known to me. It is this varied and widely diffused effort which has rendered possible the realisation of the practical results which I have the gratification to record, and all the members of this Society must equally join in the common satisfaction in the measure of success which has been achieved.

Six years back, when the subject was discussed in this hall, there were probably not a few who viewed the propositions then submitted as merely fanciful theories. Others, who did not refuse to recognise their bearing, entertained the feeling that many grave difficulties presented themselves to interfere with any successful attempt to reform or modify usages so ancient as the computation of time. But the Institute, as a body, was hopeful. The action taken by the Council to extend the field of discussion and awaken the attention of foreign communities, evinced confidence, and we may now ask, was this confidence justified? What are the facts to-day? Twelve months have passed since an important change in the notation of railway time was made with general approval throughout the length and breadth of North America; a revolution in the usages of 60,000,000 of people has been silently effected and with scarcely a trace that it has happened. That proceeding has been followed by events of equal importance. On October 1 last a body of accredited delegates from the different nations, on the invitation of the President of the United States, met in Conference to consider the problem first submitted to the world by this Institute. The delegates were the representatives of 25 civilised nations. The Conference continued during the whole month of October, and, as a body, they came to conclusions affecting all peoples living under our theories of civilisation.

It was early understood that a determination with respect to Universal Time was not possible without the general recognition of a Prime Meridian. Hence the importance attached to its choice, that it should be universally accepted.

SOCIETIES AND ACADEMIES

London

Royal Society, December 10, 1885.—Abstract of a Paper on "Preliminary Results of a Comparison of Certain Simultaneous Fluctuations of the Declination at Kew and at Stonyhurst during 1883-84, as recorded by the Magnetographs." By the Rev. S. J. Perry, F.R.S., and Prof. B. Stewart, F.R.S.

The authors remark that such fluctuations almost always occur as couplets or groups of couplets; a couplet meaning first an ascent and then a descent, or the reverse. In their opinion this duality and the other facts of their paper can best be explained by supposing that a recorded magnetic fluctuation is the joint result of two causes: the one of these being a true magnetic change, and the other a secondary current caused by this change. The secondary current would probably appear as an earth-current. Its maximum strength would depend on the maximum rate of magnetic change, but as this last element is quite unknown, we may perhaps suppose that this maximum strength will be practically proportional to the mean rate of magnetic change.

On this supposition the authors suggest the following formula as capable of being used as a preliminary working hypothesis.

Let K denote the observed Kew change, and k the true magnetic change at Kew, also let t represent the duration; then $K = k\left(1 \mp \frac{\alpha}{t}\right)$ where α is a constant. Also if S represent the observed simultaneous Stonyhurst change, then $S = k\left(\beta \mp \frac{\gamma}{t}\right)$, the sign − being applicable to the first limb, and the sign + to the second limb of the couplet.

It follows from this that $\frac{S}{K} = \frac{\beta \mp \frac{\gamma}{t}}{1 \mp \frac{\alpha}{t}}$, or, in other words, that the ratio between the Kew and Stonyhurst observed disturbances will be a function of the duration, quite apart from all theoretical considerations, which can only in the meantime be regarded as pointing out a method of treatment. The authors then practically discuss their results, and have obtained the following preliminary conclusions:—

(1) S is always greater than K, or the ratio $\frac{S}{K}$ is always greater than unity.

(2) This ratio appears to depend in some way on the duration of the disturbance;

(3) But not, as far as can be seen at present, upon its magnitude.

Finally, they hope to make a more extended investigation of the subject, going over a greater number of years, and perhaps adding to their methods of treatment.

"On the Limited Hydration of Ammonium Carbamate." By H. J. H. Fenton.

The hydration of ammonium carbamate affords an example of a chemical action of the simplest type, namely, the direct union of two simpler molecules to form one more complex—

$$CO(NH_2)(ONH_4) + OH_2 = CO(ONH_4)_2.$$

There are but few actions of this type which can be investigated when all the substances concerned are in the liquid state, and all extraneous matter absent.

In a former paper it was shown that ammonium carbamate, when acted upon by sodium *hypochlorite* in presence of sodium hydroxide, yields one half of its nitrogen in the free state, the other half remaining in the form of sodium carbamate—

$$2CO(NH_2)(ONH_4) + 3NaClO + 2NaOH = 2CO(NH_2)(ONa) + 3NaCl + 5OH_2 + N_2.$$

Sodium *hypobromite* at once decomposes sodium carbamate, yielding the nitrogen in the free state. This, in fact, is claimed as a specific reaction for carbamates, since no other substance yet investigated will yield free nitrogen by action of a hypobromite *after* the completed action of a hypochlorite.

Based upon this reaction, then, we have a direct and simple method of determining the amount of carbamate existing in a solution at any given time.

Experiments were conducted with a view of examining the influences of time, mass, and temperature upon the hydration of ammonium carbamate, and also the reverse action, namely, the dehydration of normal ammonium carbonate into ammonium carbamate. The hydration is expressed by the ratio—

$$\frac{\text{molecules of water assimilated}}{\text{molecules of carbamate taken}}.$$

(1) *Influence of Time.*—Solutions of ammonium carbamate of different strengths were examined at stated intervals. In all cases the action proceeds rapidly at first, becomes progressively slower, and finally reaches a limit short of complete hydration.

The time required to reach a determinate state of hydration is less as the relative number of water-molecules is greater.

(2) *Influence of Mass.*—The hydration is shown to be a function of the number of water-molecules present. As far as the action could be legitimately studied, the minimum hydration corresponded to the case in which the substances are present in equal molecular proportions.

(3) *Influence of Temperature.*—The hydration is in all cases less, as the temperature is lower. Probably at a sufficiently low temperature the hydration would be practically *nil* when the substances are present in equal molecular proportions—*i.e.* ammonium carbamate and water would practically not combine at all.

(4) *Dehydration of Normal Ammonium Carbonate.*—It was shown that this salt undergoes dehydration in solution, becoming in part converted into carbamate. The dehydration is greater, as the relative number of water-molecules is less. It seems not unlikely that if the same relative number of molecules could be started with, the same equilibrium state between carbamate, carbonate, and water, would be arrived at for the same temperature, whether ammonium carbamate or normal ammonium carbonate were initially taken.

Since there is a tendency for normal ammonium carbonate to become in part dehydrated in aqueous solution, and for the system to come to a state of equilibrium where the carbamate and carbonate co-exist, it seems probable that the hydrolysis of urea under the action of ferments may be less simple than is usually represented. The author proposes to attack the problem by a method based on the actions of sodium hypochlorite and hypobromite, by means of which it is possible to detect, and quantitatively estimate, urea, carbamic acid, and ammonia, when all present in the same solution. A preliminary trial of the method gave satisfactory results.

Geological Society, December 16, 1885.—W. Carruthers, Vice-President, in the chair.—Charles John Alford, Samuel Blows, James Warne Chenhall, William Farnworth, Paget

Henry Cater Fulcher, and Harold Temple Wills, were elected Fellows of the Society.—The following communications were read:—Old sea-beaches at Teignmouth, Devon, by G. Wareing Ormerod, F.G.S. The author stated that while old records show that no important changes have taken place in the level of the Teignmouth district during the historical period, the excavations made in recent drainage-operations in the present year showed the existence of at least two series of beaches. The oldest sea-beach, which is a few feet above the present sea-level, was partly washed away and then covered up by later deposits exhibiting evidence, in a number of delicate bivalve shells in an unbroken condition, of having been deposited in a calm sea.—On the gabbros, dolerites, and basalts of Tertiary age in Scotland and Ireland, by Prof. John W. Judd, F.R.S. In previous papers published in 1874 and 1876, it has been demonstrated by the author that there exist in Scotland and in Hungary igneous rock-masses presenting the most perfectly crystalline characters, and belonging to the Tertiary period. It was further shown that such highly crystalline, plutonic rocks are seen passing insensibly into volcanic rocks of the same chemical composition—gabbros into basalts, diorites and quartz-diorites into andesites, and quartz-andesites and granites into rhyolites—the lavas in turn graduating into the perfectly vitreous types known as tachylites and obsidians. The present paper deals with the basic rocks of Western Scotland and Northern Ireland, which are shown to exhibit the most marked analogies with rocks of the same age in the Faroe Isles and Iceland; these facts lend strong support to the doctrine of the existence of petrographical provinces. The Tertiary age of the Scotch and Irish rocks is placed beyond dispute by the fact that they overlie unconformably the youngest members of the Cretaceous system, and are interbedded with stratified deposits of Lower Tertiary age. With regard to the nomenclature of these rocks, the identification of the more crystalline forms with the gabbros, which was made by Zirkel and Von Lasaulx, is supported; while the use of the term "dolerite" as a convenient one for the connecting links between the gabbros and basalts is advocated. Of the original minerals contained in these rocks, plagioclase felspar (ranging in composition from anorthite to labradorite), augite, olivine, and magnetite, are regarded as the e sential ones; while enstatite, biotite, chromite, picotite, and titanoferrite are among the most frequently occurring accessories. It is shown, however, that these original minerals may belong to different periods of consolidation. The Secondary minerals are very numerous, including quartz, epidote, zoisite, hornblende, serpentine, and zeolites, with many other crystallised and uncrystallised substances. There are remarkable variations in the relative *proportions* of the original minerals in different examples of the rock; and by the complete disappearance of one or other of the constituents, the gabbros are sometimes found passing into picrites, eucrites, or troctolites. In their microscopic structure these rocks present many interesting features. From the highly crystalline gabbros there are two lines of descent to the vitreous tachylites: one through the *ophitic* dolerites and basalts, and the magma-basalts wtth skeleton-crystals; and the other through the *granulitic* dolerites and basalts, and the magma-basalts with granular microliths. The former are shown to result from the cooling down of molten masses which were in a state of perfect internal equilibrium, while the latter were formed when the mass was subject to movement and internal strain. It is shown that in the most deeply-seated of these rocks (gabbros) the whole of the iron-oxides combines with silica; but, as we approach the surface, the quantity of these oxides separating as magnetite increases, until it attains its maximum in the tachylites. In all the varieties the order of separation of the different minerals is shown not to depend solely on chemical causes, but to be influenced by the conditions under which the rocks have cooled down. Although these rocks are not highly-altered one, yet they afford admirable opportunities of studying the incipient changes in their constituent minerals. The nature of these changes is discussed, and they are referred to the following causes:—(1) The corrosive action of the surrounding magma on the crystals; (2) the changes produced by solvents acting under pressure in the deep-seated masses (these have been already described under the name of "schillerisation"); (3) the action of heated water and gas escaping at the surface; (4) the action of atmospheric agents on the rocks when exposed by denudation; and (5) the changes induced by pressure during the great movements to which rock-masses are subjected.

Physical Society, December 12, 1885.—Prof. Guthrie, President, in the chair.—Mr. C. F. Casella and Prof. T. E. Thorpe were elected Members of the Society.—The following papers were read:—On a magneto-electric phenomenon, by Mr. G. H. Wyatt. The author had conducted a series of experiments with a view of testing experimentally an expression obtained by Mr. Boys for the throw of a copper disk suspended by a torsion-fibre between the poles of an electro-magnet, when the current was made or broken, and communicated by him to the Society on June 28, 1884. Disks of various metals and of various dimensions were used, the results being such as to agree with the theory within narrow limits. It was, however, found that when the throw of the disk was used to measure the magnetic field, the value obtained from the throw at break was uniformly greater than that obtained on making the current. Prof. S. P. Thompson observed that the case presented was analogous to that of the ballistic galvanometer, and that for the theory it was necessary that the magnetic field should be made and destroyed before the disk had moved sensibly. Mr. Boys believed that the results of the experiments showed this to be the case, since the result of such a movement would be to increase the throw on breaking the current when the disk made an angle of less than 45° with the lines of force, and to decrease it when the angle was between 45° and 90°, whereas no such variation from the theoretical result was observed.—On some thermodynamical relations, by Prof. William Ramsay and Dr. Sydney Young. In this paper experimental proof is given of the following relations:—(1) The amount of heat required to produce unit increase of volume in the passage from the liquid to the gaseous state, at the boiling-point under normal pressure, is approximately constant for all bodies. (2) If these amounts of heat be compared at different pressures, for any two bodies, then the ratio of the amount at the boiling-point under a pressure, p_1, to the amount at another pressure, p_2, is approximately constant. (3) The products of the absolute temperature into the rate of increase of pressure with rise of temperature are approximately the same for all stable substances. (4) The rate of increase of this product with rise of pressure is nearly the same for all stable substances. (5) A relation exists between the absolute temperatures of all bodies, solid or liquid, stable or dissociable, which may be expressed in the case of any two bodies by the equation

$$\frac{T_A}{T_B} = \frac{T'_A}{T'_B} + c(T'_A - T_A),$$

T_A and T_B being the absolute temperatures of the two bodies corresponding to any vapour-pressure; T'_A and T'_B, absolute temperatures at any other pressure; and c, a constant which may be zero or a small positive or negative quantity. (6) The variations from constancy of the expression $t\frac{dp}{dt}$, though mall, may be expres ed by a similar equation. (7) If L_A, L_A', L_B, and L_B', represent similar relations of latent heat at different pressures, the same for A and B, it appears probable that

$$\frac{L_A}{L_A'} = \frac{L_B}{L_B'} + c(T'_A - T_A).$$

(8) The ratio of the heats of vapori ation of any two bodies at the same pressure is approximately the same as that of their absolute temperatures at that pressure. The authors conjecture that this statement is also true of dissociating bodies. A large part of the experimental work consisted in obtaining the relation between vapour-pressure and temperature of different substances, values of $\frac{dp}{dt}$ had been obtained from these observations in two ways, by plotting curves with t and p as co-ordinates and drawing tangents, and by the method of differences. Prof. Perry suggested that the curve should be expressed in such a form as

$$\log p = \alpha - \frac{\beta}{t} - \frac{\gamma}{t^2},$$

which Rankine has shown to be a very true expression for the relation between pressure and temperature, and that $\frac{dp}{dt}$ should be obtained from this by differentiation. Prof. Guthrie hoped the authors would experiment upon the vapour-tensions of mixed liquids, a subject to which he had himself given some attention.

EDINBURGH

Royal Society, December 21, 1885.—Prof. Douglas Maclagan, Vice-President, in the chair.—Mr. J. Y. Buchanan, communicated a paper on the temperature of Loch Lomond and also one on oceanic islands and shoals.—Prof. Herdman discussed elaborately the phytogeny of *Tunicata*.—Mr. John Aitken gave a communication on dew, which will be found in full at p. 256.—Mr. Frank E. Beddard read a paper on the structure of *Lumbricus complanatus*, Dugès.—In a paper on the salinity of the water about the mouth of the Spey, Messrs. H. R. Mill and T. Morton Ritchie show that the sea-water slowly forces its way like a wedge between the river-water and the bottom as the tide rises, and dams back the water further up the stream, while the surface-water always remains quite fresh, and a brackish zone separates the two strata. When the ebb sets in the salt water runs out very rapidly, and before half ebb there is only fresh water inside the bar. The salinity of the water in Spey Bay was also studied. The river-water could be traced as a stream sweeping to the north-east, with a sharply-defined western margin. Alkalinity and temperature observations were also given.—Mr. A. Wynter Blyth discussed the distribution and significance of micro-organisms in water.

January 4, 1886.—The President submitted notes on the recent experiments at the South Foreland lighthouse.—Mr. Omond, of the Ben Nevis Observatory, communicated an account of the glories, halos, and coronæ observed there. The small number of glories seen is remarkable. Only four have been noticed since the Observatory was established.—Prof. Crum-Brown read a note on the simplest form of half-twist surface.—The Rev. T. P. Kirkman submitted a discussion of the linear section PR of a knot M_n, which passes through two crossings, P and R, which meets no edge, and which cuts away a $(3 + r)$-gonal mesh of M_n.—Messrs. Rainy, Ellis, and Clarkson gave an account of the exploration of the central portion of the field of a Helmholtz galvanometer.—In a paper on systems of colliding spheres, Prof. Tait showed that Maxwell's law of the distribution of energy between two different sets of molecules is erroneous. If two sets of molecules at a given temperature and pressure be mixed, the resultant temperature and pressure will be the same, but the average kinetic energy of the less massive molecules will exceed that of the more massive molecules. In the case of hydrogen and oxygen the excess will be 25 per cent.

Paris

Academy of Sciences, January 4.—M. Jurien de la Gravière, President, in the chair.—On the potential of two ellipsoids, by M. Laguerre.—Researches on the sulphur of antimony, by M. Berthelot. Here the author determines the measure of the heat of formation of this compound under its various conditions, that of its chlorides and oxichlorides having already been ascertained by MM. Thomsen and Guntz.—Remarks on Dr. A. Sprung's treatise on meteorology ("Lehrbuch der Meteorologie"), recently published at Hamburg, by M. Faye. The author's comments are confined chiefly to the vexed question of the ascending or descending movement of the air in whirlwinds or cyclones. Three points he considers now settled: (1) that the movement of translation is inexplicable according to the old theory; (2) that this rapid movement of translation corresponds with the upper cirrus-bearing currents; (3) that a descending movement cannot be denied within the cyclones themselves. Another step, and the old ascending will give place to the new descending theory.—Note on the differential invariants of M. Halphen, by Prof. Sylvester.—Note on the angular movement which a vessel takes on a wave of given size and velocity, by M. L. de Bussy.—Rectangular co-ordinates and ephemeris of Fabry's comet, by M. Gonnessiat.—Note on the new star in Orion, by M. Ch. Trépied. The magnitude of this star is 6·7, its colour an orange-red, and its spectrum very remarkable, showing six dark bands, two in the red and orange, four in the green and blue; bright lines have also been doubtfully detected in the green.—Note on the transformation of the Fuchsian functions, and on the reduction of the Abelian integrals, by M. H. Poincaré.—A tentative application of the calculus to the study of colour sensations, by M. R. Feret.—On the emetics of tellurium, by M. Daniel Klein. The author has succeeded in preparing some tartrotelluric emetics with the tellurites of the alkaline bases, which are alone soluble, and treating them with tartaric acid in due proportion.—On the transformation of the essence of turpentine to an active terpilene, by MM. G. Bouchardat and J. Lafont.—Note on the employment of the metallic oxides for the purpose of detecting in wines colouring substances derived from coals, by M. P. Cazeneuve.—Note on the cultivation of beet-root in the Wardrecques district, Pas-de-Calais, during the year 1885, by MM. Porion and Dehérain.—On the toxic action of the alkaline salts, by M. A. Richet. From a series of experiments made on fishes, pigeons, and guinea-pigs, the authors conclude that in absolute weight the metals are the less toxic the higher their atomic weight, which reverses the law formulated by Rabuteau; also, that the chlorides are, in absolute weight, more toxic than the bromides, and these than the iodides. But, with equal molecular weight, the reverse is the case. In general the alkaline salts are toxic through their chemical molecule, and the higher the weight of this molecule the more toxic it becomes, although the difference is slight and the molecule always about equally toxic.—On the circulation in the ganglionary cells, by M. Alb. Adamkiewicz.—On the morphology of the ovary in insects, by M. Armand Sabatier.—Note on the trunks of fossil fern-trees occurring in the Upper Carboniferous formations, by MM. B. Renault and R. Zeiller.—On the present value of the magnetic elements recorded at the Observatory of the Parc Saint-Maur.—Notes were presented by M. Ch. Beaugrand, on the meteoric dust collected in the atmosphere on November 27-30, 1885; by M. L. Sandras, on the modifications of the human voice by means of inhalations; and by M. Durif, on a remedy for diseased vines.—This number of the *Comptes rendus* contains a complete list of the members of the Academy on January 1, 1886, and announces the election of M. Gosselin as Vice-President for the current year.

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