THURSDAY, SEPTEMBER 8, 1892.

THE HIGHER THEORY OF STATISTICS.

Die Grundzüge der Theorie der Statistik. Von Harald Westergaard, Professor an der Universität zu Kopenhagen. (Jena : Verlag von Gustav Fischer.)

THIS is an important contribution to the Calculus of Probabilities and the higher theory of Statistics. The foundation of experience on which the whole edifice of probabilities is based has been strengthened and extended by the new material which Prof. Westergaard has deposited. Here, for instance, is one of his experiments :— From a bag containing black and white balls in equal numbers, he drew (or caused to be drawn) a ball 10,000 times, the ball being replaced in the bag and the bag shaken up after each extraction. He records not only the total numbers of each colour, but also the number of white balls in each of 100 batches, each numbering 100 balls, also in 50 batches each of 200 balls, and so on. The diminution of the relative deviation from the average as the size of the batch is increased comes out clearly. On an equally large scale Prof. Westergaard has observed the proportion of prizes to blanks in batches of tickets drawn at a lottery; and the frequency with which different numbers, drawn under conditions such that one number was as likely as another, were observed to occur actually. He has similarly tabulated the frequency with which the different digits 1, 2, 3, &c., terminate certain officially recorded amounts, the "kontis" of a savings bank, of which documents he has examined 10,000. These experiences afford new confirmation to the first principles of the calculus : namely, the fundamental fact of statistical regularity which the definition of probability involves, and the postulate that certain events are independent of each other in such wise that, if the probability of each be , the probability of the double event is a quarter.

Ascending from these simple experiences, Prof. Westergaard reaches by a new and easy route the formula for the measure, or *modulus*, of the extent to which the observed number—*e.g.* of white balls in a batch of 100 or 1000—is likely to differ from the most probable number ; in the instance just given $100p$ or $1000p$, if p is the probability of drawing a white ball. The sought expression, it is presumed, must be a *symmetric* function of the probability of the event (drawing a white ball), which we have called p, and the complementary probability (drawing a non-white ball), viz., $1 - p$. This hint enables us to decipher from the records of experience that the modulus is proportioned to $\sqrt{p(1-p)}$. The influence of the *size* of the batch upon the extent of the deviation is similarly elicited from observation. Thus with a minimum of mathematical equipment, by easy steps and through an unpretentious *a posteriori* gate, we are led into the very stronghold of Probabilities—if not to the law of error itself, at any rate to one of its most important properties.

Prof. Westergaard has not only popularized the law of error, he has also proved it. He has added considerably to its evidence, by observing in an immense number of instances the exact correspondence between fact and theory. We must content ourselves with citing one set of instances. Ten thousand balls having been drawn at random, as above mentioned, and the composition of each batch of a 100 being examined, it was found that for twenty-five out of a hundred such groups the number of white balls lay between 49 and 51 (inclusive)—limits distant ± 1 from 50, the most probable number. For forty out of the hundred groups the number of white balls lay between the limits 50 ± 2. And so on. The observations are exhibited and compared with theory in the annexed table :—

Number of batches in which the number of white balls is between certain limits.		Limits.
Observed.	Calculated.	
25	24	± 1
40	38	± 2
50	52	± 3
70	73	± 5
85	87	± 7
95	96	±10

The multiplication of correspondences like this, the concatenation of evidence in favour of the law of error which the author has put together in his fifth chapter, is very cogent.

Another sort of verification to which the law of error is submitted is to compare it with the explicit binomial to which the exponential law is an approximation. This approximation is closer than may be supposed. For example, if a hundred balls be taken at random, each ball being as likely to be black as white, the probability of obtaining exactly 50 balls, as evaluated by the binomial theorem, is ·080, as approximately determined by the exponential law of error is also ·080. The probability of obtaining either 49, 50, or 51 is, according to the exact calculation, ·236, according to the approximative formula, also ·236. And so on.

Among other contributions to the calculus which Prof. Westergaard has either adduced from authors rarely read, or himself deduced, may be noticed his elegant treatment of the case where the probabilities of two alternative events (say, drawing white or black balls) are not equal (p. 70). Suppose that the probability, say p, of one event is very small, then the formula for the deviation of the number of white balls actually drawn from the number most likely to be drawn, viz. np, admits of simplification. The "mean error" ($=modulus \div \sqrt{2}$) is in general ... $(\sqrt{np(1-p)}$; in the particular case it becomes approximately $\sqrt{np}$. A further simplification may be explained by an example. Suppose that we know the number of deaths, say 900, per unit of time in a certain population. Then, without knowing the number of the population, or without taking the trouble of referring to it and calculating the death-rate, we may determine approximately the fluctuation to which the number of deaths is liable. For the measure of that fluctuation the "mean error," is approximately $\sqrt{np}$; n being the number of population, a large number, and p the death-rate, a small fraction. Now np is 900, and accordingly 30 is the mean error, that is, assuming that the urn in which the lots of Fate are shaken—"omnium Versatur urna

serius ocius Sors exitura"—is constituted as simply as the urn in which we have supposed black and white balls to be shaken up. This is a question in Applied Probabilities to which we are just coming.

Prof. Westergaard's applications of the calculus to statistics are even more striking than his developments of the pure theory of probabilities. The law of error may be applied to concrete phenomena in two cases: where the fluctuation of averages follows the analogy of the simpler games of chance—as we just now assumed with regard to deaths—and where this condition is not fulfilled. Prof. Westergaard's contributions belong chiefly to the first class. He has considerably added to the instances discovered by Prof. Lexis, in which a set of ratios—such as the proportion between the mortality of male and female infants in different years—are grouped according to the same law of dispersion as the percentages of white balls in a set of batches drawn at random from an urn containing black and white balls mixed up in a certain proportion. The uses of this discovery are twofold—negative and positive. In the first place, we may be deterred from a search after causes which is hopeless. In the typical instance of the urn and balls it would be vain to trace the reason why any particular ball, or set of balls, extracted should be white (or black). We cannot hope to analyse the "fleeting mass of causes"—as Mill calls Chance—upon which the event depends. We may have been able to break up our batches of balls into two classes, say rough and smooth, such that the rough balls are extracted from an urn containing mostly white, while the smooth balls are more frequently black. But when this process of "depouillement" has been carried as far as possible, when we have reached the ideal type of a single urn and constant proportions, then the investigation of causes halts. Then it is only crazy gamblers who hope to discover a principle underlying the "runs" of black and white balls. We have reached the bounds of the territory of science; beyond there is only the sea of chance. Prof. Westergaard has not only indicated this limit, but also pushed many of his investigations up to it.

These considerations do not preclude us from applying the theory of error to detect delicate distinctions such as the difference between a loaded and a perfect die, which make themselves felt in the averages of great numbers of observations. In fact, it is by the mathematical method that we can best determine whether a difference between two averages is significant of a real constant difference, or only apparent and accidental. Prof. Lexis, and Dr. Duesing after him had applied this method to the investigation of the conditions under which the excess of male over female births is greater or smaller than usual. Prof. Westergaard shows that the method is applicable to many other subjects, among which the mortality at different age-periods promises to be most useful. We could wish, indeed, for more copious evidence in favour of the premise that the mortality of a population at a certain age-period (say of clergymen or innkeepers between the ages 35-44. See *Grundzüge*, p. 82, with context, and *cf.* p. 52) fluctuates according to the analogy of games of chance.

Here the question arises: must the phenomenon under consideration be known to vary after the manner of balls extracted from an urn, in order that the mathematical method may be applicable? Certainly the apparatus of the law of error—probable and improbable deviation—may be employed to ascertain whether the difference between the average heights of two groups of two men is significant or accidental; though in this case the modulus (or mean error) does not follow the analogy of the simpler games of chance. Might we not similarly compare the *general* mortality of two sections of population, although the dispersion of such death-rates about their average is much greater than it should be on the hypothesis of pure sortition. The advantage, indeed, which we have above distinguished as negative, would no longer exist in this case. But might not the positive advantage still be enjoyed in some degree? Prof. Westergaard, so far as we have observed, is silent on this topic.

We have left ourselves too little space for noticing Prof. Westergaard's other contributions to applied Probabilities. His treatment of Insurance, together with the adjacent theory of Life-Tables, involving the arts of Interpolation, may dispute with Cournot's classical chapters the honour of forming the best introduction to the subject for the general reader—the reader prepared by a general mathematical, as distinguished from a special actuarial training. Nor must we pass over the chapter in which the author surveys "economic" (exclusive of Vital) statistics. He has here occasion to employ largely the important principle of inference from samples. For instance, in order to discover the amount of wood in a country, we should first select one or more sample surfaces (*Probe-flächen*), and a sufficient number of sample trees thereat, and then measure the quantity of wood on those trees. "From the figures so found conclusions can be drawn as to the whole sample-surface, and from those to the total quantity of wood in the country." So in order to determine the quantity of milk, we must proceed by way of *Probe-kühe*. The method of samples is no doubt a potent instrument when wielded by a trained hand like Prof. Westergaard's. We may perhaps extend to economics generally what he suggests with reference to its statistical side: that a given effort and expense may be better laid out in obtaining a detailed knowledge of a few parts with a general view of the whole, rather than a more uniformly distributed information.

The last part of the work is devoted to a history of statistics; not a chronicle, but such a history as a great tactician would write of past wars. The criticism of Quetelet's methods is particularly instructive. In connection with Quetelet we may note—without assenting to—one of the Professor's objections to the principle of the "Mean Man." It is in effect the same objection as Cournot raised: that the average of one limb derived from measuring several specimens might not fit the average similarly found as the type of another limb. The model man constructed by putting together these averages of parts might prove to be a monster.

In conclusion we venture to express the hope that this important treatise may be translated into English; in order that the insular student may not have to encounter the difficulties of German and Probabilities at once. We might advise the translator to follow the excellent English custom of prefixing descriptive headings to all the

tables. As they stand, a close attention to the context is sometimes required in order to be quite certain of the principle in which figures referred to as "calculated" have been obtained. We refer chiefly to the fourth chapter. There occur also, in the second chapter, some terms vital to the meaning, which may require to be interpreted for the benefit of the English reader; e.g. *Zahlenlotto*, *Klassenlotterie*, *Kontis* relating to the *Sparbank* "Bikuben" in Kopenhagen.

F. Y. E.

THEORETICAL PHYSICS IN ITALY.

Trattato di Fisico-Chimica secondo la Teoria Dinamica. Opera Postuma di Enrico dal Pozzo di Mombello. (Milano, 1892.)

THIS is an elementary treatise from the hand of the late Prof. Mombello, of the Free University of Perugia. In the general nature of its contents it might be compared to Prof. Ostwald's *Allgemeine Chemie*. It is, however, much smaller; and is indeed less of a systematic treatise than a condensed statement of the many principles and laws on which physics and chemistry are built. The English terms physics and chemistry have, under the influence of our examination systems, become so stereotyped in meaning that neither term could fitly describe the character of this *Trattato di Fisico-Chimica*. The time-honoured division of subjects would ill fit into its plan. Dynamics, properties of matter, heat, light, sound, electricity, and magnetism are certainly all treated in their more theoretical aspects; but there are also introduced the laws of chemical combination and the atomic theory, which give the book a character possessed by none of our English treatises on physics. A brief sketch of its character may not then be wholly valueless.

The treatise is divided into five parts, under the headings *Dinamica*, *Azione Moleculare*, *Elettrologia*, *Luce e Colore*, *Filosofia Scientifica*.

The first part contains much that we understand as Dynamics; but it contains a good deal more. In chapter I. (*Moto ed Energia*) physics is described as the science of motion. The universal law of nature is the law of causality, after a brief discussion of which we are introduced to four general principles—namely, the law of the conservation of mass, the law of the equality of action and reaction, the rectilinear action of force, and the composition of motions. Then follow two *General Physical Laws*, the conservation of energy and the transformation of energy (*la correlazione ed equivalenza dei moti*). Thereafter are introduced somewhat less general formulæ, which are distinguished as *Definite Physical Laws* and *Definite Chemical Laws*. Of the former, two examples are given—namely, "Pascal's Law" concerning the transmission of pressure in a liquid, and "Dalton's Law" that there is no physical action between the particles of gases, which are not chemically combinable. Then of the definite chemical laws four are particularised, being distinguished by the names of Lavoisier, Proust, Avogadro, and Cannizzaro, the last being a modified statement of Dulong and Petit's law of the specific heats of the elements. The rest of the chapter is devoted to a discussion of inertia, of Newton's laws of motion with special reference to the second interpretation of the third law, of kinetic (*attuale*) and potential energies of action at a distance, and of the conception of stress (*conflitto*) between particles. Chapter II. (*Composizione dei Moti*) is purely kinematical. In chapter III. (*Velocità moleculare*) the physical molecule is led upon the stage. Cohesion, viscosity, rigidity, porosity, volatility, critical points, crystalline form, and gravitation—in a word, the essentially molecular and *dynamic* qualities of bodies—are touched upon; and the whole finishes with an elementary treatment of the kinetic theory of gases, including an account of Crookes's experiments on radiant matter. It is satisfactory to notice that Prof. Mombello, like Prof. Ostwald, has the boldness to speak simply of Boyle's Law untainted by the Marriotte blend. This, of course, is merely historic justice. On the other hand, surely Herapath deserves mention as one of those who aided in the development of the kinetic theory of gases.

This early introduction of the kinetic theory has no doubt its merits; but a more logical course would have been to give in the first place some notion of the real meaning of temperature. This is touched upon in the immediately succeeding chapter, *Teoria termo-dinamica*, which forms Chapter I. of Part II. The treatment here is certainly peculiar. Two theorems (*enunciati*), we are told, are to be taken for the study of heat. The first embraces Carnot's doctrine of the logical necessity for a complete cycle, and his great principle of the reversibility test. Lord Kelvin's definition of temperature is brought in as a kind of corollary and dismissed in a few sentences. We hear no more of Carnot. "The second *enunciato* is concerned with the fact that in the universe an immense indefinite quantity of heat is being generated constantly during the formation of the stars." Then follows a brief sketch of some of the conclusions of spectroscopy, leading up to a broad discussion, in terms of the molecular theory, of the meaning of temperature, and of radiant energy in its four-fold aspect—thermal, luminous, chemical, and phosphorescent. After this thermodynamics, in the usual significance of the term, is presented under the guise of two propositions ascribed to Hirn. These propositions are, to all practical intents and purposes, simply the two laws of thermodynamics. But we search in vain for any reference to Joule; while Rankine and Clausius are merely mentioned as having proposed a demonstration of Hirn's second principle! Now Hirn deserves all credit for his experimental corroboration of the truth that only a fraction of the heat which leaves the boiler is transformed into useful work; but to magnify his labours in the way indicated is surely an inversion of history. Moreover there is no hint as to the relation between Carnot's reversible engine and the second principle; and the absolute zero of temperature is defined only in terms of the gaseous laws. Of entropy and the dissipation of energy we find no trace.

The succeeding chapters of Part II. are devoted to such subjects as the atomic theory (chemical) and the various aspects of capillarity, diffusion, osmose, &c. A brief account is also given of electro-chemistry, although electrical phenomena in general are not discussed till later. The seven chapters of Part III., in which electricity and magnetism are treated, form a highly condensed and instructive compendium of fact and theory, the two not always, perhaps, very clearly distinguished.

Chapter V. is concerned with "The Induction Balance of Hughes"; and here, for the first and last time, we encounter the name of Joule, who appears as the discoverer of the elongation of iron in a magnetic field. This is, of course, thoroughly accurate; but why, we naturally ask, is there no mention of Joule's Law of the heating accompanying conduction of electricity? The whole question of resistance is, indeed, barely touched. It is difficult to imagine by what process of reasoning such an important subject is omitted in a book which positively bristles with laws and principles named after their discoverers.

This method of cataloguing physical laws—for it is little else at times—has its advantages, especially from an examinee's point of view. It is doubtful, however, if it can be carried out consistently. Prof. Mombello certainly has not done so, although in the majority of cases he seems to be historically sound. One objection to the method is that, as it is impossible to group physical principles, like geometrical propositions, in a logical series, and as physical principles belong to different axiomatic, experimental, or hypothetical grades, there is a strong tendency, in a compendium of the kind we are reviewing, to present these principles in a false perspective. There is no doubt, however, that Prof. Mombello has placed in the hands of the countrymen of Galilei an instructive and suggestive treatise bearing on the varied phenomena of molecular physics. There is editorial carelessness in the spelling of foreign names, and serious faults of omission of the character discussed above. But the teaching is in general sound, and Part V. fitly closes with an account of Maxwell's electromagnetic theory of light, and a discussion of the character of the ether.

C. G. K.

THE MICROSCOPE IN THE CLASS-ROOM AND LABORATORY.

The Microscope and Histology for the use of Laboratory Students in the Anatomical Department of the Cornell University. By Simson Henry Gage. Third edition. Part i. (Ithaca, New York, 1891.)

THIS is a practical handbook by a thoroughly practical histologist. It is an expansion of an earlier and more concise treatise, written not for the amateur and the dilettanti, but for the laboratory student.

The recognition of the need of such a handbook is in itself an evidence of the practical character of its author, and of his knowledge of the wants of the serious student. To follow intelligently the best and most suggestive histological teaching requires more than a passing or perfunctory knowledge of the use of the microscope; and this can only be really acquired by those who have at least an elementary knowledge of the principles upon which this now really complex instrument is constructed. It has become an instrument of precision, and precise methods must be adopted in its use. This does not mean that it is more difficult to use than it was in the early years of the last quarter of a century; but it only implies that the principles upon which it is to be successfully employed should be thoroughly understood and practised.

Thus the apochromatic system of lens construction is an immeasurable gain, an improvement so great that its amount cannot be exaggerated; and these lenses are, if anything, rather easier to use than those of the older achromatic construction; but if the principles of their construction, and consequently the principles involved in the employment of them, be not understood and carefully practised, they yield results entirely unsatisfactory.

Again—and this is a point not referred to by Prof. Gage—those who may be provided with a good battery of achromatic lenses, and do not desire to face the cost of changing these for a series of apochromatics, may come wonderfully near the best results of the finest apochromatic objectives by the use of real monochromatic light. To obtain this with complete certainty, using any monochrome of the spectrum we may desire, with good lamplight, is now not only possible, but easily within the reach of all, and in such a manner as to lend itself to employment with the condenser and any magnifying power it may be needful to apply; and by this means not only is a good achromatic lens, as it were, elevated optically into an "apochromatic," but its numerical aperture is increased—the great desideratum, all else being equal, of good optical performance.

These are indications enough to emphasize the importance to the medical student generally, and to the histological student in particular, of a book that will briefly and accurately give him a knowledge of the principles involved in the construction and employment of the microscope, upon his intelligent use of which so much depends, but to which, as a rule, so little time is devoted, and therefore so little knowledge is possessed.

We do not for a moment suppose that a treatise like this, however well conceived and carried out, can give efficient, to say nothing of exhaustive, knowledge of optical theory, principles, and the laws and conditions of construction so as to enable a student to become in this sense a master of microscopic manipulation and interpretation; but it will go far to enable him to go through his work as a student with an intelligence and insight otherwise unapproached; and what is still more important, it will give him the opportunity of acquiring ability to see in the preparations he is instructed to make, or which he is required to study, or which he makes of his own initiative, that which he is *not* directed to look for, and which may open up for him and his science new and important paths. But this cannot be done if the student is not, in a strictly scientific sense, using his instrument, and is therefore approximately certain of the propriety of the interpretation of what he has been able to make out in his preparation.

Prof. Gage has adopted a system of illustrations (which we think might have been of a more refined artistic character, with much advantage) which are concisely and in the main accurately explained, and are intended to cover the entire subject; definitions, descriptions, and textual illustrations are added, which, taken together give a completeness to the treatise, that thoroughly fit it for its intended purpose. In many points it is as a matter of necessity, from its very nature, inefficient. It can only indicate, and not exhaustively explain, many most important points. But to the intelligent student alive to his subject, these are but spurs to

further reading; and the larger treatises, giving full explanations of the matter in hand, will not be long unread. In short this treatise lays the foundation for a thorough microscopical training, entirely adapted to the wants of medical students.

It is printed only on one side of the page throughout, so that the blank page is open for notes, and by using the opportunities presented with wisdom, the book may acquire, in the hands of an industrious student, a doubled value.

We may note that there are some points that even with the restricted object of the book we think might have received fuller, or even more accurate treatment. A fuller treatment might certainly have been given to the subject of "oblique light," which is very lightly touched; but which is none the less, to the partially instructed, whether medical student or ordinary amateur, one of the most prolific and frequent sources of erroneous judgment and entire misinterpretation; and we believe that no treatise on microscopic work, whatever its object, can be thoroughly efficient without giving it grave and careful consideration.

On the other hand it would have given greater value from the point of accuracy if the details given for the "Centring and arrangement of the Illuminator," by which is meant the sub-stage condenser, had been of a somewhat later period. On the use—the right use—of the condenser much of the best English work of the past quarter of a century has been spent. Happily German microscopists and opticians have during the past seven or eight years begun to perceive the value, nay, indispensable importance, of this apparatus, and the firm of Zeiss have, through Abbe, made successively chromatic, and subsequently achromatic condensers of increasing value. We trust they may be induced to follow English opticians and make apochromatic condensers, especially one adapted in numerical aperture to their latest optical triumph in lenses, viz., that possessing a N.A. of 1·60; the full value of which as an apochromatic objective can never be seen without it. It is a pleasure to note that Prof. Gage tells us that "for *all* powers, but especially for high powers," the condenser is of "great advantage." We believe it for the highest results, even with "low" powers, to be indispensable. But it will never be by the employment of "a pin-hole diaphragm . . . put over the end of the condenser" so that this aperture shall appear in the middle of the field, that the best possibilities of the condenser will be reached. The student is plainly told that the "optic axis of the condenser and of the microscope should coincide," but the best way of securing this coincidence is certainly not stated.

The blemishes of the book are nevertheless few, it has a decided purpose, and there is a large sphere for its action. We believe that another edition will not long hence be called for in which its author will not find it difficult to emend and expand it in certain parts, and possibly still further to enlarge it, and we will add that we think it may not only prove of value to the students in the Anatomical Department of the Cornell University, but also to others on both sides the Atlantic.

W. H. DALLINGER.

OUR BOOK SHELF.

An Elementary Text-book of Magnetism and Electricity. By R. Wallace Stewart. Univ. Corr. Coll. Tutorial Series. (London: W. B. Clive and Co., 1892.)

IN this work Mr. Wallace Stewart presents us with another of his excellent text-books on elementary science. Just as his treatment of the subject was concise and clear in his book on heat and light, so here he has followed the same lines, and has placed before the student, especially one who is preparing for the matriculation examination of the London University, a course in magnetism and electricity which will give him a thorough knowledge of the subject and a sound basis on which to make further study. The illustrations and diagrams will be found to form a valuable addition to the text, while the numerous examples at the end of each chapter, if thoroughly worked out, should give a student a good insight into the art of solving problems.

Key to Arithmetic for Beginners. By J. and E. J. Brooksmith. (London: Macmillan and Co., 1892.)

THIS key will be welcomed by all those who are employing Mr. Brooksmith's excellent arithmetic. It has been prepared especially for the use of teachers, who will find it a valuable aid in their work, but no doubt it will be largely demanded by those who are studying this subject for themselves, for much may be learnt by a judicious use of such a book. The examples, so far as we have been able to see, have been very carefully and concisely worked out, and many difficulties that usually arise have here received careful attention.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

International, Geological, and other Records.

MY friend Mr. Minchin's letter has opened a question that I have been ruminating for a very long time. We occasionally hear of the organization of science, but the very ABC is at present neglected, or carried out in a spasmodic and disjointed manner. Let us take for example geology. We have several attempts at a catalogue and review of its yearly literature, of which I give the following examples. First comes the "Geological Record," a publication very well in its way, but making its appearance at irregular intervals, and often much behind time. We have in Prof. Blake's Annual the attempt of a single individual to cope with a mass of literature that it is impossible for him to read, and treating of questions that no single person is or can be qualified to deal justly with. The very obvious result of this is careless reviewing, and general dissatisfaction of most authors whose papers are submitted to the abstracting process. I hope Prof. Blake will not take these words as a disparaging appreciation of his attempt, which I think does him much credit as a single-handed worker, but it will not satisfy the geologists in general. Next we have the "Annuaire Géologique Universel," for which great credit is due to Drs. Carey and Agincourt. Here we have the geological literature of each country treated separately, followed by a subject literature. Each article is compiled by a specialist in his own branch, and one who is able to form a just opinion of the work and appreciate the salient points of it. Altogether the organization of the "Annuaire" is on the right lines, but I understand it is not a financial success, and I have very grave doubts if it will continue, because the supporters of one publication cannot be the supporters of several. The motto "L'union fait la force" is as true in this case as in any other. Then again there is not that official character about it that there would be with international co-operation, supported by governments, scientific societies, &c. As two years' collaborator for the subjects of seismology and

vulcanology I can give some of my experiences. In the first place it means a very big slice of time to read (for without this the thing had better be left alone) and review the annual literature of such subjects; for this there is no recompense whatever, but as I shall show actual money out of pocket. It is impossible for the reviewer, unless residing in such towns as London, Paris, or Berlin, to see all the literature of his subject. He, therefore, has to send out circulars, the expenses and postage of which, without counting labour of addressing, I found to come to about 2*l.* annually. A considerable proportion of these circulars are not even answered by those who have published papers on the subject during the year, and I am sorry to say that in one or two cases I have had a reply insinuating that I had been "*cadging*" for a copy of the author's paper or book. After the review is published come protests from authors (not many in my case, fortunately,) whom, out of common courtesy, time and money must be spent in answering. Finally, with every care such a work is far from complete. I would, therefore, hazard the following propositions:—A preliminary committee to be formed as soon as possible to study the question of international records of scientific literature. That such committee should determine the language of such records, the methods of organization of each separate subject committee, the means and resources of such, and invite the co-operation of other nations.

To my mind each record committee—say, for example, that of geology—should invite the specialists who are willing to collaborate to do so, should examine their manuscripts before going to print, keep a list of all known workers in that particular branch, and find as many subscribers to the work as possible. The central committee should nominate the subject committees, treat with governments, societies, and universities for support, and keep a loose card catalogue of all scientific investigators in the world, to whom should be posted annually a circular requesting the dispatch of their publications, if possible with a short abstract by themselves, to the reviewer of their special subject, the names and addresses of whom should be appended to the circular. In this way reduplication of reviewers circulars would not take place; and if a botanist wrote a paper on an earthquake, for example, he would be reached by the application from the vulcanologist as well as by the botanist. Finally, should profits accrue in the future, I would suggest that they be equally divided annually amongst the reviewers. I really hope that the subject will be taken by the horns before we reach—and we are near—a great scientific literary deadlock.

Harrogate, August 30. H. J. JOHNSTON-LAVIS.

A Suggestion for the Indexing of Zoological Literature.

IT is obvious that the numerous records of all sorts which comprise the zoological literature of each year are only of use so far as we have access to and knowledge of them, and that their existence is actually a very serious encumbrance to those workers who are unable to make use of them.

It is self-evident that sooner or later, if zoology is to be preserved from chaos, every fact of any importance will have to be indexed for reference. Otherwise, nearly the whole lives of zoologists will come to be spent in libraries, until the thing gets so intolerable that some one suggests that we burn all the books, and start afresh from nature.

Of course, a great deal of indexing has been done, and is being done. The "Index Gen. et Spec. Anim." is well on the way, and the "Zoological Record" and other works of a like nature appear annually. But these are mainly records of names of species and genera described as new, and the "Zoological Record," admirable and invaluable as it is, is not always complete, nor in some sections (notably the last on mollusca) entirely accurate. Much indexing is continually being done in monographs, such as the Brit. Mus. Catalogues, and the value of this work can hardly be over-estimated, but here again it mostly relates to *species* as such. Then there is the Royal Society's "Catalogue of Scientific Papers," which is good so far as it goes, and the still more perfect Engelmann and Taschenberg. Putting aside, for the present, the question of indexing past records, would it not be a great advantage if we could begin now, and index everything as it appears? Possibly this could be done on the following plan:—

Let a society be formed, called, say, the Zoological Index Society, consisting of all writers on zoological subjects who will join.

The members of the society to be provided with uniform record slips at cost price, on which they will undertake to record *everything* in their writings that they believe to be important or new. These records might be under various heads, *e.g.*, the "semi-melanoid variety" of the leopard, described to the Zoological Society on November 20, 1883, might be indexed under *Felis pardus*, under *Melanism*, and under *Cape Colony*.

These slips to be sent to the secretary of the society, who would arrange them in alphabetical order, in cabinets provided for the purpose. The slips, under each special heading (*e.g.*, Species, Higher Groups, Variation, Distribution, &c.) would form continuous series. The slips of each year might be kept separate for six months, and then merged in the general index.

The members would be required to pay a subscription sufficient to cover the expenses of the above; but it would probably be possible to obtain assistance from some of the scientific societies, and the most suitable place for the index to be kept is doubtless the Natural History Museum. If this were accomplished, it would still be desirable to raise further funds, in order to increase the utility of the index in the following ways:—

(1) By obtaining an assistant secretary, whose duty it would be to copy out records from the index for workers residing in the country or abroad, at a certain small charge. The applicant might ask, *e.g.*, for *Limax*, or Jamaica, or Albinism, and would pay according to the number of records.

(2) By publications. Possibly some arrangement might be made with the Zoological Record Committee, and special publications containing the records relating to matters then of interest might appear as often as possible.

Volunteer work in indexing earlier works would be acceptable. Thus, some admirer of Darwin might be willing to index the works of that author. But in such cases a careful list should be kept of the books indexed, and every index should be complete. Presumably no one will dispute the utility of an index as proposed, but some may doubt the possibility of getting sufficient co-operation. If the idea of such an idex became familiar to writers, it can hardly be doubted that each would desire to place his writings on record along with the rest. If a man's writings are not worth this trouble, they are surely not worth printing, unless, of course, they are of such a nature (*e.g.*, educational works) as not to require indexing in this manner. T. D. A. COCKERELL.

Institute of Jamaica, Kingston, Jamaica, August 15.

Rain with a High Barometer.

IN NATURE of September 1 in your note on the Annual Report on the Royal Botanic Gardens, Trinidad, you emphasize the fact that at Trinidad it always rains with a high barometer.

This is a not uncommon phenomenon in other parts of the world. Last year I made a series of meteorological observations in Mashonaland, and more especially while stopping during June and July at Zimbabwe, and I there found that a high barometer was invariably accompanied by rain, and the higher the barometer the more certain and heavy was the rain. The atmosphere was driest when the barometer was lowest, and then the difference of the readings of the dry and wet bulb thermometers sometimes exceeded 20° F.

This state of climate in Mashonaland is I think mainly due to the configuration of the country, which is such that moisture can only be carried there by southerly and south-easterly winds, and they—as winds blowing towards the equator generally do—increase the atmospheric pressure.

It will be interesting to know if some such explanation will not account for the condition of things in Trinidad, and if any of your readers can tell of a similar state of climate elsewhere.

ROBERT M. W. SWAN.

15, Walmer Crescent, Glasgow, September 3.

The Perseids.

WITH reference to the note, August 18th, that no news of the Perseids had then come to hand, I fancy the shower must have been fairly bright this year. One of our scholars, C. E. Elcock, while crossing from Belfast on the 9th, saw some bright meteors in ten minutes between 9 and 9.30, one lasting some time. Afterwards only occasional ones occurred.

J. EDMUND CLARK.

Bootham, York, August 29.

Variable Star T Cassiopeiæ.

FROM long-continued observations of the above star, irregularities in the ascending light curve may be expected about October or November next. I shall be happy to supply a diagram of the field to any one interested in the question.

CUTHBERT E. PEEK.

Rousdon Observatory, Lyme, September 5.

THE OPPOSITION OF MARS.

THE *Times* of Saturday contains a most important telegram, giving the results of Prof. Pickering's observations in Peru during the present opposition of Mars, which is one of the most favourable which has occurred during the last half of the present century. The work done at Arequipa in one respect contradicts, and in others goes far beyond, the results recently announced from the Lick Observatory. There can be no doubt that a considerable advance has been made by this year's results; many prior observations which have been considered doubtful have been confirmed, and an additional interest lent to the observation of the planet.

The time, therefore, seems opportune for considering several questions connected with Mars, and it will be convenient to begin with the conditions of this year's observations, especially since the least astronomical among us has certainly noted with surprise the bright red star which now nightly rises low down in the south-east. Nor will he or she be less inclined to regard it when it is recognized as the planet about which during the last month so much has been written of human rather than of astronomical interest. If everything that one sees in print be true, the inhabitants of Mars are signalling to us, and it only remains for us to choose our manner of reply. Of course from signals the imagination of the ready writer has passed at once to words, and having got so far, each planet is about to become acquainted with the history and present conditionings of the other by means of a language understanded of our neighbours as well as ourselves.

But first as to the cause of its excessive brilliancy during the last month or so, for this doubtless has had something to do with the present general interest taken in the planet. Mars was as bright in 1877, but on that occasion nothing like the present amount of interest was taken in its movements and possible structure. For this there are two obvious causes—one the increasing interest taken by people in science generally; the other, popular glosses on several recent discoveries made regarding Mars itself.

The popular idea that the changes which have been recently observed on the planet are changes due to the work of its inhabitants—an idea based upon a mistranslation of a word—has, of course, generated the other one—namely, that vast operations have been undertaken for signalling purposes; and from this idea the step to Mr. Galton's or Mr. Haweis's method of signalling back is a small one. Small though it be, however, the public interest has thereby been greatly enhanced.

One of the most serious suggestions in modern times regarding signalling to bodies outside the earth we owe to a German astronomer, who some while ago enriched the world with the idea that the inhabitants of the Moon might possibly be communicated with by establishing on the vast plains of Siberia geometrical figures, such as circles, &c., built up of fire-signals, to which signal, if seen, the Lunarians would reply by reproducing them.

Then the popular mind was content to bridge the chasm of 240,000 miles which separates us from the moon. But *now* Mars is the objective—Mars, which at its nearest approach is 35,000,000 of miles removed!

...t Mars when in opposition may be very much further away than that; so far, indeed, that it is then observed to be 1-5th of its maximum brightness, and naturally with very reduced angular diameter. The two preceding oppositions at which its brightness has been at all comparable to its present one, took place in 1860 and 1877, so that we find the most favourable oppositions about sixteen years apart. The reason of this will easily be gathered from Fig. 1, which shows with sufficient accuracy the very elliptic orbit of Mars in relation to that of the earth. The lines joining the two orbits are those connecting the two planets during some oppositions from 1830 onwards to 1871. The outer planet, Mars, is represented nearly at the *perihelion* part of its orbit, that is the point at which it is nearest the sun (and therefore the earth, if we treat the earth's orbit as a circle), and the reason that the 1830 and 1862 observing conditions were so much better than those of 1869 and 1871 is at once clear. The opposition of 1877 and the present are not shown on the diagram, but they occurred at a time when Mars was not far from its perihelion.

The diagram also allows us to see that at the perihelion point of Mars' orbit the planet is very nearly at the

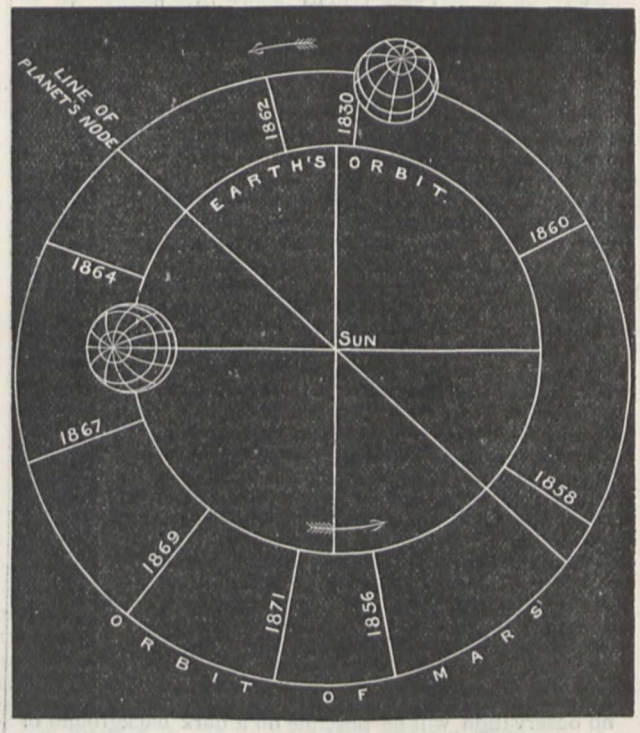

FIG. 1.—The orbits of the Earth and Mars.

time of the southern solstice, the N. pole being inclined away from the sun. Also that this must occur about four months before the southern solstice of the earth, the direction of the axis of which is also shown.

So that at an opposition which occurs in August, as the present one does, we observe what happens in the summer solstice of the northern, and winter solstice of the southern, hemisphere of the planet. In fact, generally we have:—

Time of opposition.	N. hemisphere.	S. hemisphere.
August	Winter	Summer
November ...	Spring	Autumn
February	Summer	Winter
May	Autumn	Spring

The perihelion point of a planet's orbit is astronomically expressed by its heliocentric longitude, and the apparent size of its disc (on which its apparent

brightness depends) by its semi-diameter in seconds of arc. Presuming that the longitude of the perihelion of Mars may be taken as about 334°, the following table will show how the great brilliancy of the planet in 1877 and the present year was caused; other less favourable oppositions are given for purposes of comparison :—

Date of opposition.	Semi-diameter.	Heliocentric longitude of planet.
	"	°
1862, October 5	10·8	12
1869, February 13	8·2	145
1873, April 27	9·7	217
1877, September 5	**14·7**	**343**
1881, December 26 ...	9·2	95
1884, January 31	8·3	132
1888, April 10	9·2	201
1892, August 13	**14·7**	**312**

So much, then, for the distance conditions. At its nearest approach the planet is 35,000,000 miles removed —let us say 150 times more distant than the moon.

We next come to the conditions of visibility. Mars is nearest to us (the degree of nearness depending upon its position in its orbit) when "in opposition," as we have said—that is, when it is in the south at midnight, and opposite the sun, the sun then being, of course, due north below the horizon. It will then appear to us "full," as the moon is said to be full when she occupies an analogous position. At this moment, then, the earth is invisible to the inhabitants of Mars unless she happens to transit the sun's disc.

The earth appears to Mars precisely as Venus does to us, and if inhabitants there be on Mars, and they study astronomy, a transit of earth to them will be what a transit of Venus is to us.

Further, as we see Venus as a half-moon, and when nearer to us as a fine large crescent, so the Martians, as the earth approaches them, will see her as a half-moon and then as a crescent, getting finer as the apparent diameter of the completed circle gets greater.

Mars, to see us best, must occupy a point near its perihelion. These things may be gathered from Fig. 2, in which an opposition at Mars' perihelion is shown, the orbits, but not the size of the bodies concerned, being to scale. Before the conjunction of the three bodies (in the line Mars, earth, sun) is approached, Mars will first have the earth as a half-moon at a; this will gradually melt into a crescent till the moment of conjunction. Afterwards the crescent will broaden, and its diameter will be reduced till the point a' is reached, when the earth will appear as a half-moon again.

It is clear, therefore, that the earth will be a morning and evening star to Mars at the time of their nearest approach. The earth's crescent must not be too fine, or no observation will be possible on a dark background of sky. In other words, although we can observe Mars best when he is nearest, the privilege of seeing the earth when nearest to Mars is denied to his inhabitants.

We are now, then, in a position to discuss, so far as the mere conditions of visibility are concerned, the two suggestions as to earth-signalling to which I have already referred.

Mr. Galton's proposal depends upon the observation that a "reflected beam of sunlight sent through a hole in a plate in front of the mirror was just distinctly visible as a faint glint at a distance of ten miles when the hole was a square of one-tenth of an inch in the side." He then adds: "The amount of fog and haze that a beam of light would traverse between us and Mars when the planet was high above our horizon could not exceed that along a terrestrial base of ten miles; consequently the same proportion between the size of mirror and the distance would still hold true. It follows that the flash from many mirrors simultaneously, whose aggregate width was fifteen yards, and whose aggregate length (to allow for slope) was, say, twenty-five yards, would be visible in Mars if seen through a telescope such as that at the Lick Observatory. With funds and good will, there seems no insuperable difficulty in flashing from a very much larger surface than the above, and sending signals that the inhabitants of Mars, if they have eyes, wits, and fairly good telescopes, would speculate on and wish to answer. One, two, three, might be slowly flashed over and over again from us to them, and possibly in some years, to allow time for speculation in Mars to bear practical fruit, one, two, three, might come back in response. Dr. Whewell, if I recollect right, wrote a paper on the possibility of coming to an understanding with lunar inhabitants, if there were any. He would begin from the mathematical side. The practical difficulty is by no means insuperable of enabling many independent observers (who need not be near together) to direct their flashes aright. If mirrors could be mounted without much cost as heliostats (and perhaps they can be) it would be easy enough to do this. My own method is not practicable, at least without considerable addition and

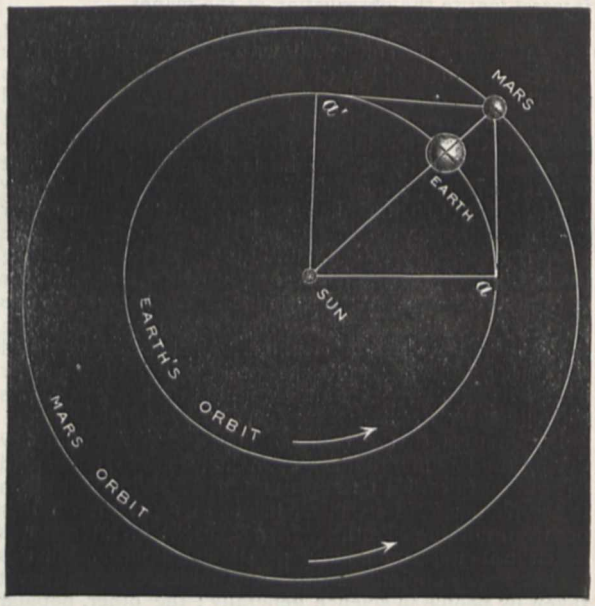

FIG. 2.—The Conditions of Visibility of the Earth from Mars.

modifications, as it requires the object to be visible towards which the flash is directed, but Mars is not visible to the naked eye at day." [1]

Mr. Galton then uses sunlight and works in the day; Mr. Haweis, on the other hand, suggests electricity and night-time :—

"I infer from the astronomers that a signal on our earth about six miles in size of the nature of a bright light could be seen by the inhabitants of Mars, who by all accounts seem to be making the most systematic and herculean efforts to communicate with us by flashing triangular signals of presumably electric light. Why cannot we answer those signals by something which would resemble the lighthouse intermittent signal? Here is the method. London every night presents an area of at least twelve miles square brilliantly illuminated. That illuminating power might be enormously increased with only a few additional centres of powerful electric light. But without *any additional expense*, a little co-operation on the part of the gas companies would suffice to alternate darkness and light at intervals of five

[1] *Times*, August 6, 1892.

minutes over the whole of London between certain hours when traffic is more or less suspended. If only tried for an hour each night some results might be obtained. . . . . We have actually the mechanism for interplanetary communication every night—why not use it?"[1]

Mr. Galton is careful to point out that his method of signalling requires sunlight, and that the signals are to be flashed to Mars in the Earth's daytime; the moment of opposition therefore is at once out of the question. Even with the Earth at either *a* or *a'* in our Fig. 2, the Sun and Mars would be 90° apart, and in any case the signals would be visible to the Martians (if visible at all) on the part of the earth lit up by the Sun. This does not seem a favourable condition, or at all events the most favourable one.

Mr. Haweis' plan secures a much stronger contrast. If it or something like it could be carried out, we can imagine the inhabitants of Mars studying the delicate earth crescent (with telescopes as powerful or more powerful than our own *bien entendu*), whether as a morning or evening star, and then seeing rhythmic flashes, reproducing the star included in the crescent of the Ottoman flag well within the horns of the crescent. Here we certainly get light on dark instead of light on light.

But there are other conditions of visibility besides those we have so far discussed. Supposing the whole electric energy of London turned on Mars would the volume of light be sufficient to produce a valid signal?

It is worth while, quite independently of the popular expectations of the present moment, to inquire into the actual conditions of the problem, telescopes on Mars as powerful as our own being always assumed.

If we are armed with a powerful telescope, under the best seeing conditions, first among which is its location at a considerable elevation, we may perhaps reckon upon using a power of 1000, that is, the object is magnified a thousand diameters; in other words, it is brought a thousand times nearer. In the case of the moon, under these conditions any part of her we might choose to study could be examined, as if from London we were viewing it over Yorkshire with the naked eye.

The late Mr. Lassell, I believe, claimed as the highest achievement possible with his 4-foot telescope in the pure air of Malta, that if the lunarians were shaking a carpet as large as Lincoln's Inn Fields he could see whether it was round or square. This then would be the *ne plus ultra* in the case of a body 240,000 miles away.

Now, if we take the nearest distance to Mars as 35,000,000 miles, as I have stated,

			Miles.	
1,000,000	magnifying power would give us the power of studying Mars as if it were		35	away from us.
100,000	ditto	ditto	350	
10,000	ditto	ditto	3500	
1000	ditto	ditto	35,000	

We can put this differently. To the naked eye at the distance of Mars 1″ = 160 miles. Were Mars 1000 times nearer 1″ would become ·16 mile. Now this at first seems very hopeful, for the exterior satellite of Mars has been seen in various telescopes.

We have already learned that the power employed last month at the Lick Observatory has not been so much as 1000, but such that the planet has been brought within a distance of 50,000 miles. Under these conditions a line on Mars a quarter of a mile long will subtend an angle of 1″, or two lines a quarter of a mile apart should be separated and appear as doubles.

The second satellite to which reference has been made is only some 10 miles in diameter. We are justified by the visibility of the satellite, then, in saying that if a space 10 miles in diameter could be lighted up, as brilliantly as by sunlight, on the dark hemisphere of the Earth when Mars is above the horizon and at perihelion, it could be seen from Mars by telescopes equal to our own.

London, of course, is more than 10 miles in diameter, and we can imagine all the navies of the world with their search lights to flash simultaneously towards the planet, or to light up the clouds in a space as large as London, but there then will remain the question of the intensity of the light. What do electricians say is possible in this direction?

Whatever the answer to this question may be, it seems that signalling on Mr. Haweis' lines, light on dark, is a more hopeful proceeding than that suggested by Mr. Galton, and that on this system our conditions for reading signals are far better than those on Mars, as our dark hemisphere is much more exposed to our sister planet than is hers to us.

It is time now that we turn to those recent observations of our neighbour which have given rise to the ideas we have been discussing—ideas based upon the supposition that there is evidence which goes to show that the Martians are signalling to us by digging "canals" 1000 miles long and 200 miles wide, and then doubling them, and in addition lighting numerous signal fires or flashing electric lights!

Here we approach a region of astronomical inquiry which requires no enhancement of its interest by the intrusion of popular delusions or imaginings, which, moreover, for the next few months as details come to hand, will have all eyes directed to it.

It is not necessary to go further back than the year 1830 to appreciate the importance of the later inquiries. In 1830 Beer and Mädler made an admirable series of drawings of the planet which enable d them to affirm the existence of fixed markings, and having fixed markings, not a long series of observations was necessary to determine the period of the planet's rotation on its axis.

In 1862 I (and many others) had no difficulty in recognizing the features on the planet which Beer and Mädler had observed with smaller optical power thirty years before. The instrument employed was a 6-inch Cooke achromatic, which I still hold to be one of the finest telescopes ever made. It enabled me to add details to those before noted, and the observations left no doubt on my mind that Mars had an atmosphere like our own; that its temperature did not vary many degrees from our own; that there were land surfaces and water surfaces; clouds and very obvious cloud drift; polar snows which melted with marvellous rapidity as the perihelion sun made its full strength felt. Further, that the changes in the appearances observed, especially in the lighter or darker shading, depended upon clouds and the smoothness or roughness of the water surfaces.

This latter conclusion I arrived at from the fact that the darkest markings, assuming them to be water surfaces, were more or less land-locked, and that changes in some of these surfaces were always most obvious close to the land. It was clear also that the rapid melting of the polar snow must be accompanied by tremendous inundations.

I append, as an example of the kind of work done on the planet with the small refractors generally available thirty years ago, some extracts from a memoir I communicated to the Astronomical Society at that time.[1] The large refractors employed added so far as I know very little.

"Although the complete fixity of the main features of the planet has been thus placed beyond all doubt, daily—nay, *hourly*—changes in the detail and in the tones of the different parts of the planet, both light and dark, occur. These changes are, I doubt not, caused by the transit of clouds over the different

[1] *Pall Mall Gazette*, August 18.

[1] Mem. R.A.S. 1863, p. 179.

features. The effect of a cloudless and perfectly pure sky, both here and on Mars, appears to be that the dark portions of the planet become darkest and most distinctly visible; the coast-lines (if I may so call them) being at such times so hard and sharp, that (as has been mentioned by Mr. Lassell) it is quite impossible to represent the outlines faithfully; and this effect, be it observed, is completely distinct from the way in which the features grow upon one. MM. Beer and Mädler remark: 'Generally some time elapsed before the undefined mass of spots seen upon first looking into the telescope resolved itself into recognizable parts.' This observation will commend itself to all who have observed such a delicate object.

"The effect of clouds, on the contrary, will be, I think, to make the *dark portions less dark* in proportion to the density of the clouds, and the *light portions lighter* in the same proportion. *It can never make a light portion dark.* If this be so, when we see a dark spot well defined, we can be sure that no clouds are above it, and that we actually see the planet itself; we cannot be sure, however (unless we are acquainted with the locality from previous observation), that dark spots do not underlie any of the lighter portions. Some instances of cloud-transit were suspected by Father Secchi in 1858. Several unmistakable instances occurred during my observations. . . .

"But besides the cloud-masses, which, as we have seen, obliterate the dark portions either partly or wholly, giving rise to different contours and tones, and rendering the actual features of the planet undistinguishable, the dense atmosphere of Mars, with its fogs and mists, appears to go for very much. I mention this more especially to point out that—although its effect was evident in the southern hemisphere in mid-summer, upon the spots as they came on, and left the disc, as remarked by previous observers—it was much more evident in the northern hemisphere in mid-winter, blotting out, as before remarked, *even on the central meridian*, all features north of + 30° latitude. This would appear to furnish another proof of extreme seasons on Mars, in addition to that supplied by the rapid melting and great extent of the polar snows, and to point out the desirability of taking advantage of all oppositions which happen, as did those last year and in 1830, in the full summer-time of the southern hemisphere, when the atmospheric conditions of the planet may be considered the best possible. With regard to this last point, it may be remarked that the southern hemisphere is the one which we shall ever be able to study best, in consequence of the great distance of the planet from us at those oppositions which occur when the northern one is turned to us.

"With regard to the green and red tints so often noticed on Mars, my observations have led me to hold the same opinions as to their nature as those arrived at by Father Secchi in his study of the planet in 1858. Nor do I think that it can any longer be doubted that—as he considered probable—the green and red portions do actually represent seas and continents, and are not the effect of contrast.

"The dark portions were noticed to be decidedly green in my instrument, both by myself and others who observed Mars from time to time with me, the colour being especially marked in Beer and Mädler's spot *p n* (Drawings Nos. 7 and 8). In spite of the over-correction of my object-glass, which should have 'reinforced' the red tinge, it was never sufficiently decided, I think, to suggest a contrast; and, indeed, the green was sometimes unmistakable when the red was not noticed, and when therefore there was no contrast to mislead the eye.

"Another point of agreement between the two series of drawings is not a little remarkable: the spots which were observed to be of a most decidedly dark tint in 1830 were darkest last year; and supposing the dark portions to be water, the darkest spots are those which are nearly, if not quite, land-locked. Passing on from the consideration of the general features of the planet, the snow-zone next demands our attention. . . . . Last year the solstice occurred on August 30, on the 23rd of which month the snow-zone was estimated to be $\frac{1}{5}$ of the apparent diameter; by the 25th of the next month, September, this was reduced to about $\frac{1}{10}$, and again to $\frac{1}{15}$ by October 11, when it was at times scarcely discernible; after which it began apparently to increase again.

"To the great eccentricity of the orbit of Mars, and the fact that the summer of the southern hemisphere occurs when the planet is near perihelion, is doubtless to be ascribed this very rapid melting of the southern snow-zone, an observation confirmed by the much slighter variation in the dimensions of the opposite one. It appears to follow from my drawings, and I think also from those of Messrs. Beer and Mädler, although they make no mention of the fact, that even at its minimum the centre of the snow-zone was not absolutely coincident with the planet's pole, being situated in somewhere about 20° of areocentric longitude (using Beer and Mädler's start-point), and in a latitude probably only a very few degrees from it. . . . . The snow-zone was at times so bright that, like the crescent of the young moon, it appeared to project beyond the planet's limb. This effect of irradiation was frequently visible; on one occasion the snow-spot was observed to shine like a nebulous star when the planet itself was obscured by clouds, a phenomenon noticed by Messrs. Beer and Mädler, recorded in their valuable

FIG. 3. Mars September 25, 1863, showing the darker shading of a land-locked water surface and its projection into the open water beyond.

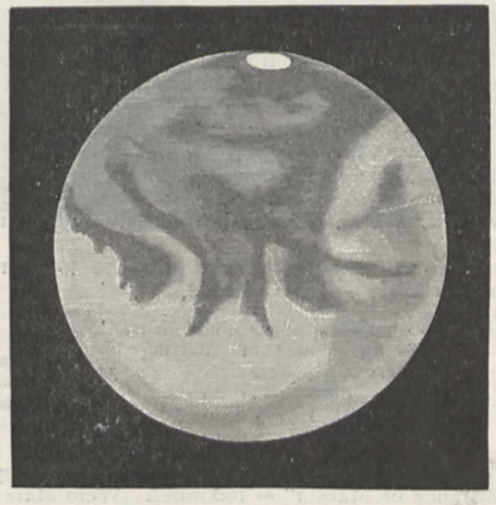

FIG. 4. Mars September 23, 1862, showing bright appearance of snow cap, and the details of one of the chief coast lines.

work, *Fragments sur les Corps Célestes*. The brightness, however, seemed to vary very considerably, and at times, especially when the snow-zone was near its minimum, it was by no means the prominent object it generally is upon the planet's disc."

We owe it to the illustrious Italian astronomer Schiaparelli that a world of wonders undreamt of thirty years ago now forms the chief subject of inquiry. His work was begun at the opposition of 1877, which, as we have seen, was as favourable as the present one, and continued during that of 1879-80. He showed that those

parts of the planet which had been regarded by myself and others as the land surfaces, instead of being wanting in detail, as they had been seen, were really riddled by streaks, many of them very long and very straight, but in every case running towards a water surface, and in many cases connecting two water surfaces. These streaks he called *canali*, which in Italian, as *canalis* in Latin, means either a channel, a canal, or a pipe. Unfortunately, however, whenever it has been translated into English the word *canal* has been used, which of course with us suggests human labour. We have already seen what this has led to.

As a result of this minute inquiry rendered possible by his fine instrument (8¾ in. Merz) and perfect observing weather, a complete map of the planet with these channels was made.[1] But this was but the beginning of marvels. During the opposition of 1881-82 the work was continued, and now Schiaparelli, besides endorsing all the discoveries of 1880-81, found that in at least twenty cases the channels were doubled and consisted of two streaks 200 or 400 miles apart, instead of one. I append

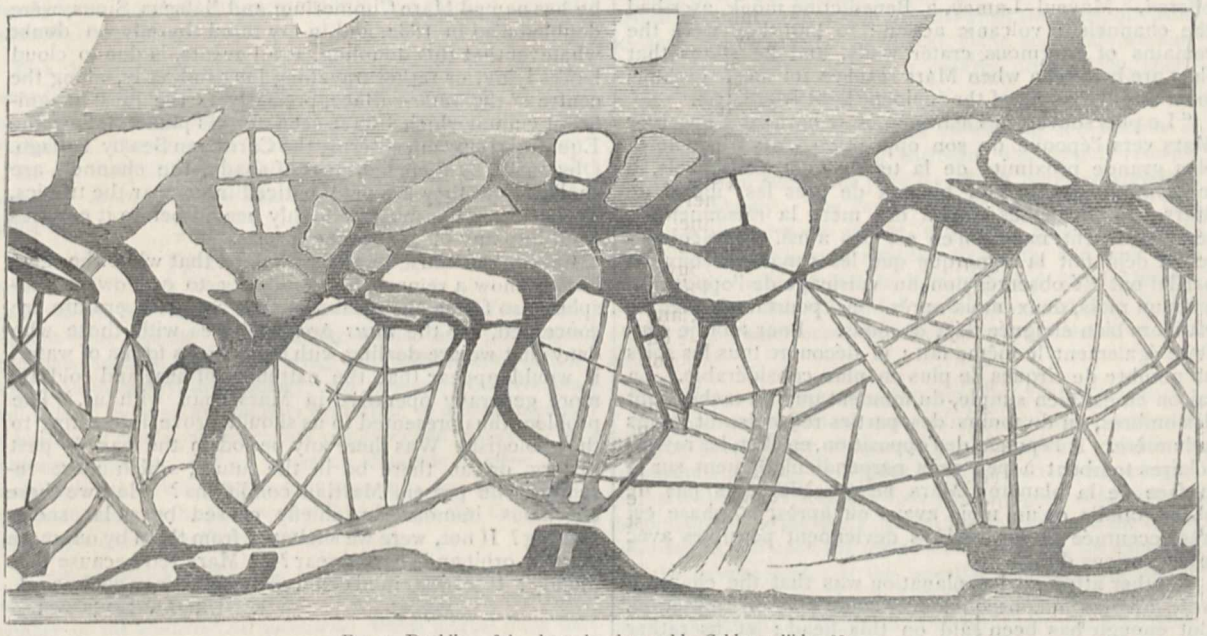

FIG. 5. Doubling of the channels, observed by Schiaparelli in 1882.

a copy of the sketch map he gave in his preliminary communication to the Academy of the Lincei.[2]

He distinctly stated that the doubling of these channels seemed to be connected with the time of the planet's year, and to occur simultaneously over the superficies of the planet which is supposed to represent land. When the opposition took place in August, that is in the full winter of the northern hemisphere, no trace of the doubling was visible which is precisely what we should expect if the doubling depended in any way upon inundations caused by the melting of the northern snows, the north pole being turned away from the sun. The vernal equinox took place on December 18, 1881, and the opposition took place in the same month. The doubling of 17 of these channels was observed between January 19 and February 19—that is, in the late spring of the northern hemisphere, which again is precisely what we should expect if they were connected with inundations.

[1] Osservationi astronomiche e fisiche sull' asse di rotationie e sulla topografia del pianeta Marte. R. Accad. dei Lincei, 1880 81.
[2] Memorie della Soc. Spettroscopisti Italiani, vol. ix. Dis. 6, p. 25.

Not only was this wonderful change noted, but here and there bright spots (previously noted by Green in 1877, and recalling Dawes' "snow island," seen in 1865), were recorded.

In the doubling of these water channels then, and in these snow-tipped hills, we have the origin of the "canal digging" and "fire signals" of which we have lately heard so much.

It will thus be seen that the widespread notions of the signals from Mars rest only on a mistranslation and upon the popular imagination running riot among the startling revelations of modern observers, among whom in this special line of work Schiaparelli must be acknowledged as *facile princeps*.

The observations which engendered invention in one class of minds engendered doubts in others, but the work of Perrotin and Thollon at Nice in 1886 with the 15-inch refractor has completely endorsed the main points advanced by Schiaparelli with regard to the existence of the channels or straits. Two or three references to their published papers will show clearly what their view of the relation of them to the variously-tinted parts of the planet really is :—

"The triangular continent, somewhat larger than France (the Lybia of Schiaparelli's map), which at that time stretched along both sides of the equator, and which was bounded south and west by a sea, north and east by channels, has disappeared. The place where it stood, as indicated by the reddish-white tint of land, now shows the black, or rather deep-blue, colour of the seas of Mars. The Lake Mœris, situated on one of the channels, has also vanished, and a new channel, about 20° long and 1° or 1°·5 broad, is now visible, running parallel with the equator to the north of the vanished continent. This channel forms a direct continuation of a previously existing double channel, which it now connects with the sea. Another change is the unexpected appearance about the north pole of another passage, which seems to connect two neighbouring seas through the polar ice."[1]

A short time afterwards M. Perrotin stated that this same district of Libya, had undergone a further change, the "sea" which had so recently covered it having retreated

[1] Abstract in NATURE May 21, 1888.

again for the most part, so that the appearance of the district was intermediate between that which it recently presented and that under which it was seen in 1886. Of the channels M. Perrotin has noticed four, three of which are double, which, starting from the "seas" of the southern hemisphere near the equator, and following a nearly meridional course, extend right up to the north polar ice cap, being traceable across the "seas" which immediately surround the latter.

Although Schiaparelli, as it will have been seen, connects the changes in the channels with the seasons of Mars, and although Perrotin and Thollon show their relation to the seas in their vicinity, other explanations of the phenomena have been suggested. Among these we must first refer to the view of Fizeau,[1] that we were in presence of the results of glaciation on a tremendous scale, the parallel ridges being likened to crevasses or rectilinear fissures! It was imagined by him that relatively longer seasons and a lower temperature were capable of producing crevasses some thousands of miles long and hundreds broad.

But this was not the only physiographic explanation offered. Mayeul Lamey, a Benedictine monk, ascribed the channels to volcanic action; to him they were the remains of enormous crater walls, and he states that they are best seen when Mars reaches its most gibbous form and the angle of the incident light is greatest.

"Le plus souvent les astronomes se bornent à observer Mars vers l'époque de son opposition, c'est-à-dire de sa plus grande proximité de la terre; c'est, pensent-ils, le meilleur moyen de voir bien et de près les 'mers' de Mars. Si ces taches étaient des mers la raisonnement serait excellent, mais il n'en est pas ainsi. M. Schiaparelli a déjà fait la remarque que les canaux découverts par lui ont été observés non au voisinage de l'opposition mais un mois, deux mois après. Et pourtant la planète est alors bien eloignée déjà de nous. Pour moi, je constate également le même fait; je découvre tous les soirs un nombre de cirques de plus en plus considérable. La raison en est bien simple, du moment que les taches sont des ombres, ou du moins des parties réfléchissant moins lu lumière. A l'époque de l'opposition, en effet, les rayons solaires tombent à peu près perpendiculairement sur la surface de la planète; Mars ne possède alors pas de phase, tandis qu'un mois avant ou après, la phase est très accentuée et les ombres deviennent possibles avec les élévations du sol."[2]

Another attempted explanation was that the channels were doubled in consequence of some play of diffraction. But enough has been said on this head; let us rather turn to the first fruits of last month's work.

At the Lick Observatory the channels were seen, and one of them was considered by three observers to be doubled.

From Peru we learn that Prof. Pickering saw many of the channels observed by Schiaparelli, but all were found to be single. The telegram adds, "not double, as stated by him"; but here is an error. We are near the southern solstice, as in 1877, and they were *not* seen double at that epoch. But even this is comparatively uninteresting after the revelations as to the effects of the melting snows.

Prof. Pickering discovered two mountain ranges in Mars to the north of the green patch near the planet's south pole. Between these mountain ranges the melted snow has collected before flowing northward. In the equatorial mountain regions snow fell, covering two of the summits, on August 5. On August 7 the snow had melted. "I have seen eleven lakes," the professor writes, "varying in size. These lakes branched out in dark lines connecting them with two large dark areas like seas, but not blue. There has been much local disturbance in the clouds round the planet since the snow melted, as is evident from the dense clouds which were concentrated within one area. These clouds were not white, but yellowish in colour, and partly transparent. They now seem to be breaking up, but are still hanging densely on the south side of the mountain range. The northern green spot has been photographed."

Surely we have here the connection between the work of 1862 and 1877. The channels are true water channels; at one time at low channel we may have an unimportant stream like the low Nile; at another an ancient river-bed, as it were, is filled to the utmost limit by the inundation. One requires to have seen an Indian river, or better still, the Nile valley to realize what an inundation may mean, and especially under the conditions which have now been established to exist on Mars. But we may go further. A comparison of Schiaparelli's sketch of 1882 with his map of 1879, helps us considerably, and shows that we must take the effect of clouds over warm water into consideration. Two among the most undoubted and continuous water-surfaces which I observed in 1862, which he has named Mare Cimmerium and Sabæus Sinus, were doubled also in 1882, and in my mind there is no doubt whatever that this doubling, at all events, is due to cloud banks lying, or rather travelling longitudinally, along the centre of the water-surface, precisely as the most magnificent cumuli which I have seen on this planet, follow the Equatorial current, entering the Carribean Sea by Tobago. Obviously, by their lightness of shade, the channels are shallow, and they are only noticed in or near the tropics, so that the water must be highly heated before it empties itself into any of the southern seas.

Certainly it must be acknowledged that while the revelations show a remarkable similarity to our own atmosphere, so far as chemical structure and temperature are concerned, for the *onus probandi* lies with those who deny that we are dealing with the various forms of water, it would appear that the extremes of heat and cold are more generally operative in Mars than with us. The problem thus presented to us should prove interesting to the geologist. Was there any period in the earth's past history, or can there be in the future, which more resembles the present Martian conditions? Had we these enormous inundations, chiefly caused by polar snows melting? If not, were we sheltered from them by our more circular orbit and shorter year? Is Mars red because it is muddy? If so, what mud could give it the tinge we know?

J. NORMAN LOCKYER.

[1] *Comptes Rendus*, June, 1888.

[2] "Note sur la Découverte du Système Géologique Éruptif de la planète Mars." Par Fr. Mayeul Lamay, O.S.B. Autun. (Dejussien, 1884.)

NOTES.

FOR some days much anxiety was felt as to the condition of Sir Richard Owen. We are glad to say that his health has greatly improved, and that he is now able to take more nourishment.

THE four hundredth anniversary of the discovery of America is being celebrated this week with great splendour at Genoa. The King and Queen of Italy are taking part in the celebration, and the maritime Powers are represented by a fine assemblage of warships.

A BOTANICAL CONGRESS, which is attended by some of the most eminent botanists of Berlin, Paris, Jena, and St. Petersburg, was opened at the University of Genoa on September 5.

AN interesting ceremony took place at the University of Genoa on Tuesday, when the Hanbury Institute was formally handed over to that body. The correspondent of the *Times* at Genoa says that Mr. Thomas Hanbury, an English gentleman, whose house at La Martola, near Ventimiglia, is well known to visitors to the Riviera, had already won the gratitude of Italians

by his generous deeds in that neighbourhood, and a year or two ago he offered £4000 to found an institution in Genoa for the encouragement of the study of botany. Senator Secondi, president of the University, gave expression to a sincere feeling of gratitude towards Mr. Hanbury, and accepted the gift of the institute in the name of the University. A large number of distinguished botanists, who are attending the congress now being held there, were present at the ceremony.

THE meeting of the German Mathematicians' Union in Nürnberg, and the Mathematical Exhibition, are postponed on account of the cholera.

THE German Chemical Society have resolved to found an Institute in remembrance of the late Prof. von Hofmann. Large funds will naturally be required, and all pupils and those who honour Hofmann's life and work are earnestly requested, in a recently-issued circular, to send contributions. Even those who had no personal knowledge of the illustrious *savant*, but have been inspired to work by his example, will no doubt be willing to take part in the scheme. The proposed Institute will not merely serve chemical purposes, but will be a place of general scientific research.

THE International Congress of Physiologists has held its second triennial session at Liège with Prof. Holmgren (Upsala) as President, in the Physiological Institute under Prof. Léon Fredericq. The Congress terminated on Thursday, September 1, after a banquet at which the Burgomaster of the city was present. More than one hundred physiologists attended the Congress.

THE thirteenth Congress of the Sanitary Institute will be held at Portsmouth from September 12 to 17. Sir Charles Cameron will preside. The Congress will be divided into three sections—one dealing with sanitary science and preventive medicine, another with engineering and architecture, and a third with chemistry, meteorology, and geology. Conferences will be held by naval and military hygienists, by medical officers of health, by municipal and county engineers and surveyors, by sanitary inspectors, and by ladies on domestic hygiene. A health exhibition, including sanitary apparatus and appliances, in connection with the Congress, will be held in the Drill Hall from September 12 to October 8.

A PHOTOGRAPH of the late Admiral Mouchez—one of the best photographs of him we have seen—appears in the July number of the *Bulletin Astronomique*, which journal owes its existence to his indefatigable exertions. There is also a brief account of his life written by M. Tisserand.

THE sixth session of the Vacation Courses, known as the Edinburgh Summer Meeting, has just come to a close after a very successful month's work. The importance of this meeting increases year by year with the steadily increasing number of students, and with the more complete organization of the plan of study. This has again been arranged so as to assist in the training of school teachers and University Extension lecturers for the new duties which are beginning to devolve upon them in connection with the requirements of County Councils for technical education. Hence the principle of "Regional Study" has again been kept prominently in view, Edinburgh and its districts being taken as a typical area, and affording a starting point and vivid concrete illustrations for the courses on sociology and anthropology (Profs. Geddes and Haddon) on the one hand, and on the other for those on biology (with special courses of zoology and botany) and physiology by Mr. J. Arthur Thomson, Prof. Haycraft, and others. The course on literature by Prof. Moulton, which was very largely attended, followed to a large extent the same general lines as the more purely scientific courses. The work in the historical seminary and the studio was continued, and a series of technical education lectures was given in the evenings by Principal Dyer, Profs. Mavor, Geddes, and Prince, Mr. C. Williams, and others. Many nationalities were represented among both students and teachers. Besides many British Association and other visitors, Profs. Haeckel (Jena), Delage (Paris), attended the meeting. Special lectures were delivered by Profs. Devine and Rolf (Philadelphia), Profs. Manouvrier and Demoulins (Paris), Principal Dyer, Profs. Mavor, Prince, Lloyd Morgan, Sollas, Messrs. R. Aitken, W. Renton, R. Irvine, and others. A series of interpretative recitals by Prof. Moulton, and four concerts illustrating the history of music were also given.

FIFTY scholarships, named the Townshend Scholarships, from funds bequeathed by the late Rev. Chauncey Hare Townshend, for working-class boys or girls between 14 and 21, to be held for one year, have just been established in connection with the Westminster Technical Institute, 40 being free and 10 competitive. The subjects taught in the Institute, which was founded by the Baroness Burdett-Coutts, are rudimentary, commercial, and technical, and include drawing, technical, mechanical, and artistic; geometry, practical, plane, and solid; working in wood, lead, metal-plate, &c.; cookery, dressmaking, shorthand, foreign languages, &c.

A REMARKABLE grotto, which is exciting the interest of French geologists and mining engineers, was recently revealed by an explosion during the progress of the ordinary work in a quarry at Taverny. The Paris correspondent of the *Times* says there is a subterranean gallery, with walls polished as if by water; and that it is some 1500 feet in length, and ends in a great chamber about 40 feet in diameter and 6 feet in height. Scientific men have hazarded various conjectures as to the source of the watercourse by which this cavity seems to have been formed.

MR. HERMANN KRONE gives, in No. 7 of Wiedemann's "Annalen," an account of some further experiments connected with the photography of spectra in their natural colours by Lippmann's method. He finds that the correct rendering of the various colours depends upon a high degree of accuracy in the proportions of the finely divided silver haloid and the colour sensitiser, as also upon the temperature of drying, the exposure, and the development. If the essential conditions are not fulfilled, it may happen that yellow appears in the place of red, or that green exhibits a direct transition into violet, the blue being unrepresented. The result also depends upon the amount of water contained in the film, as influencing its thickness, and in the case of the solar spectrum upon the altitude of the sun. With a very long exposure the infra-red appears as a dark purple, and the ultra-violet as a yellowish-pink lavender colour. Mr. Krone has also succeeded in producing coloured photographs without Lippmann's mercury mirror. He simply covers the film with black velvet, exposing, as Lippmann did, through the glass. In this case, the reflection from the inner surfaces of the glass takes the place of that from the mercury. The exposure has to be considerably prolonged, and the colours towards the red end are less pure; but the blue, violet, and ultra-violet are quite as brilliant and well defined as in the mercury process.

DURING the past week the weather has assumed a decidedly autumnal character, the maximum temperatures being below 65° in many parts of the United Kingdom, and below 55° in some of the northern parts. For the first few days depressions from the Atlantic caused unsettled and showery weather, with strong winds or gales. On Sunday, however, an area of high pressure spread over England, and under its influence the sky

rapidly cleared, and the wind became northerly, while at Greenwich Observatory a temperature of 4° below freezing point was registered on the grass; but the more northern and western parts of the Kingdom were still disturbed by depressions from the westward. These have subsequently spread over the greater part of the country, and winds have again become south-westerly generally. The facts shown by the *Weekly Weather Report* for the period ending the 3rd instant, are interesting:—The rainfall exceeded the mean in all districts, the greatest excess being in the west of Scotland and the north-west of England, and the fall was more than twice as much as the normal amount over the Kingdom generally. Temperature was below the mean in all districts, except the south of England and the Channel Islands, while in Scotland the lowest shade minima were between 32° and 35°.

PROF. MOHOROVIĆIĆ, of Agram, writes to the *Meteorologische Zeitschrift* for August a preliminary notice of a most destructive wind-rush, which occurred at Novska, in Slavonia, on May 31 last, and which he has been requested by the government to investigate on the spot. He reports that as the train left Novska station soon after 4 p.m. on that day, a sudden darkness came on; all the carriages of the train were thrown off the line with a great crash, and three of them were carried by the force of the wind to a distance of about 100 feet, the violence of the wind being aided by the bursting of two water-spouts over the railway. The tornado then traversed a primeval forest which lies to the north-east of Novska, tearing up over 150,000 large trees, and stretching them on the ground round the centre of the disturbance with the regularity of arrows around a barometric minimum of a weather chart, in a lane of about 1½ to 2 miles in diameter. Among the curious instances is one of a girl, seventeen years old, being carried unhurt for a distance of over 300 feet. Were it not for the trustworthy source whence this information is obtained we should consider it to be greatly exaggerated, but Prof. Mohorovićić states he crossed the forest three times and carefully noted the position of the fallen trees, and he will no doubt give an official report of the occurrence later on, accompanied by meteorological data from various stations.

IN vol. xiv. of *Aus dem Archiv der Deutschen Seewarte* there is a discussion by E. Herrmann on the storms of the German coast in the years 1878–1887, based upon an examination of the observations taken at forty-seven stations, and containing monthly and yearly charts showing the prevalence of the winds from the various points of the compass. The results show a great preponderance of storms in the Baltic as compared with the North Sea; in ten years 191 storms are recorded in the Baltic and 101 in the North Sea. The decrease of storms in the North Sea in summer is also much more marked than in the Baltic. The maximum of westerly storms occurs in December, and that of the easterly storms in March and April. In the summer months most storms occur in August. The change of direction of the storms from south-west to north-west occurs most frequently in February, March, October, and November; and from north-west to south-west in January, February, and October.

IN a recent valuable memoir to the Berlin Academy on Thermodynamics of the Atmosphere (fourth of a series), Prof. von Bezold considers the cases of supersaturation with vapour, and of "overcooling" (regarding the latter it may be stated that clouds have been observed at a temperature below freezing, but having no ice-particles,—purely water clouds). A sudden cessation of these states, he shows, must result in rapid rise of air-pressure, which is generally of short duration, unless conditions are present which prevent its descent again. As such variations of pressure are characteristic of thunderstorms, the author goes on to investigate the *rôle* of supersaturation and overcoolings in these phenomena, and he shows how various movements and changes in form of thunderclouds, and the origin of hail and other phenomena, may be explained by them. He is of opinion that much thunderstorm rain has, high up, the form of hail or sleet, and the large drops are simply melted hail or sleet particles, these forms playing a more important part in thunderstorms than is commonly supposed.

A REUTER'S telegram from Catania, dated September 2, announced that the eruption of Etna had broken out afresh, and that the chestnut woods on the mountain slopes were being devastated by the lava, which was pouring down the mountain in one dense mass, instead of flowing in two separate streams, as it did before.

THE Norfolk and Norwich Naturalists' Society has issued its Transactions for 1891-92. We are glad to see that this Society, which has now entered upon its 24th year, continues to prosper, the roll of members numbering 250, and the balance-sheet being very satisfactory. The catalogue of the library, which is printed in the current number of the Transactions, occupies 43 pages. Dr. Wheeler, in his presidential address, discourses on the changes which have taken place in recent times in the distribution of some species of insects, more especially of the typical insect fauna of the old fen-land of Huntingdonshire and Cambridgeshire and of the Norfolk Broads. Dr. Plowright contributes a paper on "Neolithic Man in West Norfolk," with illustrations, by Mr. Worthington Smith, of a number of flint implements found on Massingham Heath, near Lynn, and a description of the site of an ancient British village in the same locality. This is followed by a paper on the St. Helen's Swan Pit, in Norwich, where, towards the end of August, from 80 to 100 cygnets may yearly be found gathered together for the purpose of being fatted for the table. Mr. Southwell, the writer of the paper, also gives some interesting particulars of the breeding of the Mute Swans, which abound on the Norfolk waters. Mr. Clement Reid follows with a paper "On the Natural History of Isolated Ponds," as illustrating the dispersal of the fauna and flora of a district in recent times; and Mr. O. V. Aplin contributes a paper "On the Distribution in Great Britain and Ireland of the Red-backed Shrike." This is followed by the eleventh annual report on the Herring Fishery of Yarmouth and Lowestoft, by which it appears that the enormous number of 290,650,800 of these fish were landed at those ports in 1891. There are other minor papers "On the Meteorological Features of 1891," by Mr. Preston, and shorter notes on the "Marine Fishes of Yarmouth," the "Botanical Occurrences of the Past Year," and other matters of interest.

ACCORDING to a report compiled by the French Statistical Bureau, the vineyards of Europe cover 22,973,902 acres. Italy comes first with 8,575,000 acres, followed by France with 4,592,500, Spain with 4,012,500, Austria and Hungary with 1,637,500, and Germany with 300,000 acres. The annual average production of the European vineyards is put at 2,652,300,000 gallons; Italy producing (in round figures) 697,000,000 gallons, France and Spain 608,000,000 each, Austria-Hungary 208,000,000, and Germany 51,000,000 gallons. Spain exports most wine (200,000,000 gallons), but it is chiefly common wine, and it is estimated at only £12,000,000, while the value of the 56,000,000 gallons exported from France is put at nearly as much. Italy comes third with exports of 45,000,000 gallons, estimated at £2,800,000, while Austria and Hungary exported only 16,500,000 gallons worth £1,720,000.

THE American journal *Electricity* notes that Prof. Elisha Gray, Chairman of the World's Congress Committee on an Electrical Congress, has returned to America from Europe. He

visited England, France, Germany, Austria, Roumania, Turkey, Italy, Greece, and found everywhere that a lively interest was taken in the Columbian Exhibition. In an interview in the daily press he says, "Many eminent electricians of different countries are expected to attend the congress, including a large number from Great Britain. The work of the World's Congress auxiliary has been done so quietly that the general public is not aware of its extent and efficiency. There seems now to be no question that the World's Congress of 1893 will be very much more largely attended and will be conducted on a more imposing scale than those of any previous occasion in the world's history."

A MODEL of ocean currents is to be shown at the Chicago Exhibition. The surface of the earth is represented on "a huge scientific tank" by an area of about 30 feet square, the ocean and seas being shown by actual water. Small streams of water are ejected through pipes under the model so that the whole body of water moves exactly as the ocean currents move. The direction of the currents is shown distinctly by a white powder on the surface of the water. Near the model will be placed a large map giving details as to the force, volume, and direction of the various ocean currents.

A USEFUL catalogue of Michigan plants, prepared for the thirteenth annual report of the Secretary of the Michigan Board of Agriculture, has been issued separately. It has been drawn up by W. J. Beal and C. F. Wheeler. It is based on a "Catalogue of the Phænogamous and Vascular Cryptogamous Plants of Michigan, Indigenous, Naturalized, and Adventive," by C. F. Wheeler and E. F. Smith. The compilers hope that the publication of their list will stimulate local observers and collectors to do what they can to add to what is known about the plants of Michigan, especially in the matter of geographical distribution.

DR. R. W. SHUFELDT contributes to the Proceedings of the U.S. National Museum (vol. xv., pp. 29-31) a short but interesting paper on "A Maid of Wolpai"—a girl of about fifteen years of age, belonging to the pueblo of Wolpai in north-western Arizona. A portrait of her accompanies the paper. The writer's object is not so much to talk about this particular girl, as to describe the life of a Wolpai woman at the various stages of her career. His conclusion is that, upon the whole, it is by no means an unhappy life. "From her babyhood to maturity," he says, "it is filled in with many pleasurable chapters, and no doubt a great deal of this is due to their contented dispositions, their love of home, and their untiring industry."

IN another paper contributed to the same volume (pp. 279-282) Dr. Shufeldt discusses the evolution of house building among the Navajo Indians. From November, 1884, to the early spring of 1889 Dr. Shufeldt lived at Fort Wingate, a military station in north-western New Mexico, and during the early part of this period there was always to be found a floating population of Navajos living on the outskirts of the fort. He had thus many opportunities of studying their various arts and industries. He shows that contact with the civilization of the white man has led these Indians to improve their plans of house building, and has had "the effect of bringing about an evolution of the same."

A VERY original mode of treatment of some nervous complaints has been recently developed by Dr. Charcot, at the Salpêtrière, in Paris (*La Nature*). He was led to it by observing that patients afflicted with *paralysis agitans*, or shaking palsy, often seemed greatly relieved after long journeys by rail or carriage. The greater the train speed and oscillation, the rougher the road and the shaking, the more they liked it and were benefited. Dr. Charcot, taking up the idea, had a chair made, to which a rapid movement from side to side was imparted by electrical agency; like what one sees in processes of sifting by machinery. To a healthy person the experience is execrable; he very soon seeks relief. Not so the patient, however; he enjoys the shaking, and after a quarter of an hour of it, is another man. He stretches his limbs, loses fatigue, and enjoys a good night's sleep afterwards. There are various other nervous diseases to which the method applies. Certain physicians, indeed, have before used such things as tuning-forks and vibrating rods in treatment of neuralgia, &c. A student of Dr. Charcot, Dr. Gilles de la Tourette, has had a vibrating helmet constructed for nervous headaches. It is applied to the head by means of a number of steel strips. Above is a small electric motor making 600 turns a minute; and at each turn a uniform vibration is imparted to the metallic strips, and so to the head. The sensation is not unpleasant; it induces lassitude and sleepiness.

ON Friday last Prof. R. L. Gardner, of Virginia, addressed the Balloon Society of Great Britain on his researches relating to what he calls the speech of monkeys. He defined speech as that form of materialized thought which was restricted to such sounds as were designed to convey a definite idea from mind to mind. It was, therefore, only one mode of expressing thought; and to come within the limits of speech the sounds must be voluntary, have fixed values, and be intended to suggest to another mind a certain idea or group of ideas more or less complete. Not only did these marks characterize the sounds of monkeys as speech, but, in addition, the sounds were always addressed to certain individuals, with the evident purpose of being understood. Monkeys usually looked at the individual addressed and did not utter these sounds when alone or as a mere pastime. They understood and acted in accordance with the sounds when imitated by the phonograph or other mechanical means, and this indicated that they were guided by sounds alone, and not by signs, gestures, or a physical influence. He had also discovered that some monkeys could count three and had favourite colours, but he did not think they had names for them. He had for hours together watched monkeys convey to each other by sound the apprehension of danger and other emotions. His task, which was not easy, was to perpetuate or imitate these sounds. In some cases he was successful, but to no great extent. At last he turned to the phonograph—an instrument which was practically unknown in this country, save as a clumsy toy. But a properly manipulated phonograph could repeat sounds, previously recorded, with mathematical precision. He had the good fortune to find that the sounds so carefully preserved in one zoological garden provoked interest, and were apparently quite intelligible to monkeys in other gardens in distant countries. His observations had hitherto been conducted with monkeys in captivity, but he was now on his way to the deep forests of Western Africa, once visited by Paul du Chaillu, in order to study the language and habits of the great apes. He was carrying with him an outfit of the most complete and unique character that had ever been brought into use for such purposes. He meant to live in a cage and to provide himself with an electrical apparatus. His cage was convertible, and weighed 320lb., and he could make four cages of it and bring home a gorilla in one of them.

AT the last prize contest instituted by the City of Paris for the best electric meter the prize of 5000 francs was awarded to Prof. Elihu Thomson. Desiring that this sum should serve for the development of the theoretical knowledge of electricity, Prof. Thomson requested M. Ernst Thurnauer, General Manager for Europe of the Thomson-Houston International Electric Company, to offer a prize for the best work on a theoretical

question in electricity, and to organize a committee who should propose the subjects, examine the productions, and decide the prize. The following gentlemen have consented to act as members of the Committee:—J. Carpentier, President of the Société Internationale des Electriciens; Hippolyte Fontaine; E. Hospitalier, Professor in the School of Physics and Chemistry of the City of Paris; E. Mascart, Member of the Institute; A. Potier, Member of the Institute (Examiner); B. Abdank-Abakanowicz, Consulting Engineer (Secretary of the Committee). The Committee has decided that the prize should be given for an investigation on one of the following subjects:—(1) The heat developed by successive charges and discharges of condensers under different conditions of frequency, nature of dielectric, and quantity of charge. (2) It has been shown theoretically that when the two surfaces of a condenser are connected by a conducting body, the condenser becomes the source of alternating currents as soon as the resistance of the conducting body decreases below a certain limit. The formula that permits calculating the period of this oscillation has not yet been completely verified. This period of oscillation should be investigated experimentally under conditions such that the exact measure of resistance, capacity, and coefficients of self-induction may be possible, in order to arrive at a complete and precise verification of this formula. (3) When a condenser made with an imperfect insulating material has been charged and then left to itself, the charge is gradually dissipated. The time necessary for the charge to be reduced to a given fraction of its initial value depends only on the nature of the insulating material. It is proposed to investigate whether, as certain recent theories would seem to indicate, analogous phenomena do not present themselves in metallic conductors, and whether these can be shown experimentally. (4) It is proposed to arrange and systematize our present knowledge of the graphical solutions of electrical problems, and deduce from them some general methods as in graphical statics. The theses presented may be written in any one of the following languages:—English, French, German, Italian, Spanish, or Latin. They may be in manuscript or printed. Each thesis presented must be signed by a pseudonym and accompanied by a sealed envelope bearing the same pseudonym on the outside, and with the name and address of the author inside. The papers must be sent before September 15, 1893, to B. Abdank-Abakanowicz, Consulting Engineer, the Secretary of the Committee, at 7 Rue du Louvre, Paris, who will furnish any further information required.

THE additions to the Zoological Society's Gardens during the past week include a Black-handed Spider Monkey (*Ateles geoffroyi*) from Nicaragua, presented by Mr. F. Vyner; a Macaque Monkey (*Macacus cynomolgus* ♂) from India, presented by Mr. Gerald E. Bridge; a Black-shouldered Kite (*Elanus cæruleus*) captured at sea, presented by Mr. J. Watson; a Falcated Teal (*Querquedula falcata* ♂) from China, presented by Mr. A. C. Moule; an American Black Snake (*Coluber guttata*) from North America, deposited; two Mule Deer (*Cariacus macrotis* ♀ ♀) born in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE STAFF AT THE LICK OBSERVATORY.—We are sorry to notice the very considerable changes that are now taking place in the staff at the Lick Observatory. It seems only quite recently that Prof. Keeler tendered his resignation to take over the directorship of the Allegheny Observatory, but now we hear that Mr. Burnham has resigned, and that Prof. Henry Crew has done the same, the former having accepted a position of clerk in one of the courts of Chicago, and the latter having been elected to a Professorship of Physics in the North-Western University at Evanstown, Ill. With the loss of these men the observatory will be crippled for some time; for, although very good men will be found to take their places, a thorough acquaintance with the instruments can be obtained only by constant and frequent practice. Of the remainder of the staff Mr. Barnard and Mr. Schaeberle will be the only representatives of the older members. What the cause of these changes is we do not know, but there seem to be signs of a little friction somewhere, for what is the probability that three men should sever their connection with such an observatory in the space of a year—assuming, of course, normal conditions?

THE OBSERVATIONS OF KLINKERFUES REDUCED.—The second part of the *Astronomische Mittheilungen of the Royal Observatory* in Göttingen contains a complete reduction of Klinkerfues' observations which he made in the years 1858 to 1863. The work has been undertaken by the Director of the Göttingen Observatory, Prof. Wilhelm Schur, and has been printed at the expense of the König. Gesellschaft der Wissenschaften zu Göttingen. In the introduction Prof. Schur gives a complete account of the instruments used and the methods by which the observations were made. The zone included in this work is that which lies between + 15° and − 15° declination. The interest that is attached especially to these observations is caused by the fact that Klinkerfues did not wish to adopt the usual method for determining the declinations directly from the readings of the vertical circles, but he used that generally known as Gauss' method, in which a mirror and scale played an important part. The epoch to which all the places are referred is that of 1860, and a table is also added by which the yearly precession in right ascension and declination can be easily determined.

PHOTOGRAPHS OF SOLAR PHENOMENA.—To the August number of *Astronomy and Astro-Physics* are contributed some striking pictures that represent some of the latest advances made by the application of the photographic plate to the telescope. These photographs were taken by Prof. G. E. Hale, of the Kenwood Astro-Physical Observatory, with the new spectro-heliograph, a description of which instrument will be found in the May number of the same Journal. The first photograph displays the spots and faculæ on the solar surface on May 21 last: a single glance at it will show us that we shall have to change very considerably our present ideas as to their extent, for instead of equalling the spots in area they exceed them so much as to place them relatively in entire insignificance. Another point that is at first noticed from the same photograph is the paucity of the faculæ at the limb with respect to the more central part of the disc, but this is, as we are told, only a fault in the process of reproduction, for in the original negatives the faculæ "are equally well shown on all parts of the solar surface." Another photograph of interest is that of the chromosphere and prominences taken on the same day; this was obtained by cutting off the light issuing from the solar disc by means of a metallic diaphragm; it resembles very strikingly a short-exposed photograph of the eclipsed sun, as the prominences on it as distinctly visible, while the presence of streamers and rifts is lacking. Since these photographs were taken, Prof. Hale has been able, by making two exposures on the same plate, to produce pictures each of which displays all the solar phenomena. For the first exposure he employed the metallic diaphragm, allowing the slits which move across it to travel with the velocity required for the prominences; for the second exposure the diaphragm was removed, and the rate of movement of the slits was this time very much increased.

A METEORITE.—In the *American Journal of Science* for August, Mr. H. L. Preston gives an account of the finding of a meteorite in Kenton County, eight miles south of Independence. In the year 1889 during the cleaning out of a spring, something very hard was struck which from the sound was thought to be metal. It was entangled among the roots of an ash tree three or four feet down in the ground, and was not removed from the spot until August 1890, when it was placed in a shed, and more recently bought for the Ward collection of meteorites. The measurements along its greatest diameters were 21 × 14 × 8 inches, and it weighed 359½ pounds. Its surface was covered with numerous but mostly shallow pittings, but was entirely free from crust. An analysis showed that it contained iron to the amount of 91·59 per cent., nickel 7·65, cobalt 0·84, carbon 0·12, with traces of copper and sulphur.

MOUNTING OF OBJECTIVES.—A novel but very useful way of mounting objectives is that adopted by Prof. Hale, who has

added another object glass to his equatorial. What he has done has been to employ a twin cell in which the glasses have been placed; the whole is then hung on an axis fixed rigidly to the side of the telescope tube so that by a simple rotation each glass, whether for photographic or for visual purposes, can be brought to the centre of the front of the tube. In order to make use of that objective which is not temporarily required for the main instrument, a tail-piece near the eye-end is also mounted, thus completing another telescope, only without a tube. One great disadvantage of this arrangement would be the difficulty of centring the lenses after each change, but this is not so as we are informed, no difficulty at all being experienced. In *Astronomy and Astro-Physics* for August, there is shown a picture of Mars emerging from occultation on July 11, taken without the tube. In the original photograph, which is about $\frac{1}{32}$ inch in diameter, the polar caps on the planet are clearly shown together with some of the other markings on the surface.

JUPITER.—During the next two months the planet Jupiter will be in a very good position for observation. This year he is as much as 5° to 8° north of the equator, being situated now in the constellation of Pisces, just north of the two stars μ and ν. The next opposition occurs on the 12th October.

NOVA AURIGÆ.—In a communication to the *Daily Graphic*, the Rev. A. Freeman gives the results of some observations of the revived new star in Auriga, made by him on Sunday, August 28. Adopting Mr. Stone's values for the magnitudes of the neighbouring stars, the nova would appear to have then been a trifle brighter than mag. 10·3, but decidedly fainter than 9·7. By comparison with the zone star +30° 924, the nova was rated at mag. 10·1. As Mr. Espin estimated it to be 9·2 on August 21, it is probable that the star is again waning.

From the Astrophysical Laboratory at South Kensington we have received the following:—There was no opportunity of observing the nova here until 1.30 a.m. on Thursday, September 1, and it was then too dim to be readily seen with the 10-inch refractor. A photograph of the region was taken with the 3¼-inch portrait lens, the exposure being thirty minutes, but this failed to show the nova, although clearly showing stars of the 10th magnitude.

COMET SWIFT, MARCH 6, 1892.—The following is a continuation of the ephemeris for Comet Swift, which we take from *The Edinburgh Circular*, No. 29:—

1892.	R.A. h. m. s.	Decl. ° ′	log. Δ.	log. r.	Br.
Sept. 8	0 32 27	+51 56·5			
9	31 8	51 48·8			
10	29 49	51 40·7	0·2751	0·4085	0·073
11	28 30	51 32·1			
12	27 10	51 23·2			
13	25 50	51 13·9			
14	24 30	51 4·1	0·2788	0·4164	0·069
15	23 11	50 54·0			

Brightness at time of discovery is the unit of Br.

The Edinburgh Circular, No. 30, announces the discovery of a comet by Mr. Brooks, at Geneva, U.S., at midnight on the 29th ult. The comet was then in R.A. 6h. 20min. and declination 31° 48′ north, its daily motion being +1min. 44sec. and 2′ south. The same comet has also been observed at Kiel on the 31st inst. at 12h. 32·2min.; its place then was found to be R.A. 6h. 5min. 59·1sec. North declination 31° 42′ 27″. Whether this comet is a new one or not cannot of course be said yet for certain, but it is neither Brooks' 1886 IV. nor Tempel 1867 II. if we can depend on the two search ephemerises we have at hand, for their declinations in both instances should be at this time over 30° south.

GEOGRAPHICAL NOTES.

MONTENEGRO, though one of the smallest, is certainly one of the least known countries in Europe. Dr. K. Hassert, who has already made important journeys in the less known parts of the Balkan peninsula, is this summer travelling through Montenegro, and describes the scenery as in many places of very great beauty. The frontier river Cijevna flows through a steep-sided gorge, the height of the precipices bordering which he estimates as over 3000 feet, while in its appearance it rivals the cañons of the Colorado. The traveller in this part of the country runs considerable risks from the predatory Albanian tribes.

THE *Times* publishes a telegram from Captain MacDonald of the Mombasa-Victoria-Nyanza Survey, announcing that the Survey had found a good route for a railway to Sio Bay on the Nyanza, and had returned to Kikuyu on August 8. The Survey work has been carried on rapidly, and, which is more important, without any fighting.

RAILWAYS in tropical Africa may ultimately derive more revenue from native passengers than might be anticipated. The railway from St. Paul de Loando is being pushed forward to Ambaca, and now nearly reaches Casengo, where there are flourishing coffee plantations under Portuguese management. Until this point is reached the revenue from goods cannot be large, but the natives having speedily got over their distrust of the innovation, now travel freely by rail in large numbers.

PROF. POUCHET has this summer succeeded in visiting Jan Mayen Island and Spitzbergen in the French gun-boat *La Manche*. Jan Mayen, on which a landing had not been made for ten years, was visited on July 27, and the vessel proceeded to Spitzbergen, where a fortnight was spent. The west coast was followed up to 78° N., and some excursions made on foot into the interior. Glacier phenomena were studied, and collections of native fauna and of fossils made. The sea was found to be entirely free from ice.

NEWS has recently been received in Copenhagen of the safety and success of the East Greenland Expedition, which left Denmark in June 1891 under Lieutenant Ryder. The expedition passed the winter on the Greenland coast in Scoresby's Land at a point in 70° 27′ N. Important scientific results have been obtained, but the expedition is not yet over, Lieutenant Ryder intending, after a short visit to Iceland, to make an attempt to trace out the hitherto unvisited coast-line between 70° N. and the Arctic circle.

THE first chart on which the American continent appears is being reproduced in facsimile for the approaching Columbus Exhibition in Madrid. The following details are given in a Reuter telegram from Madrid. The work, which is now approaching completion, is being done by Señor Canovas Vallejo, a nephew of the Spanish Premier, and by Prof. Traynor. The original chart, which was traced in the year 1500 by the famous navigator and cartographer Juan de la Cosa, who acted as pilot to Columbus in more than one of his voyages across the Atlantic, has been since carefully preserved in the Naval Museum in Madrid. The chart presents some most interesting features, displaying, as it does, the extent of the knowledge of the best-informed geographers of the day. On it are depicted the West Indies and a small portion of South America—namely, the north-eastern section lying between the River Amazon and Panama. To this land the general name of Tierra Firme is given, to mark the contrast between the continent and the Antilles. Here and there are traces of modern names, such as Venezuela, Maracaibo, and Brazil. The chart even comprises some particulars of the discoveries made in Northern America by Sebastian Cabot in 1497, and such titles as these:—"Sea discovered by the English," "English Cape," "Lizard," and "St. George." La Cosa has also clearly depicted Cuba as an island, whereas Columbus died in the belief that it was a continent, and it was not until eight years later that the correctness of La Cosa's chart was in this respect finally established.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

ROCHESTER MEETING.

THE forty-first annual meeting of the American Association for the Advancement of Science was held at Rochester, New York, August 17–23, Prof. Joseph Le Conte, of California, the well-known geologist, presiding.

Rochester is one of the most beautiful of American cities, being laid out quite on the *rus in urbe* principle, so that each residence is generally surrounded by grounds, instead of being built in a solid block. It is pre-eminently a city of freeholders, as appears by the fact that a recent census showed more landowners than voters in the city. It is moreover situated in the beautiful and picturesque region of western New York, within a very short distance from numerous glacial lakes, as well as the

Falls of Niagara. The fertile valley of the Genesee was long ago renowned for its wheat as it now is for its fruit and flowers, and Rochester, formerly called the flour city, is now known as the city of flowers. The river flows through the city, falling in pretty cascades to a wild glen, and furnishing the water power which is utilized in flouring mills and other manufactures. Lake Ontario is a few miles distant, but yet it is so far away, and the navigation of the Genesee is so restricted, that Rochester is considered an inland city, and it is the largest inland city in the United States, having a population of 144,000.

The meeting of the Association coincided in time with the railroad strikes at Buffalo, some seventy miles distant, where several regiments of militia were stationed at that time to protect the railroads from mob violence. The sense of insecurity doubtless deterred a few members from attending, though the attendance was above the average.

For the last few years, specialists have shown a growing tendency to organize special societies outside of, though affiliated to, the general Association. This year the larger meeting was preceded by meetings of the American Microscopical Society, the Geological Society of America, the Society for the Promotion of Agricultural Science, the Association of Economic Entomologists, and this year was organized the American Association of State Weather Services. The latter is composed of weather observers from the several States of the Union. Every State now has a weather-observing station, and an observer co-operating with the general government.

The first day of the meeting was taken up with opening general exercises, organizing the sections, and addresses by the retiring president, Prof. Albert B. Prescott, of Ann Arbor, and the presidents of the several sections, namely, mathematics and astronomy, J. R. Eastman; physics, B. F. Thomas; chemistry, Alfred Springer; mechanical science and engineering, J. B. Johnson; geology and geography, H. S. Williams; biology, S. H. Gage; anthropology, W. H. Holmes; economic science and statistics, Lester F. Ward.

The remaining days of the meeting were given to reading of papers in the various sections, after a brief business meeting in general session. The general business included a division of the biological section into Section F, zoology, and Section G, botany, the former Section G, microscopy, having been abolished years ago. The biological section has long been overcrowded.

The preservation of forests has been and is one of the most important economic matters of our age. Reckless and wasteful methods have prevailed to such an extent that many fine forests have been ruined, and others are rapidly going to ruin. The large areas still owned by government are subject to the double peril of robbery and fire. Mr. Fernow, chief of the Bureau of Forestry, in a paper before the economic section, stated that the annual loss to the government by thieves is 10,000,000 to 15,000,000 dols., while that by fire is probably twice as much more. To protect the twenty thousand square miles of government forest land, a paltry force of twenty to twenty-four watchmen is employed, and even these are not clothed with sufficient authority. They are barely able to reclaim some 100,000 dols. worth of timber annually from depredators, which only suffices to repay the expense of maintaining the service. Proper protection would require an annual outlay of 2,000,000 dols. to 3,000,000 dols., and would preserve 20,000,000 to 50,000,000 dollars' worth of property in each year. The section recommended a resolution favouring suitable legislation, such as is embodied in the bill introduced by Senator Paddock, and the resolution was unanimously adopted in general session.

Much interest was manifested in the approaching World's Columbian Exposition at Chicago. Prof. F. W. Putnam, permanent secretary of the Association, is also chief of the department of ethnology, &c., at the Exposition. In a paper before the anthropological section he detailed plans adopted for taking anthropmetrical measurements of native American tribes, also of children in public schools, both white and others, as well as children in the Indian schools. An exhibit of special interest will be a collection of representatives of all the native American tribes, including a family from each tribe, engaged in native industries. This will require the gathering of at least five hundred aborigines, and probably more than that number, and it will be the last opportunity when such an exhibit can be made, since the extension of railroads and other appliances of civilization is rapidly subverting aboriginal methods and conditions; the tribes are becoming disintegrated and amalgamated, and machine-made articles are supplanting those by hand.

Committees were appointed from each section to co-operate with other organizations having similar aims, in holding joint meetings during the Exposition. By resolution in general session the Secretaries of the several sections were appointed a committee to co-operate with the World's Congress Auxiliary in securing space for each section for the entire time of the Exposition in which to register as headquarters for that section, and similar organizations, both foreign and domestic.

Thursday evening was occupied with a reception by the Women's Reception Committee of the Local Committee at the Powers Art Gallery. This is by some considered to be the finest art collection in America, including pictures by Diaz, Corot, Millet, Verboeckhoven, Gérome, Munkacsy, Doré, Bonheur, Vibert, Bougereau, Zimmerman, Cooman, Leloir, Hagborg, Schreyer, Henner, Le Rolles, Knaus, Jackobides, Defregger, Daubigney, Rousseau, and other foreign artists, besides works of the best American artists, and copies of Rubens, Titiens, Raphael, Correggio, and others.

Besides the annual address of the retiring President, Prof. Prescott, only one other address was made in general session. This was by Dr. Joseph Jastrow on Friday evening on "Hypnotism and its Antecedents." In the first part of his lecture he gave a historical sketch of the development of hypnotism, and described various procedures in which it is involved. The careers of Messmer and other early hypnotists were sketched, up to the time when it obtained scientific recognition about fifteen years ago through the efforts of Charcot and Richet. The second part of the lecture described the chief phenomena of modern hypnotism as revealed and recognized during the last score of years. The lecturer illustrated the illusions of sense in various ways, and described in detail the methods of inducing the state. In some instances, it was stated, the subject may not lose control, but simply finds it impossible to resist the demands of the operator. For instance, upon being told that he cannot open his eyes, he finds it impossible to do so, though perfectly conscious; a cane placed in his hands he is unable to drop, and fingers set in motion he is powerless to stop. Many interesting phenomena were cited. One of the most curious of these is what is termed the post-hypno suggestion. While the subject is asleep it is suggested that he shall perform some act at a certain time after awakening. These acts are performed by the patient, sometimes even when the time set to elapse has been a year. But perhaps the most surprising of all the phenomena cited was the control of the patient over involuntary powers. Upon being told that a postage stamp placed on the arm is a plaster which will raise a blister, the effect is actually accomplished. Sometimes the mere tracing of a line upon the skin has produced the same effect. In some cases rigidity of the muscles is induced, so that the arm may be kept extended or the body may be rigidly supported, with the head on one chair and the feet on another, for a long time. Important legal questions may be raised as to the responsibility of hypnotized patients. Crimes may be committed at the instigation of the operator. It has long been known that petty crimes could be so caused. It is found also that the gravest crimes are equally controlled, as shown by repeated instances where the patient was given a dagger and told to stab a person lying on a certain cot in the hospital, which the patient did, though the person stabbed was only a straw figure, but so covered as not to be recognized as such. The control over the nervous system renders hypnotism a valuable remedial agent in paralysis, aphasia, tetanus, and many other diseases controlled by or specially related to the nervous system.

Another lecture, which was practically tantamount to a public address before the Association, was that of G. K. Gilbert, President of the Geological Society of America, before the Rochester Academy of Sciences, on "Coon Butte and Theories of its Origin." This extinct crater, located in Eastern Arizona, is unique in showing no signs of lava or scoriæ, and also in the fact that meteoric iron is found abundantly near it, numerous specimens, one of them over 600 pounds in weight, having been picked up here. This suggested to Prof. Gilbert the hypothesis that the crater may have been caused by the impact of a larger meteor, sufficient to make such a hole three-quarters of a mile in diameter, just as a cannon ball fired into a target would do, especially as the general appearance of this crater is remarkably similar to that of some results caused by projectiles. To test the correctness of this theory, he caused a careful magnetic and geodetic survey to be made to determine whether any large mass of iron was buried beneath the crater, and also whether

the rim exceeded the crater in bulk sufficiently to indicate a mass of matter in the rim larger than would be caused by the displacement of the material removed from the crater. Both these surveys, however, gave negative results. The magnetic survey indicated that if any considerable mass of iron exists there it is buried at least fifty miles deep, and a comparison of the quantity of matter in the rim shows no more than would fill up the space of the crater. He was compelled, therefore, to abandon the meteoric theory, notwithstanding that the chances of the fortuitous concurrence of such a crater accompanied by such a meteoric downfall is only one in five thousand. The origin of the butte must therefore be an explosion of steam.

The president elect of the Association, Prof. William Harkness, of Washington, was born at Ecclefechan, Scotland, in 1837, where his father, Rev. James Harkness, resided till 1839, when the family removed to America. The father was for a while pastor of a church at Rochester, where the son was educated, after having spent part of his college life at Lafayette College, in Pennsylvania. He graduated at the University of Rochester in 1858, and received from the same university the degree of doctor of laws in 1874. It was, therefore, peculiarly appropriate that he should be elected to the presidency at the Rochester meeting.

Prof. Harkness studied medicine, and practised as an army surgeon in 1864; but, with the exception of a short time in the army, he has been employed by the Government as an astronomer for about thirty years. During the total eclipse of 1869, he discovered the 1474 line of the spectrum of solar protuberances. He became prominent in observations of the transits of Venus.

It is difficult to select the most important and valuable papers from the whole number of 182 read before the several sections, but a few abstracts will be subjoined which appear to merit notice.

George E. Hale, of Chicago, read a paper before the astronomical section on "The Spectroheliograph of the Kenwood Astro-physical Observatory, Chicago, and results obtained in the study of the Sun." He described the ingenious apparatus which he had invented and perfected for photographing the faculæ and protuberances of the sun. This apparatus gives by far the most perfect pictures ever taken, and is the first which has successfully photographed the bright spots, showing faculæ which the eye cannot detect. Means were devised for taking on the same plate at one exposure both the faculæ and the protuberances, and Prof. Hale exhibited the first complete picture of the sun ever taken. Comparison with the best plates made at the Lick Observatory showed the great superiority of the work at Chicago. An observation of unusual interest was made on July 15, 1892. A photograph of the sun showed a large spot. A few minutes later another photograph was taken, which, when developed, showed that the bright band had appeared since the last exposure. Twenty-seven minutes thereafter another photograph showed that almost the entire spot was covered with brilliant faculæ, which by the end of an hour had entirely disappeared, leaving the spot as at the first exposure. This indicates an eruption proceeding with indescribable and inconceivable velocity. This disturbance seems to be connected with magnetic disturbances and the brilliant aurora noted the next day. The section, with much enthusiasm, passed a vote of thanks to Prof. Hale for his researches.

Edwin B. Frost read a paper on "Thermal Absorption in the Solar Atmosphere." Among the interesting phenomena observed were some cases where the umbra of sun spots radiated more heat than the neighbouring photosphere, indicating either that the dark spot is at a higher elevation than the surrounding photosphere, and consequently loses less heat by absorption of the sun's atmosphere, or that it is attended by an invisible facula.

Prof. R. S. Woodward described the iced-bar base apparatus lately devised by him for the Coast and Geodetic Survey. This is a line measure, micrometer microscope apparatus. The measuring bar is of steel, five metres long, and its temperature is kept constant by a packing of melting ice. The use of thermometers is thus avoided entirely. From results submitted by the author it appears that the total probable error of one measure with this apparatus of a distance a kilometre or more in length will not exceed one part in four to five millions.

One of the most important uses to which Prof. Woodward has applied the iced-bar apparatus is that of showing that long steel tapes, when properly handled, will give from one measure the length of a line, a kilometre, or more long with a probable error not exceeding one part in a half-million. Considering that this can be done at the rate of two kilometres per hour with a 100-metre tape, it would seem that such tapes must soon take high rank amongst apparatus for measuring bases.

Prof. W. A. Rogers read two papers before Section D, the first of which was a description of a standard yard and metre upon polished steel. The standard, which was exhibited, had upon one edge a metre subdivided by 20 millimetres and 40 inches subdivided to tenths of inches. Both are standard or 62° Fahr. It appears from an investigation of these standards that 772 of the separate millimetres have errors not exceeding one mikron, and that of the 400 tenth-of-inch spaces 280 have errors not exceeding one-twenty-five-thousandth of an inch.

Prof. Rogers read a second paper on an investigation of a 21-foot screw. This screw was made by the Pratt and Whitney Company for R. Hoe and Co., of New York. It appeared from this investigation that the pitch of this screw was very regular in its character, but that the linear error amounted to nearly one-hundredth of an inch in 21 feet. A part of this is undoubtedly due to flexure, but a part is due to changes of pitch in the screw itself.

In the section of anthropology Permanent Secretary F. W. Putnam gave an interesting talk on "Copper Implements and Ornaments in the Ohio Mounds." He emphatically denied the statements that these copper instruments were fashioned by white men and given to the Indians in trade. "It must be," said he, "that these implements were made by the native Americans. In all cases where implements and ornaments are found in these mounds there are found also on the altars nuggets of copper. So it is with the silver implements and those made of meteoric iron. Now, is it likely that the trader would furnish the Indian with nuggets of the natural material? There is conclusive proof that the original settlers of the Ohio Valley worked the metal into these implements and ornaments. Again, many of these mounds have trees growing on them that are between 400 and 500 years old. This carries them back beyond the time of trading." Prof. Putnam explained that holes could be cut in the sheet copper which had been hammered out by the Indian by simply placing the sheet of copper on the trunk of a tree and pounding into it one end of an oak limb squared. He was unable to describe the probable mode adopted by the Indians in cutting edges shaped like the teeth of a saw, but thought it was done by the use of an instrument made of meteoric iron.

In the section of biology, C. V. Riley read a paper on "Fertilization of the Fig and Caprification." In the production of the best Smyrna figs certain minute insects perform an essential function in fructifying the fig. The process is called "caprification," and has been performed by the aid of fig-growers ever since the time of Aristotle. The cultivator is accustomed at a certain season to place the fruit of the "caprifig," which contains these insects, on the fig tree which contains the edible fig. The caprifig does indeed produce a fig, but it is small and insipid. The tree which produces the edible fig does not yield fruit of fine flavour unless it is thus fertilized by the aid of these insects, the scientific name of which is Blastophaga psenes. The absence of these explains the insipidity of figs raised in California. There are, indeed, a dozen species of Blastophagæ found in America, but it is improbable that any one of them is adapted to the fertilization of the Smyrna fig, which growers there are trying to cultivate. The caprifig, however, is already well established, and the desideratum seems to be to introduce the insects. This, Prof. Riley thinks, can be done by gathering the fruit containing them in Smyrna and rapidly transporting it to California, which, he urges, should be undertaken by the Government. An attempt was made last summer by J. Shinn, of Niles, Alameda County, California. The fruit containing insects was gathered at Smyrna in the last days of June and received at Niles on July 23, within twenty-five days, but it is not known whether the experiment was successful.

In the section of physics, several valuable papers were contributed by G. W. Hough, A. E. Dolben, W. L. Stevens, E. L. Nichols, B. W. Snow, and others. One of the most interesting papers giving results of original research was by Edwin S. Ferry on "Persistence of Vision."

Prof. Frank P. Whitman, in a brief paper on the "Magnetic Disturbances caused by Electric Railways," gave the following results of recent observations:—"No magnetic instruments dependent on the earth's field can be used for reasonably accurate work at less than 1500 feet from an electric railway, and the

distance must be made greater still if the building in which the instrument is placed is fitted with a system of iron pipes. Minor galvanometers must use iron shields and artificial fields, while earth indicators and other similar methods of finding the constant of a ballistic galvanometer must be abandoned. Experiments are under way for providing the thinnest shield of soft iron which will serve as complete protection to magnetic instruments under such conditions as just mentioned."

The preliminary meetings of affiliated societies drew off much material which would otherwise have been presented to the chemical and zoological sections.

Prof. Robert T. Hill read to the geological section a paper on "The Volcanic Craters of the United States," in which he said:—"At the present moment, when many of the great volcanoes of the world are in activity, Vesuvius and Etna in Europe, others in the Australian region, and Colima in Mexico, I thought it a good idea to review the many beautiful volcanic craters found in our own land. The great cinder cones of New Mexico, Arizona, California, and Oregon are among the most interesting. The most eastern crater in the United States is Mount Capulin, a vast mountain in New Mexico. This is composed of volcanic cinder, which looks very much like that which comes from a locomotive. It rises 2750 feet above the plain on which it stands. It is twelve miles in circumference at its base. Were it situated in the eastern part of the United States it would be considered one of the greatest objects of natural interest, but in the West, where the phenomena are so abundant, it is hardly noticed and it has not found a place on the maps. In Arizona and New Mexico over 300 old volcanic necks or 'pipes' are found, and there are 20,000 square miles of lava which has flowed from them. The recent earthquakes in California were shown to have been produced by the terrific volcanic disturbances in Western Mexico."

Prof. Hill thinks it probable that the extinct volcanoes in the United States may again become active. The volcanic region has only been known about fifty years, and experts say that appearances indicate eruptions within two hundred years past.

The next meeting of the Association will be held at Madison, Wisconsin, on the third Thursday of August, 1893, unless the date shall be changed by the council.

Cordial invitations from the city government of San Francisco, the California Academy of Science, the University of California, and the new and munificently-endowed Leland Stanford, Jun., University, indicate that a meeting at San Francisco will be arranged for 1895.

THE INTERNATIONAL CONGRESS OF ORIENTALISTS.

THE meetings of the International Congress of Orientalists are being held this week in London, and the proceedings, which are of great interest, have been attracting a good deal of popular attention. The Congress is being attended not only by a large number of British scholars, but by many representatives of other countries, among whom are the following:—Austria-Hungary: Prof. G. Bühler, the Rev. Joseph Dahlmann, Dr. I. Goldziher, Dr. J. Karabacek, Prof. L. Reinisch; Belgium: Dr. Abbeloos; Egypt: Dr. Vollers; France: Prof. J. Darmesteter; Germany: Prof. K. Abel, Prof. R. E. Brünnow, Prof. Geiger, Prof. Hommel, Prof. Hübschmann, Dr. G. Huth, Prof. Kautzsch, Prof. Kielhorn, Prof. Leumann; Holland: Prof. J. P. N. Land; Italy: Prof. Ascoli, Dr. Carlo Formichi, Count Angelo de Gubernatis, Dr. Pavolini; Sweden and Norway: Dr. Karl Piehl; United States of America: Prof. Charles Lanman, Mr. W. H. Ward.

At the opening meeting on Monday, Prof. Max Müller delivered his presidential address. After some preliminary observations, in the course of which he expressed the obligations of the Congress to the Duke of York for having consented to act as honorary president, Prof. Müller spoke of the splendid service which has been rendered by Oriental scholarship in proving that in prehistoric times language formed a bond of union between the ancestors of many of the Eastern and Western nations, and that in historic times also, language, which seemed to separate the great nations of antiquity, never separated the most important among them so completely as to make all intellectual commerce and exchange between them impossible. These two discoveries seemed to him to form the highest glory of Oriental scholarship during the present century. It was often supposed that students of Oriental languages and of the science of language dealt with words only. Even now, when scholars spoke of languages and families of languages, they often forgot that languages meant speakers of languages, and that families of speech presupposed real families, or classes, or powerful confederacies which have struggled for their existence and held their ground against all enemies. "Languages," said Prof. Müller, "as we read in the book of Daniel, are the same as nations that dwell on all the earth. If therefore Greeks and Romans, Celts, Germans, Slavs, Persians, and Indians, speaking different languages, and each forming a separate nationality, constitute, as long as we know them, a real historical fact, there is another fact equally real and historical, though we may refer it to a prehistoric period, namely, that there was a time when the ancestors of all these nations and languages formed one compact body, speaking one and the same language, a language so real, so truly historical, that without it there would never have been a real Greek, a real Latin language, never a Greek Republic, never a Roman Empire; there would have been no Sanskrit, no Vedas, no Avesta, no Plato, no Greek New Testament. We know with the same certainty that other nations and languages also, which in historical times stand before us so isolated as Phenician, Hebrew, Babylonian, and Arabic, presuppose a prehistoric, that is, an antecedent powerful Semitic confederacy, held together by the bonds of a common language, possibly by the same laws and by a belief in the same gods. Unless the ancestors of these nations and languages had once lived and worked together, there would have been no common arsenal from which the leading nations of Semitic history could have taken their armour and their swords, the armour and swords which they wielded in their intellectual struggles, and many of which we are still wielding ourselves in our wars of liberation from error, and our conquests of truth."

With regard to the question as to the exact part of the world where these consolidations took place, no definite or positive statement could be made. Nothing, however, had shaken his belief—he did not call it more—that the oldest home of the Aryas was in the East. All theories in favour of other localities, of which so much had been said lately, whether in favour of Scandinavia, Russia, or Germany, rested on evidence far more precarious than that which was collected by the founders of comparative philology. There was also a difference of opinion as to the original home of the Semites, but all Semitic scholars agreed that it was "somewhere in Asia." With regard to time the difficulties were still greater; but Prof. Müller expressed the opinion that if we must follow the example of geology and fix chronological limits for the growth of the Proto-Aryan language, previous to the consolidation of the six national languages, 10,000 B.C. would by no means be too distant as the probable limit of what he would call our historical knowledge of the existence of Aryan speakers somewhere in Asia. There must also have been a long period previous to the formation of the great Semitic languages, because thus only can the fact be accounted for that on many points so modern a language as Arabic is more primitive than Hebrew, while in other grammatical formations Hebrew is more primitive than Arabic. Whether it was possible that these two linguistic consolidations, the Aryan and Semitic, came originally from a common source was a question which scholars did not like to ask, because they knew it did not admit of a scholarlike answer. Another question also which carried us back still further into unknown antiquity, whether it was possible to account for the origin of languages or rather of human speech in general, was one which scholars eschewed, because it was one to be handled by philosophers rather than by students of language. The deeper we delved the farther the solution of this problem seemed to recede from our grasp; and we might here too learn the old lesson that our mind was not made to grasp beginnings. And yet, though accepting this limitation of their labours as the common fate of all human knowledge, Oriental scholars had not altogether laboured in vain. No history of the world could in future be written without its introductory chapter on the great consolidations of the ancient Aryan and Semitic speakers. It might be said that this great discovery of a whole act in the drama of the world, the very existence of which was unknown to our forefathers, was due to the study of the Science of Language rather than to Oriental scholarship. But where would the Science of Language have been without the students of Sanskrit and Zend, of Hebrew and Arabic? "At a

Congress of Orientalists we have a right to claim what is due to them, and I doubt whether anybody here present would deny that it is due in the first place to Oriental scholars, such as Sir W. Jones, Colebrooke, Schlegel, Bopp, Burnouf, Grimm, and Kuhn, if we now have a whole period added to the history of the world, if we now can prove that long before we know anything of Homeric Greece, of Vedic India, of Persia, Greece, Italy, and all the rest of Europe, there was a real historical community formed by the speakers of Aryan tongues, that they were closely held together by the bonds of a common speech and common thoughts. It is equally due to the industry and genius of Oriental scholars such as de Sacy, Gesenius, Ewald, and my friend the late Prof. Wright, if it can no longer be doubted that the ancestors of the speakers of Babylonian and Assyrian, Syriac, Hebrew, Phenician, and Arabic formed once one consolidated brotherhood of Semitic speech, and that, however different they are when they appear for the first time in their national individuality on the stage of history, they could once understand their common words and common thoughts, like members of one and the same family. Surely this is an achievement in which Oriental scholarship has a right to take pride, when it is challenged to produce its title to the gratitude of the world at large."

Turning to another field, Prof. Müller showed that Oriental scholars had inspired the oldest period in the history of the world with a new life. Instead of learning by heart the unmeaning names of kings and the dates of their battles, whether in Egypt or Babylon, in Syria or Palestine, we had been enabled, chiefly through the marvellous discoveries of Oriental scholars, to watch their most secret thoughts, to comprehend their motives, to listen to their prayers, to read even their private and confidential letters. The ancient history of the world might be said to have assumed, under the hands of Oriental scholars, the character of a magnificent dramatic trilogy. The first drama told us of the fates of the Aryan and Semitic races, as compact confederacies before their separation into various languages and historical nationalities. The second drama was formed by the wars and conquests of the great Eastern Empires in Egypt, Babylon, and Syria, but it showed us that besides these wars and conquests, there was a constant progress of Eastern culture towards the West, towards the shores and islands of the Mediterranean, and lastly towards Greece. The third drama represented the triumphant progress of Alexander, the Greek far more than the Macedonian, from Europe through Persia, Palestine, Phenicia, Egypt, Babylon, Hyrcania, and Bactria to India, in fact through all the great empires of the ancient East. Here we saw the first attempt at re-establishing the union between East and the West.

Prof. Müller concluded his address with an eloquent and impressive plea for the encouragement of Oriental studies in England. "When," he said, "I accepted the honourable post of president of this congress, it was chiefly because I hoped that this congress would help to kindle more enthusiasm for Oriental scholarship in England. But that enthusiasm must not be allowed to pass away with our meeting. It should assume a solid and lasting form in the shape of a permanent and powerful association for the advancement of Oriental learning, having its proper home in the Imperial Institute. If the members of this congress and their friends will help to carry out this plan, then our congress might hereafter mark an important epoch in the history of this the greatest Eastern Empire, and I should feel that, in spite of all my shortcomings, I had proved not quite unworthy of the confidence which my friends and fellow-labourers have reposed in me."

A vote of thanks to Prof. Müller for his interesting address was moved by Prof. von Bühler, seconded by Count de Gubernatis, and carried with enthusiasm.

On Tuesday the work of the sections was proceeded with. Special interest was given to the proceedings on Wednesday by the reading of an address written by Mr. Gladstone, for the section dealing with Archaic Greece and the East.

THE ERUPTION AT SANGIR.

ON Friday last the *Times* printed some interesting extracts from a letter (dated Labuan, July 11, 1892) by Mr. George Ormsby, a magistrate in the British North Borneo Company's Service, containing an account of the recent eruption in Sangir, and of a visit paid to the spot immediately afterwards. Mr. Ormsby left Sandakan on June 4 in the s.s. *Normanby*, and arrived at Menado on the morning of the 7th. After a visit to Govontalo the vessel returned to Menado on the 10th, and here Mr. Ormsby heard that there had been an eruption on some of the islands to the north, and that the s.s. *Hecuba*, which had arrived at Menado just after the *Normanby* had started for Govontalo, had been chartered by the Dutch Government, and had gone out to find the scene of the eruption and to render assistance. On the 12th the *Hecuba* was sighted coming into Menado, and Mr. Ormsby and the skipper of the *Normanby* went on board as soon as she dropped anchor. "The captain," says Mr. Ormsby, "told us that he first went to an island called Siow, as the volcano there was known to be active. He found the island covered with ashes, but was told that the eruption had taken place at Sangir, an island about 30 miles further north. He went on there, and found it buried in ashes; they were digging the houses out at Tarona, the port. The cocoanut trees were all destroyed, and the loss of life was unknown. The volcano was slightly in eruption when he arrived. He went along the coast, stopping at the villages, and sending rice ashore, as the people were without food. He said some of the people were frightfully burned and maimed."

When the Dutch official who was on board the *Hecuba* reported the state of affairs to the Resident, the *Normanby* was chartered to take rice to the island and land it at Tarona. She left Menado at midnight, and arrived at Tarona next afternoon. "As we steamed up the coast of Sangir we could see the cocoanuts, with all the leaves broken and hanging downwards and covered with ashes, although the southern end of the island is sheltered from the volcano by hills. The harbour of Tarona is a narrow inlet, about half-way up the western side of the island, with steep hills on each side. The village is on the north side of the harbour, and is sheltered from the volcano by the hills behind it; behind the hills a large plain stretches to the foot of the volcano."

The eruption took place on the 7th at 7 p.m., and there was a slight eruption on the 9th, followed by heavy rain. The only damage done in Tarona was by the weight of ashes; many of the lightly-built native houses were crushed. "The afternoon we arrived," Mr. Ormsby says, "I went ashore, and followed the road from Tarona along the harbour. On rounding the end of the hills the road turned and ran along the northern slope of the hill; down below the road there was a deep ravine, with a small stream at the bottom, which was warm and smelt strongly of sulphur. The ravine was 40 ft. or 50 ft. deep, and had evidently been partly cut out by a stream of mud, which had rushed down it from the foot of the mountain and torn away the road in places. Looking across the ravine towards the crater the whole plain was burnt up, and near the foot of the mountain there was a jet of steam and thick black smoke. On the slope of the crater there was no sign of lava or mud. The three mud rivers I saw started from the foot of the mountain. I followed the road for some distance. About two miles from the sea it crossed a small triangular plain, and then zigzagged up the central range of hills. Where it crossed the plain it was entirely washed away by mud and ashes, which had been hardened by the rain after the eruption. The bridge across the stream was also destroyed, only the butts of the piles remaining. I got up to the top of the hills and a bit down the other side. I had a fine view of the volcano from the top; it was smoking, but there were no fireworks while we were on the island. I noticed a column of steam rising from the plain, close to the foot of the volcano, and determined to try and reach it next morning."

The column of steam was visited next day by Mr. Ormsby and the chief engineer, but they reached it with difficulty. On the way they had to jump a "stream which was steaming, and must have been very hot." He says:—"We went up to where the steam was blowing up through the mud. The mud was quite firm, but so hot that we had to shift from one foot to the other. The steam was puffing up through a lot of holes, but not very strongly where we were. I poked up a lot of stones out of one of the holes with my stick; they were so hot you could not hold them. I let two of them cool a bit, and then rolled them up in my handkerchief and put them in my pocket. One of them was covered with sulphur crystals, but, unfortunately, I lost it as we were returning. The whole place smelt strongly of sulphur, and we soon decided we had had enough of it, as it was about 9 a.m., and between the sun above and the earth below we were both streaming with perspiration. We got back to the ship pretty well fagged, and I stayed on board

till we left at 3 p.m. We went direct from Tarona to Sandakan, and as we steamed past the north end of the island I counted 18 jets of steam and smoke on the plain where in the morning there had only been two. The volcano itself was wrapped in smoke, and there were heavy clouds of smoke hanging over the plain. . . . . The Dutch controleur told us that they had already recovered 300 bodies, but that it was impossible to estimate the total loss. He said the other side of the island was worse, lava as well as mud having overflowed there, and that whole villages were buried. No lives were lost in Tarona itself, but forty men from there went into the jungle just before the eruption, and only one got back alive. . . . . We got to Sandakan at midnight on the 16th, and stopped a day there. The eruption was distinctly heard at Sandakan, though it is nearly 500 miles from Sangir."

THE WEST INDIAN FAUNA IN SOUTH FLORIDA.

DR. C. H. MERRIAM has lately published a paper on "The Geographical Distribution of Life in North America" (Proc. Biol. Soc. Wash., April, 1892), which should attract attention on account of the important problems discussed, and the interesting and somewhat novel views advanced. On pp. 49–55 there is a review of the faunal relations of Southern Florida, in which Dr. A. R. Wallace is severely criticized for having stated that Florida is, from a biological point of view, essentially North American, and totally distinct in character from Cuba and the Bahamas, from which it is separated by only a narrow strait. The phrase specially attacked is out of "Island Life," as follows: "Between frigid Canada and subtropical Florida there are less marked differences in the animal productions than between Florida and Cuba."[1]

I well remember that some time ago, when I knew next to nothing of the West Indian fauna, this particular phrase seemed to me very erroneous. An American zoologist cannot fail to be struck with the presence of a colony of West Indian forms in Southern Florida, so distinct from the species and genera of the United States. Following Dr. Merriam's enumeration, we see nine genera of tropical birds, hundreds of tropical insects, a dozen or more land shells, many plants, and so forth. It would seem impossible to doubt that Southern Florida should be referred to the West Indian faunal division in the face of such evidence.

But if we examine the matter from the point of view of a West Indian, who is searching for a fauna in Florida, which is identical, or nearly so, with that of the islands, things look very different indeed. Dr. Wallace's reference was to Florida as a whole, the term "subtropical" being used as descriptive of the State, not of the southern coast only, as used by Dr. Merriam. In the map given by Dr. Merriam, about nine-tenths of Florida are coloured orange, to indicate that they belong to the Lower Sonoran Region of the author. Now this, with the Upper Sonoran, which stretches into Canada, north of Lake Erie, forms the Sonoran, one of Dr. Merriam's primary divisions, the distinction of which from the Tropical region he has so well demonstrated. Furthermore, a large part of Canada is coloured blue on the map, to show that it belongs to the Transition Region between the Sonoran and the Borcal. Hence it appears, from Dr. Merriam's own map, and the statements throughout his paper, that by far the greater part of Florida is more allied faunally to portions of Canada than it is to the West Indies, so far exactly confirming the truth of Dr. Wallace's statement.

This will no doubt be readily admitted by Dr. Merriam, who bases his criticisms on the ground that Dr. Wallace had overlooked the existence of a West Indian fauna along the extreme south coast of Florida. We may, therefore, consider the evidence whereby this limited portion of the State is placed in the Tropical division. For convenience, we may allude to this tract as Tropical Florida, using the term tropical to indicate the climate rather than the fauna.

In order to get at the necessary facts, I have compared the birds of the regions under consideration, using Cory's "Birds of the West Indies" as a guide to the ornithology of the several islands.

Dr. Merriam says that "no less than nine" genera of Tropical American birds inhabit Tropical Florida, and cites nineteen species or subspecies of Antillean birds living in the same area, but not further north.

I find on examining and comparing the West Indian statistics,[1] that no less than 51 genera of West Indian land birds *fail* to reach Florida or any other part of North America. These genera are as follows:—

Mimocichla; Cichlherminia; *Margarops*; Ramphocinclus Cinclocerthia; Leucopera; Catharopera; *Microligea*; *Teretistris*: *Glossiptila*; *Laletes*; *Dulus*; Calliste; *Spindalis*; *Nesospingus*; *Phœnicophilus*; *Calyptophilus*; Saltator; *Loxigilla*; *Melopyrrha*; *Loximitris*; *Sicalis*; *Nesopsar*; *Elainia*; *Lawrencia*; *Blacicus*; *Nyctilius*; *Siphonorhis*; *Hemiprocne*; Glaucis; *Lampornis*; Eulampis; *Aithurus*; Thalurania; *Mellisuga*; *Doricha*; *Bellona*; *Sporadinus*; *Priotelus*; *Temnotrogon*; *Saurothera*; *Hyetornis*; *Todus*; *Picumnus*; *Nesoceleus*; *Ara*; *Chrysotis*; *Gymnasio*; *Rupornis*; *Regerhinus*; *Xiphidiopicus*.

Those printed in ordinary type appear to occur in the West Indies only in the Lesser Antilles.

The number of West Indian species not reaching Florida is of course overwhelmingly great, but here the comparison would be unfair, owing to the large number of representative species, on different islands. In order to obtain a just estimate I have therefore made a list of the land birds inhabiting Cuba which do not occur in Tropical Florida, and the result shows one family (*Todidæ*), 18 genera, and 52 species. There are also a few sub-species.

The list is as follows:—

Icterus hypomelas.
Agelaius humeralis.
,, assimilis.
Sturnella hippocrepis.
Quiscalus gundlachii.
,, atroviolaceus.
Corvus nasicus.
,, minutus.
Pitangus caudifasciatus.
* Saurothera merlini.
* Todus multicolor.
* Xiphidiopicus percussus.
Centrurus superciliaris.
Colaptes chrysocaulosus.
* Nesoceleus fernandinæ.
* Mimocichla rubripes.
,, schistacea.
Myiadestes Elizabeth.
Mimus gundlachi. B.
Polioptila lembeyi.
Dendroica petechia (race gundlachi) B.
,, pityophila.
* Teretistris fernandinæ.
,, fornsi.
* Cœreba cyanea.
Myiarchus sagræ. B.
* Blacicus caribœus.
Tyrannus magnirostris.
Antrostomus cubanensis.
Cypselus phœnicolius.
* Hemiprocne zonaris.
Calypte helenæ.
* Sporadinus riccordi. B.
* Priotelus temnurus.
Petrochelidon fulva.
Viveo gundlachi.
* Spindalis pretrei.
* Melopyrrha nigra.
* Pyrrhomitris cucullata.
Euetheia olivacea.
* Ara tricolor.
Conurus euops.
* Chrysotis leucocephala. B.
Asio stygius.
* Gymnasio lawrencii.
Glaucidium siju.
Accipiter gundlachi.
,, fringilloides.
* Regerhinus wilsonii.
Columba corensis.
,, inornata.
Geotrygon caniceps.

The two species of *Columba* are not definitely given as Cuban in Cory's work but I believe they occur there. Species marked with an asterisk are of genera not reaching Florida; species marked "B" also occur in the Bahamas.

The Bahama Islands also have many birds that are not in Tropical Florida, including some genera, as *Doricha* (two species).

It is thus apparent that, so far as the birds are concerned, the arm of sea between Cuba or the Bahamas and the mainland has been very efficient in preventing the mingling of two faunæ, although a limited number of species have crossed it.

To give many other instances would unduly prolong this letter; but one may cite the land shells as a much more striking case. The land mollusca of Cuba and Florida are almost entirely distinct, the small number (about a dozen[2]) of West Indian forms which have reached Florida is really surprising, considering the favourable currents and the proximity of the two areas. Cuba contains numerous generic and subgeneric types, and hundreds of species, which have never reached Florida.[3]

On the other hand, even on the Florida Keys we get such

[1] This statement is qualified by a footnote in the new edition of "Island Life," where the existence of some West Indian forms is referred to.

[1] These might be modified in slight details by searching the most recent literature, but Cory's work (1889) is very complete up to the time it was published.

[2] Dr. Merriam cites 20 on Dr. Dall's authority; but several of these are not land shells, but belong to brackish or fresh water.

[3] Thus, Cuba has considerably over 200 species of operculate land-shells which have not reached Florida.

North American types as the subgenera *Polygyra* and *Mesodon* of *Helix* (*H. jejuna*, No Name Key ; *H. pustula*, Cedar Keys ; *H. carpenteriana*, Key Biscayne ; *H. cereolus*, Indian Key, Key West, Egmont Key ; *H. septemvolva*, Key West ; *H. oppilata*, Cedar Keys (but this is also a Yucatan species) ; *H. uvulifera*, plentiful on several Keys ; *H. auriculata*, Cedar Keys).

How far the birds of Tropical Florida agree with those of the Sonoran region I do not know, having no list at hand from which to glean the facts ; but inasmuch as they must greatly exceed nineteen, the number of Antillean forms quoted by Dr. Merriam, it is apparent that the character of the air-fauna cannot be so totally different from that of more northern regions as to justify the proposal to merge it in a different primary faunal division. Dr. Merriam gives a list of the birds which are supposed to be restricted to Southern Florida, comprising two species and seven sub-species ; this list emphatically confirms the view that the region in question is really North American (Sonoran), for of the two species, one belongs to a genus which does not occur in the West Indies, and the other to a North American genus which has no endemic West Indian species. The seven sub-species are *all* of North American species, and three of them belong to genera (*Meleagris Cyanocitta*, *Sitta*) which do not exist in the West Indies.

To sum up, the facts seem to be as follows :—The whole of Florida really belongs to the eastern division of the Nearctic region (or to the Sonoran region of Dr. Merriam), but along the southern coast, on land of comparatively recent origin, a number of West Indian forms have appeared, owing to the assistance of currents conveying floating trees, &c., and to the proximity of Cuba and the Bahamas, which has permitted many birds and insects to fly across. These immigrants have formed a distinct colony, but not to any great extent, so far as can be learned, at the expense of the native fauna. The recent appearance of this colony is shown by the fact that (except somewhat doubtfully in the case of a few mollusca) there is at present no tendency to form new endemic species. Mr. Schwarr, who was so impressed with the great number of West Indian insects he found in this region, specially mentions that there were *no endemic forms*.

The northward spread of this colony has doubtless been largely prevented by climate, as stated by Dr. Merriam ; but doubtless also quite as largely owing to the *competition of the Sonoran fauna*, for, as Dr. Merriam has himself put it in another connection, "the sustaining capacity of a region is limited ; hence such a thing as overcrowding, in the sense of greatly increasing the number of organisms a region can support, is an impossibility."

If climate had been the only barrier, then Tropical Florida should have a fauna like that of Cuba ; but so far from doing so, it is still essentially Nearctic, notwithstanding the existence of a very important and interesting West Indian colony. At best it is a transition region.

Under the guidance of Dr. Merriam, researches into the geographical distribution of North American birds and mammals are being energetically carried on ; and if I am not mistaken in the above-stated opinions, no doubt information will in due course accumulate that will cause him to withdraw from the position here criticized, and to admit that Dr. Wallace was, in the main, perfectly correct. T. D. A. COCKERELL.

Institute of Jamaica, Kingston, Jamaica,
July 31.

"A NEW SECT OF HERO-WORSHIPPERS."

UNDER this title, the *Japan Mail* describes a curious Society, established in Japan, in honour of Isaac Newton, and which is not a new scientific association so much as a new cult. The day of all the year to the members is Christmas Day, being that on which in 1642 the immortal Newton was born. The constitution is of the simplest. The professors, graduates, and students of the mathematical, astronomical, and physical classes of the Tokio University are *ex officio* members ; once a member always a member ; and there are no others. The Society was launched as one for undergraduates by Messrs. Fujisawa, Tanaka, and Tanakadate, the first brilliant triumvirate of mathematical graduates which the Tokio University gave to the world. In its early days it met in the students' dormitory. But as the undergraduates developed into graduates and assistants, the professors themselves were drawn into the fold, and a more suitable assembly hall was found in the University Observatory. Now, however, that building is devoted to seismological pursuits. At Christmas, 1890, or Newtonmas, 248, for the first time, the members of the *Newtonkai*, or Newton Association, met in the Physical Laboratory of the Imperial University, to hear each other talk, to distribute appropriate gifts, and to lengthen out the small hours with laughter and good cheer. The Society has no President : a portrait of the august Sir Isaac presides over the scene. It keeps no written records, no minutes ; but its traditions are simple, and easily handed down from year to year. The entertainment provided is the work of the second-year students, assisted by those of the first year. Each professor is expected to make a little speech, which is sometimes historical, sometimes whimsical, as the individual spirit may prompt ; but it must not be suggestive of the background of a blackboard. The meeting in fact is essentially social ; and in the preparation of the magic lantern slides, the committee of management lay themselves out for frolic and jest. The picture may represent a comical incident familiar to most of the members, or it may be a pictorial conundrum to guess. It was a fine humour, for instance, which gave a caricature of one student notorious for his indefatigable asking of questions. This youth was shown labouring under a shoulder beam, from which hung two buckets filled to overflowing with points of interrogation ; while in the background was seated one of the professors, perfectly aghast as this mathematical labourer approached with his load. After the magic lantern exhibition comes the lottery for presents. This is a great feature, productive of much merriment. Each person draws a paper, which may be blank, but usually has a name on it. This name may be one of the illustrious living, or the still more illustrious dead. Corresponding to each name is an article, which, with all solemnity, is presented to the holder of the paper. The connection between the article and the name is more or less symbolic, or it may rest on a far-fetched pun, to which the Japanese language readily lends itself. Usually the jokes are very technical ; but occasionally they appeal to a circle more wide than mathematical. Thus the drawer of "Newton" got an apple, and the drawer of "Franklin" a kite. "Herschell" (Sir John) was represented by a sprig of *Nanten* ("southern heavens," which he surveyed) ; "Archimedes," by a naked doll supposed to be returning from the bath ; while the holder of "Kant-Laplace," got a puff of tobacco smoke blown in his face, symbolic of the nebular hypothesis. Some time ago it was pointed out by a European member of the *Kai* that in holding the "Newtonmas" on Christmas Day the members were guilty of a chronological crime hardly to be excused in men trained in the accurate school of Newton. For although he was registered as being born on Christmas Day, 1642, it was Christmas Day, old style. In all strictness he was born on January 5, 1643. But the great convenience of having the *fête* at the beginning rather than towards the end of the winter vacation, and the avoidance of clashing with Japanese New Year festivities, were sufficient to outweigh all other considerations whatsoever. Besides, did not Newton himself hold his birthday on Christmas Day? Why, then, should his admirers hold it on any other? After all, concludes the Yokohama journal, the peculiar interest of the "Newtonmas" lies in its existence. Only to the hero-worshipping Japanese has it occurred thus to pay honour to the memory of the greatest mathematical sage of all time. Very few English-speaking naturalists, to use the word in its widest and legitimate sense, are even aware that Christmas Day in 1642 beheld the birth of Newton. It is possible that nearly fifty years ago a bicentenary *fête* was held in Cambridge ; and it is very probable that about fifty years hence Newton's tercentenary will be celebrated in England—perhaps over all the civilized world. But an annual celebration by a Newton Club outside Japan is a thing not to be dreamed of, unless Japan influences the hero-worshipping instinct of the Western people as profoundly as she has influenced their æsthetic taste.

SCIENTIFIC SERIALS.

Royal Society of Victoria, Vol. 3 (N.S.), *Proceedings*, Part I. contains Notes on West Australian oology, by A. J. Campbell (Pls. 1 and 2) ; On some Victorian fishes, with descriptions of *Cristiceps wilsoni*, *C. phillipi*, *Syngnathus phillipi*, and *Trip-*

terygium macleayanum (Pl. 3) by A. H. Lucas; Anthropology in Australia, by A. W. Howitt; On the nomenclature of chick-embryos (Pls. 4-7). Instead of indicating the stages in the development of the chick by the number of hours or days, which is unsatisfactory, as different eggs incubated for the same length of time will frequently be found to contain embryos which have reached quite different stages of development, the stages are marked based upon the external form, and each is designated by a letter of the alphabet. On some Victorian Land Planarians, by Prof. W. B. Spencer (Pls. 11 and 12), enumerates ten species of Geoplana and describes *G. dendyi*, sp. n., and *G. frosti*, sp. n.; all the species are figured in two admirably executed coloured plates. On the movements of the heart of *Hoplocephalus superbus* in and out of the body, by Dr. McAlpine; On a Nematode from the stomach of *Hoplocephalus superbus*, and on a fluke parasitic in the respiratory and alimentary systems of the same. Neither parasites are named but the Nematode (Ascaris) is figured on pl. 8. On the presence of amœboid corpuscles in the liquid discharged from the nephridial apertures and oral papillæ of Peripatus, by A. Dendy; On the shell money of New Britain, by R. H. Rickard; On the Dukduk Association of New Britain; Notes on the miocene strata of Jemmy's Point and on the older tertiary at Bairnsdale, by J. Dennant. Some new or little known Polzyoa, by P. H. MacGillivray (Pls. 9 and 10); Notes on the marine rocks underlying Warrnambool, by G. S. Griffiths.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 29.—M. Duchartre in the chair.—Observations of the new planet M. Wolf, made at the observatory of Paris (west equatorial), by M. G. Bigourdan. From observations of comparison stars, the R.A. of the planet in question on August 27, at 12h. 20m. 33s. p.m. Paris mean time, was 22h. 41m. 24·95s., its apparent declination − 10° 25′ 51″·8, and its magnitude 12·5.—Measures of the diameter of Mars, by M. Camille Flammarion. To settle the divergence between the values of the diameters of Mars as predicted by the *Nautical Almanac*, the *Connaissance des Temps*, and Marth's "Ephémérides," measurements were taken with the 24cm. equatorial of the Juvisy observatory, resulting in values ranging from 24″·50 to 24″·91. These confirm Marth's calculations, while the other two ephemerides are about 5″ in excess, based as they are upon Leverrier's tables instead of Hartwig's.—On the solar phenomena observed at the Royal Observatory of the Roman College during the second quarter of 1892, by M. P. Tacchini.—On the bacterian origin of the bilious fever of hot countries, by M. Domingos Freire. A microscopic comparison of the germs of the yellow fever with those of the somewhat similar bilious fever of tropical countries shows that the former is due to a micrococcus, which is round, highly refractive, and easily coloured by fuchsine, methyl blue, &c., whereas the bilious fever is originated by a bacillus which the writer has succeeded in cultivating. It is about nine microns long and three broad. It is motionless, and accompanied by numerous moving spores. Each bacillus undergoes rapid segmentation into two parts, which give rise to terminal spores. It has been found possible to produce the disease in a pig by inoculation.—On the comparative assimilation of plants of the same species, developed in the sun and in the shade respectively, by M. L. Géneau de Lamarlière. A series of quantitative results, showing that under similar external conditions the decomposition of carbonic acid varies in intensity, for leaves of the same species, according to the conditions of development of these leaves; and that the leaves of a species developed in the sun, all other conditions being equal, decompose the carbonic acid of the air more energetically than those developed in the shade.—On the present eruption of Etna, by M. Wallerant. The eruption of 1892, without having the importance of that of 1865, is, from several points of view, superior to that of 1886; the flows of lava are more extended and the craters more numerous. On July 8 the volcano gave its usual warnings. Thick columns of black smoke emerged from the principal crater, and earthshocks were felt as far as Catania. On the following day the eruption began in earnest. Two openings appeared a short distance apart, one of which only gave off steam, while the other gave rise to a flow of lava which passed westwards of Monte Nero, and which has been called the western stream. It was not till after the flow had ceased that four volcanic cones arose successively from north to south at a distance of about 60 m. to the east of this cleft. Another flow of lava passed to the east of Monte Nero, and was called the eastern stream. For about a month the eruption followed its normal course; the lava continued to flow and the cones increased in height. But on August 9 important modifications took place. The ejections diminished and the explosions ceased. It was thought that the disturbance was dying out, but on the 11th such an eruption of steam took place that Etna disappeared entirely in an absolutely opaque cloud. At the same time it was found that the lava, leaving the first tracks, had taken a new path across the vineyards. In the morning of the 12th the opening of a new crater in the line of the preceding ones was found in the act of building up a cone. The previous evening the observers had passed over the same spot and had found small vents giving off vapours, but nothing to indicate the formation of a crater in so short a time. The formation of this crater was accompanied by a complete cessation of the ejections from the second volcanic cone, which had been very violent. The eruption thus seemed to have entered a new stage of development.

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