Law of Thermodynamics. With regard to non-colliding systems (Section I.), it may be asserted that a large portion of our progress has been made in, firstly, showing that Maxwell's demonstrations are faulty and unsatisfactory, and by subsequently discovering fresh methods of proof, which, while leading to the same general conclusions, show more clearly the limitations and conditions under which these conclusions hold good. Test cases of Maxwell's law are given, and also an account of Mr. Culverwell's criticism of the "decisive" test case by which Lord Kelvin claims to have effectually disposed of the law. It is urged that uniformity of nomenclature is most desirable in this as in other branches of science, and hence that some definite understanding should be agreed on as to what precisely constitutes the Boltzmann-Maxwell law. The following statements are recommended:—(1) That the distribution of a large number of molecules or other dynamical systems of the same or different kinds in which the coordinates (q) and momenta (p) of each system are so arranged that the number of systems in the neighbourhood of any given state is proportional to

$$e^{-hE}dp_1 \ldots\ldots dp_n dq_1 \ldots\ldots dq_n,$$

h being the same for all the kinds of molecules or systems, be called the Boltzmann-Maxwell distribution. (2) That the law which asserts the permanence of the Boltzmann-Maxwell distribution in any particular case be called the Boltzmann-Maxwell law. (3) That in future these names be not applied to any corollaries such as that which asserts the equality of the average value of the squares into which the kinetic energy can be split up. That corollary may be called Maxwell's law of partition of kinetic energy.

The proof of the Boltzmann-Maxwell law, and the assumptions involved in it, may now be regarded as fully satisfactory for gases whose molecules collide with one another to a certain extent at random, but in a medium in which the molecules can never escape from one another's influence the subject still presents very grave difficulties.

On Friday the Section held a joint meeting with Section G, at the headquarters of the latter in Keble Hall. The first subject of importance was a discussion on integrators, harmonic analysers and integraphs, and their application to physical and engineering problems. A number of these were exhibited, both models and working instruments, some of the latter being beautiful specimens of Swiss workmanship. For the discussion an hour and a half had been allowed: of this the opener, Prof. Henrici, occupied the greater part, but did so to the entire satisfaction of his audience. The subject had been discussed at previous meetings by Sir Frederick Bramwell at Brighton, and by the late Mr. Merrifield at Swansea; Prof. Hele Shaw had also read a paper on the subject before the Institute of Civil Engineers. The first planimeter was invented by a Bavarian engineer named Hermann. It was lost sight of, but was subsequently reinvented in 1825 and 1826, and from it our present planimeters are derived. Amsler invented his instrument in 1854, and first published an account of it in 1856. Planimeters may be classified in two ways. As Prof. Hele Shaw subsequently remarked, it is natural for an engineer to classify instruments with reference to their mechanical action, and thus planimeters may be divided into two classes, according as the wheel does or does not slip. Prof. Henrici prefers a classification depending upon the geometrical properties involved in the action of the instrument. A planimeter measures the area swept out by a line. The length of the line may either be fixed or variable. Again, a line in a plane may either move or turn. To obtain general areas we have a choice of two combinations (for only special areas could be traced, *e.g.* by a line moving parallel to itself). The first class of planimeters depends upon the motion of a line which can both turn and move parallel to itself, but which remains of fixed length. The line takes the form of a rod of fixed length, one end of which is jointed to another rod so as to move on a circle about a fixed point (the pole), while the other end is provided with a tracing-point to be moved around the figure whose area is to be evaluated. These planimeters can only be used to integrate around closed curves. It does not matter where the wheel is placed along the rod, but its axis must be parallel to the axis of the rod. This introduces one of the most serious difficulties with which the maker has to contend. In Amsler's planimeter the rod can only be used on one side, so that the error is always in the same direction; but an improved form was exhibited in which the rod can be used on both sides, so that this error is eliminated. Then there is the slipping error. Maxwell drew attention to this, and was the first to propose an instrument in which there was no slipping at all. There are a number of planimeters in which the wheel, instead of rolling on the paper, rolls on a prepared surface. There is always some resistance to the motion of the wheel and counters, and this increases the slipping. The error can be reduced to a minimum by diminishing as far as possible (1) the friction between the paper and the wheel (as by using a prepared surface); (2) the resistance to the motion of the wheel. In using the instrument we should also avoid getting the instrument in such a position that the wheel has to move much at right angles to its own plane, for then the friction and slipping error is greatest. Amsler, in his first paper (1856), foreshadowed many improvements which have since been carried out; and in his second paper (he only published two), he described a planimeter depending upon the action of a cylinder rolling on a sphere, in which there was no slipping. Maxwell suggested two forms of instrument in which slipping was altogether avoided; but they were never made. The second class of planimeters depends upon the motion of a line of variable length which moves without turning. They give the value of definite integrals between any fixed limits, and may be called integraphs. Instruments of this type have been devised by Lord Kelvin, Abdank-Abakanowitz, Vernon Boys, and Conradi. To engineers it is more important to be able to integrate a curve than an expression; and an integraph can give the integral of a curve as a curve. Lord Kelvin and Boys have shown how instruments may be made to integrate a differential equation. The idea of a harmonic analyser was given by Amsler in his first paper as early as 1856, but Lord Kelvin first actually constructed one. It has been of great service in analysing tidal motion; but it is bulky, and cannot be carried about. Prof. Henrici has devised two others, one of which will give five terms in the expansion according to Fourier's theorem of any curve. These analysers should prove of great use to engineers and electricians, *e.g.* in investigating the action of valve-gear and the behaviour of dynamos. In the discussion which followed, Prof. Hele Shaw drew attention to the Hatchet planimeter as a most simple and efficient workshop instrument. Prof. Boys explained why it was so much more difficult to construct an instrument for differentiating than for integrating. An automatic differentiator appeared at present to be an impossibility. A person can differentiate with a machine; but a machine cannot of itself well differentiate. It is of the very nature of an integraph to smooth over the irregularities of a curve; whereas a differentiator would exaggerate all the irregularities of a curve.

Mr. Arnulph Mallock followed with a note on the behaviour of a rotating cylinder in a steady current. Lord Kelvin was in his best British Association form when discussing the resistance experienced by solids moving through fluids. As the time approached for Mr. Hiram S. Maxim's paper on flight, the audience grew to dimensions most easily explained by supposing that an experimental demonstration in Keble Hall was expected.

After Friday, on account of the large number of papers, the Section had to split up into two or three departments sitting simultaneously (and continuously, without any luncheon interval). Only the more important physical papers can be noticed here. On Saturday, Prof. Osborne Reynolds described and illustrated experimentally the successive stages in the motion of water passing under gradually increasing pressure through a vertical tube constricted in the middle. At first the water leaves the constriction in the form of a narrow, steady jet. As the pressure increases it fills the lower part of the tube, and eddies appear below the constriction; but the motion is still steady. The third stage is that of turbulent motion. Finally, there is an appearance as of air-bubbles at the constriction, accompanied by a singing or hissing sound; the water is now boiling under diminished pressure. Prof. S. P. Langley gave an account of his recent researches on the infra-red spectrum to an audience most unwilling to allow him to stop, and rather impatient at the manner in which his lantern slides were exhibited. The President (Prof. Rücker) and Prof. Norman Lockyer heartily congratulated Prof. Langley on the magnificent success of his work, which will be fully described in a subsequent number of NATURE. Dr. E. Pringsheim followed with an account of his new determination of the ratio of the specific heats of certain gases.

The first paper on Monday was one by Dr. A. Schmidt, on a new analytical representation of terrestrial magnetism. Prof. Schuster followed with two papers: in one of these he examined a suggested explanation of the secular variation of terrestrial magnetism, and in the other he discussed the minimum current which could be observed in a galvanometer of given dimensions wound in various ways. Lord Rayleigh followed with three papers.

In the first of these he described experiments made by him to determine the minimum current audible in the telephone. The estimates previously put forward vary widely: Preece gives 6×10^{-13} ampere; Tait, 2×10^{-12}, and De la Rue 1×10^{-3} ampere. Ferraris is the only experimenter who has given satisfactory details of his experimental methods; he found that the current diminished when the frequency increased, and that a minimum current of 5×10^{-9} ampere was required at a frequency of 594. His experiments were made with a make-and-break apparatus, which would give higher harmonics in addition to the stated frequencies. In Lord Rayleigh's experiments electromotive forces of the harmonic type were produced by the revolution of a magnet in the neighbourhood of an inductor coil of known construction. The revolving magnet consisted of 2·5 cm. of clock-spring driven, windmill fashion, by air from an organ bellows. The magnetic moment of the magnet was deduced from observations with a magnetometer. The inductor coil was the one which had been used as the "suspended coil" in the determination of the electro-chemical equivalent of silver, and it was placed with its centre vertically below that of the magnet. From the known data the induced electromotive forces were calculated. The current was carried to a distant part of the house through leads, and was varied by introducing a resistance-box going up to 10,000 ohms; the adjustment of the sound could thus be made by the observer at the telephone. Theory shows that the minimum current required in a telephone should be inversely as the square root of the resistance. Two telephones of the Bell unipolar type were used: the data given below refer to one which had a resistance of 70 ohms. When the magnet was driven at full speed the frequency was 307, and the minimum current observed was $3 \cdot 6 \times 10^{-7}$ amperes. In order to extend the determinations to higher frequencies, recourse was had to magnetised tuning-forks vibrating with known amplitudes. With a frequency of 512 the minimum current was $7 \cdot 0 \times 10^{-8}$, and with a frequency of 640 it was $4 \cdot 4 \times 10^{-9}$ amperes. Lord Rayleigh's second paper was on the quantitative theory of the telephone. About this so little is known that even an attempt to determine the order of magnitude of the physical quantities involved is of great value. The method adopted is to consider first the case of an infinitely long thin rod of iron, divided by a transverse gap, and encompassed by an infinite coaxial magnetising coil. He finds the force exerted across the gap by a periodic current, and then replaces one-half of the infinite rod by the plate of the telephone, and reduces the coil to the actual dimensions used in practice. The force in dynes exerted at the centre of the telephone plate is calculated to be equal to $1 \cdot 7 \times 10^{6}$ C., where C is the current in amperes. By actual experiment the force was found to be equal to $0 \cdot 6$ C. Experiment also showed that the displacement of the plate produced by a current C was C $\times$ 0·08 cm. The amplitude of the motion produced depends largely upon the relation between the frequency of the impressed vibration and those natural to the plate. For the telephone in question, assuming the plate to be clamped all round the edge, the frequency of the gravest symmetrical mode is calculated to be about 991. On making the plate speak on its own account, the frequency found was 896. As it is almost impossible to estimate the amplitude when the frequency of the force is near any of the free frequencies, the vibration number 256 is taken for calculation. At this pitch the minimum recorded current is $8 \cdot 3 \times 10^{-7}$ amperes; and the amplitude corresponding to this is $6 \cdot 8 \times 10^{-8}$ cm. Assuming the telephone to be applied closely to the ear, so as to include 20 c.c. of air, it is shown that the condensation (in atmospheres) produced is $1 \cdot 4 \times 10^{-3}$. For higher frequencies than 512 the actual sensitiveness, in virtue of resonance, is greater than the value calculated by the above method.

Prof. J. A. Ewing exhibited an apparatus for measuring small strains. The measurement of Young's modulus for considerable lengths of wires, as carried out in physical laboratories, is an easy matter; but engineers have to investigate the behaviour of short bars, and require an instrument which should be convenient and expeditious in use. In the instrument described these ends are achieved without any sacrifice of accuracy. There is only a slight mechanical magnification of the extension, but by means of a microscope forming part of the instrument, readings are made to 1/100,000th of an inch, and the readings are calibrated by a simple device which forms part of the instrument. If the arms have the same coefficient of expansion as the material of bar, there is automatic compensation for change of temperature. Difference readings were given for the extensions produced in a half-inch steel bar by twelve successive loads increasing each time by half a ton: these only varied between 10·4 and 10·7. The instrument is attached to the bar under examination in such a way as to measure strictly the *axial* elongation. It is well adapted for the investigation of small strains in parts of structures (*e.g.* members of railway bridges).

Mr. F. G. Baily made an important and interesting communication on hysteresis in iron and steel in a rotating magnetic field. It has long been known that, up to the limits of experiment, the value of hysteresis in an alternating magnetic field increases continuously. But it is a deduction from Prof. Ewing's molecular theory of magnetism that in a rotating magnetic field the hysteresis should diminish at a high induction, or at least show a reduction in the rate of increase. The following experiment substantiates this deduction in a very complete manner:—An electromagnet is rotated on bearings concentric with the bore of its own pole-pieces, which were bored out cylindrically. In the polar cavity a finely-laminated armature is suspended between centres, and held by a spiral spring attached to the axle and to a fixed support. Movement of the armature is indicated by a beam of light reflected from a mirror on it. On rotating the magnet, the armature tends to rotate with it by reason of hysteresis. The motion is checked by the spring, and the consequent deflection is proportional to the instantaneous value of the hysteresis per revolution. The curve of hysteresis and induction obtained commences like that in an alternating field, rising very slowly at first, then more rapidly, but finally reaching a maximum and bending over. The fall is very rapid so far as the experiments have been tried, shows no sign of becoming asymptotic, but runs straight towards the zero line. Soft iron and hard steel give the same results, the differences between them corresponding to their differences in the B/H curve. The three states of molecular arrangement, which are the essential point of the molecular theory, are exactly reproduced in the hysteresis curve. This first stage of quasi-elastic movement gives a very small hysteresis value. The second stage of irregular molecular groups and magnetic combinations gives a value approximately proportional to the induction at a steep inclination; this extends to the knee of the B/H curve. The third stage of approaching saturation gives a rapidly diminishing hysteresis when the molecular magnets are ranged in regular order along lines of force, and new combinations and irregular movements are prevented. Since the non-appearance of a correspondence between the B/H curve and the hysteresis curve in alternating fields has been urged as an argument against the molecular theory of magnetism, this complete accord and verification of the deduction previously made is important as giving powerful support to Prof. Ewing's theory.

Prof. S. P. Thompson briefly explained how he had verified the magnetic analogues of well-known propositions respecting optical images in plane mirrors. The experiments were made by placing a magnetic pole in front of a sheet of iron, and investigating the field by an exploring coil connected to a ballistic galvanometer. Prof. A. M. Mayer showed how beats and beat-tones could be produced by two vibrating bodies whose frequencies of vibration are so great as to surpass the limit of audibility. He has also employed the transverse vibration of bars at various temperatures to determine the variation of the modulus of elasticity with change of temperature.

On Tuesday morning there was a joint meeting with Section I, to discuss theories of vision. Prof. Oliver Lodge showed experiments to illustrate Maxwell's theory of light. Electromagnetic waves produced by a small vibrator were allowed to fall upon a detector placed inside a large copper "hat." The detector consisted of a glass tube containing iron borings forming part of a circuit with a galvanometer. On account of its mode of action, this detector is called by Prof. Lodge a "coherer." Under the action of the waves its resistance diminishes and the galvanometer current increases. The coherer was used to demonstrate the reflection, refraction, and polarisation of electromagnetic waves. The audience, which filled every part of the large museum lecture-room, repeatedly showed its warm appreciation of Prof. Lodge's beautiful experiments. His electrical theory of vision may be briefly described as a suggestion that light-waves do not directly produce the sensation of vision, but that their action (like that of the electromagnetic waves in these experiments) is a kind of "trigger" action.

In the subsequent Section-meeting, Principal Viriamu Jones gave the results of further determinations of resistance in absolute measure by the Lorenz method. The apparatus had previously been used to determine the absolute resistance of mercury, and has now (with modifications ensuring still greater accuracy) been employed to measure certain coils whose resistance in terms of the Cambridge Standards is known. He also exhibited a new form of standard coil of low resistance.

In the absence of Prof. J. J. Thomson, his paper on the velocity of the cathode rays was read by Prof. Fitzgerald. The phosphorescence shown by glass in the neighbourhood of the cathode was ascribed by Crookes to the impact of charged molecules driven off from the negative electrode. The remarkably interesting experiments of Hertz and Lenard, which show that thin films of metal interposed between the cathode and the walls of the tube do not entirely stop the phosphorescence, have led some physicists to doubt whether Crookes' explanation is the true one, and to regard the phosphorescence as being due to a kind of ultra-violet light. The view to which Lenard has been led by his experiments—that the cathode rays are ethereal waves—demands the most careful consideration; for if it is admitted, it follows that the ether must have a structure either in time or space. A magnet produces no effect upon ultra-violet light unless this is passing through a refracting substance. Now these cathode rays are deflected by a magnet, so that on the above view it must follow that in the ether in a magnetic field there must either be some length with which the wave-length of the cathode rays is comparable, or else some time comparable with the period of vibration of these rays. Prof.

Thomson first proved by experiment that a magnet acts on the cathode rays through the whole of their course, and does not merely affect the place on the cathode at which they have their origin. He then proceeded to investigate the velocity with which the cathode rays travel, for it seemed that a knowledge of this velocity would enable us to discriminate between two views as to their nature. If they are ethereal waves, we should expect them to have a velocity comparable with that of light; if they are caused by molecular streams, their velocity should be that of the molecules, which we should expect to be very much smaller than that of light. The value found for the velocity of the cathode rays was $1 \cdot 9 \times 10^7$ cm./sec., which is small compared with the velocity of the main discharge from the + to the − electrode. It is much greater than the velocity of mean square of the molecules; it agrees very nearly with the velocity which a negatively electrified atom of hydrogen would acquire under the influence of the potential fall which occurs at the cathode.

On Wednesday, M. Cornu exhibited some brilliant optical experiments illustrating Babinet's principle. Prof. W. Förster described the displacements of the rotational axis of the earth. His results had been deduced by investigating the results of 6000 determinations of latitude in various parts of the globe. The maximum amplitude amounts to nearly half a second, which corresponds to a motion of the pole amounting to 40 or 50 feet. It appears that we are now approaching a period of minimum amplitude.

CHEMISTRY AT THE BRITISH ASSOCIATION.

THE meeting of Section B at Oxford will be remembered as one of quite exceptional interest. That portion of the President's address urging upon the University fuller recognition of the claims of science in their curriculum will doubtless have valuable results. Certain of the communications brought forward in the course of the meeting may be described as epoch-making. The presence of a large number of eminent foreign chemists served further to render the proceedings memorable and attractive.

The Committee for preparing an International Standard for the Analysis of Iron and Steel reported that their work was now completed, and that it is proposed to shortly deposit the standards with the Board of Trade, or with some other suitable authority where they will be at the public service.

Prof. Clowes gave an account of his experiments on the proportions of carbonic acid in air which are extinctive to flame, and which are irrespirable. He finds that the flames of candles, oil, paraffin and alcohol are extinguished by air containing from 13 to 16 per cent. of carbonic acid. The flame of coal-gas, however, required the presence of at least 33 per cent. of the extinctive gas, and the flame of hydrogen was not extinguished until the amount of carbonic acid in the air reached 58 per cent. Comparing his experiments with those of Mr. J. R. Wilson on the percentage of carbonic acid required to suffocate a rabbit, Prof. Clowes concludes that air, containing at least 10 per cent. of carbonic acid more than is required to extinguish a candle flame, can be breathed with impunity. By taking advatage of the extraordinary vitality of the hydrogen flame in presence of high proportions of carbonic acid, it is possible to maintain the flame of the composite safety-lamp (previously described by the author), after the oil flame has been extinguished.

Mr. Haldane concluded from some experiments he has made on the respirability of air containing carbonic acid, that the percentage of this gas, considered by Prof. Clowes to be respirable, is too high.

Much interest was shown in the successful experiments of Dr. Lobry de Bruyn, demonstrating the properties of free hydroxylamine. On heating a small amount in a test-tube, a sharp explosion took place. Left exposed to air, it was shown by its action on iodised starch-paper to have become converted into nitrous acid. In a series of test tubes its behaviour with various reagents was demonstrated. With potassium permanganate, and with chromic acid oxidation took place, accompanied by flame; potassium bichromate produced an explosion. The anhydrous sulphates of copper and cobalt were reduced by the substance. Free hydroxylamine was dissolved in anhydrous ether, and sodium added, hydrogen was evolved and the very explosive sodium compound of hydroxylamine produced. Chlorine and iodine were shown to act spontaneously on hydroxylamine, producing inflammation. It is of interest that hydroxylamine will dissolve many salts which are soluble in water, the order of solubility differing in the two solvents.

Dr. Bernthstein described a new bacterium which occurs in milk, whose chief property is that of peptonising the caseine, thus forming a soluble compound, and rendering the milk transparent, and more readily digested.

On Friday a discussion took place on the behaviour of gases with regard to their electrification, and the influence of moisture on their combination. It was opened by Prof. J. J. Thomson, who exhibited some brilliant experiments illustrating the connection between chemical change and electrical discharge through gases. The gases were confined, under a pressure of about 100 mm. in glass bulbs which were placed in the centre of a coil of wire connecting the exterior of two Leyden jars, the interior coatings of which were connected with the two poles of a Wimshurst machine. As each spark passes between the poles of the machine, a rapidly alternating current is set up in the coil, and hence by induction in the gas. In the case of oxygen it was found that the moist gas gives a vivid incandescence, followed by an afterglow or phosphorescence, on removing the bulb from the coil. With the dry gas, on the other hand, incandescence does not take place. The incandescence, can however, be started in the dry gas by a brush discharge, and if once started continues under the influence of the induced current. With air the phenomenon is reversed; damp air does not glow, dry air will. By making use of two coils in one of which was a beaker of fairly strong sulphuric acid, and in the other a bulb containing moist oxygen, the presence of the acid was shown to prevent the incandescence in the bulb, showing the conductivity of the gas to be much greater than that of the acid. As the glow is only given in gases forming polymeric modifications, it is suggested by Prof. Thomson that the drops of water present may act as conductors causing the original molecules to dissociate. In the case of dry gases this preliminary dissociation can only be brought about by expenditure of a large amount of energy. Alcohol vapour will behave similarly to water, and it becomes of interest to study other solvents.

Mr. Brereton Baker followed with some experiments on the influence of moisture on chemical substances. He showed that ammonia and hydrochloric acid when dry do not combine. He also exhibited tubes containing dry sulphur trioxide and cupric oxide, and dry sulphur trioxide and lime, side by side without action upon one another, a kind of "chemical happy family," as he expressed it. He concludes that the function of moisture is physical rather than chemical from the fact that on heating together a dry mixture of cupric oxide, carbon and oxygen, no action takes place. He has obtained analogous results to Prof. Thomson, by using semi-vacuous tubes, into one end of each of which a platinum wire is fused and which contain a small quantity of mercury. On shaking these tubes in a dark room incandescence takes place in those containing moist oxygen. This is less if nitrogen is present, and ceases if the gas is dry. It was resolved in committee that Prof. Thomson's and Mr. Baker's papers should be published in full.

Dr. Ewan read a paper on the rate of oxidation of phosphorus, sulphur and aldehyde, a portion of which has already appeared in NATURE. The results obtained with aldehyde are free from the uncertainty produced by the correction for the changing rate of evaporation. When proper precautions are taken this reaction goes perfectly regularly at 20°, and its velocity is proportional to the product of the pressure of the aldehyde and the square root of the pressure of the oxygen. These results are most simply explained by assuming (in accordance with Williamson's theory), that the oxygen first splits up to some small extent into atoms, and that these alone take part in the oxidation.

In the discussion which followed the reading of these papers, Prof. Schuster spoke of the difficulty experienced in passing a discharge through mercury vapour.

Prof. Pringsheim noted the importance of ascertaining the relation between the spectrum given by the discharge, and that of the after-glow in the gas.

Mr. Vernon Harcourt remarked that Mr. Baker's results show that the part played by water in these reactions is probably unique, and is not shared by many, if any, other substances.

With reference to the dissociation of molecules, Mr. Baker