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THURSDAY, APRIL 23, 1874

HERBERT SPENCER'S SOCIOLOGY

The Study of Sociology. By Herbert Spencer. (London: Henry S. King and Co.)

THERE are not a few signs, of which the book before us is an important one, that thought is moving in the direction indicated by Mr. Mill in the quasi-prophetical conclusion to his "System of Logic," where he expresses his belief in the prominence of sociological inquiries in the intellectual achievements of the next two or three generations of European thinkers. What has been called by Hegel the speculative historical method has taken a considerable step in advance since Mr. Mill wrote thus. History, written from the speculative or philosophical stand-point, may be regarded as a special Sociology—Sociology, that is, applied to the investigation of the laws of growth and development of some one society, as exhibited either throughout its whole career, or within some limited period. General Sociology stands to history in a position analogous to that occupied by general physiology with regard to the special physiology of man or of any other species of animal. This analogy will serve to throw some light upon the fact that there has been much greater progress made in the special department of speculative history than in the wider field of Sociology. Up to a certain point, the broader generalisations of the higher science must be preceded by the more restricted generalisations of the lower. But when this point has been reached, when the higher principles have been formulated with approximate completeness, then the advances along the lines of general and special thought will proceed *pari passu*; progess in one will by its reflex influence make possible a correlative progress in the other. The relations between Sociology and history appear to be nearing this stage.

Division of labour obtains in literature as well as in industry. His special turn of mind, not less, perhaps, than the character of the task to which he has devoted himself, has made Mr. Spencer a labourer in the wider field of Sociology. The volume under review, taken in connection with the two parts already issued of the "Descriptive Sociology," of which Part I. has been noticed here,* enables us, to some extent, to anticipate the character of the more elaborate and comprehensive work, the "Principles of Sociology," the promised fourth division of Mr. Spencer's "System of Philosophy." In the "Descriptive Sociology" we have an insight into the laborious thoroughness with which Mr. Spencer is preparing the foundations for his generalisations, while in the "Study of Sociology" we are introduced to his conception of the nature of the social science, of the difficulties in the way of the sociologist, and of the discipline necessary to the formation of a habit of thought adapted to sociological inquiries.

It is not necessary here to follow Mr. Spencer into the polemic contained in the first two chapters of his book, directed against the popular notions of sociological phenomena; against the dogmatic, unscientific, and off-hand way in which important and complicated sociological questions are decided not only by the vulgar, but also by men who are guided by a strict scientific method in the less intricate questions of physical science; and against the supporters of the special-providence and great-man theories of history. Mr. Spencer being the assailant, it is almost superfluous to say that the polemic is a vigorous one; indeed it may be open to question whether the assault would not have been more successful had it been conducted with less vigour and more circumspection. To use Mr. Spencer's own metaphor, a considerable correction for the "personal equation" of combativeness will be found necessary.

The possibility of a science of Sociology is shown in various ways. One cause of the denial of this possibility is to be found in the prevalent confusion between a science and an exact science. Sciences are either merely logical or mathematical also; in Mr. Spencer's phraseology, qualitative or quantitative. It is not affirmed that Sociology can be a quantitative science; but this is not to deny its scientific character altogether. Sociology presents in an extreme form that absence of quantitative definiteness which geology, biology, and psychology present in a considerable, though less, degree. Mr. Spencer puts his own case and that of the objectors to the scientific character of Sociology very forcibly in the following dilemma:—"In brief, then, the alternative positions are these. On the one hand, if there is no natural causation throughout the actions of incorporated humanity, government and legislation are absurd. Acts of Parliament may, as well as not, be made to depend on the drawing of lots or the tossing of a coin; or rather, there may as well be none at all: social sequences having no ascertainable order, no effect can be counted upon—everything is chaotic. On the other hand, if there is natural causation, then the combination of forces by which every combination of effects is produced, produces that combination of effects in conformity with the laws of the forces. And if so, it behoves us to use all diligence in ascertaining what the forces are, what are their laws, and what are the ways in which they co-operate."

Sociology is concerned with men aggregated into societies. Aggregates derive their essential properties from the natures of the individuals of which they are composed. Aggregation, though it may foster the development of some, and check that of others, of the characters of the constituent units, cannot give rise to social properties for which there is no foundation in those of the components. Setting out from this axiomatic principle, Sociology describes "the growth, development, structure, and functions of the social aggregate, as brought about by the mutual actions of individuals whose natures are partly like those of all men, partly like those of kindred races, partly distinctive. Not that the social science exhibits these or those special truths, but that, given men having certain properties, an aggregate of such men must have certain derivative properties which form the subject-matter of a science."

Nowhere, perhaps, than in sociological phenomena is the truth of the doctrine of evolution, the central doctrine of Mr. Spencer's philosophy, more strikingly displayed, and nowhere, subject to proper limitations, is it likely to prove more serviceable. To borrow Comte's phraseology, Sociology is either dynamical or statical. The dynamics of Sociology is throughout an exemplification of evolution.

* See NATURE, vol. viii. p. 544.

The statics of Sociology, at any given epoch, deals with phenomena which are the results of evolution. When Sociology is regarded in its dynamical aspect, the doctrine of evolution properly understood and limited, recognising and accounting for both the relative perfection and imperfection of a given social state, occupies the true mean between the altogether optimist view of social progress which finds expression in the lines—

> As round and round we run,
> Ever the truth comes uppermost,
> And ever the right is done;

and the altogether pessimist view embodied in the dictum of a distinguished living thinker, "The history of mankind is a huge *pis-aller*." But when Sociology is regarded in its statical aspect, an abusive use may easily be made of the doctrine of evolution. A given social state bears a relation to the past social states from which it is an outgrowth, and also to existing circumstances and conditions. Led away by the tendency of modern thought, so happily described by Mr. Bagehot as making everything "an antiquity," the sociologist is apt to dwell upon the first of these relations, to the exclusion of the second. From such one-sidedness Mr. Spencer does not appear to be altogether free.

It is always useful to know the nature, the magnitude, and the position of the difficulties that have to be encountered in the course of an inquiry. Mr. Spencer has given more explicitly and in fuller detail than any previous writer has done, an analysis of the difficulties in the way of sociological investigations. These difficulties are objective and subjective; difficulties inherent in the object of sociological science, and difficulties originating in the observer himself. The data of Sociology, the actions of men incorporated into societies, are distributed over long periods of time, and wide areas of space. The sociological inquirer must necessarily rely for his data upon past and contemporary records. But records may not exist; deep-lying circumstances of importance may be obscured by superficial circumstances; evidence will suffer vitiation through the want of perspicacity or of impartiality in the observer. A comprehensive, patient, and judicious employment of the comparative method is the only means by which order can be educed out of the chaotic mass of data which the recorded histories of societies offer. Mr. Spencer and his collaborateurs will deserve the gratitude of every sociological inquirer, for the extensive collection and collation of these materials, now in progress in the atlas-like folios of the "Descriptive Sociology."

Formidable as are the objective difficulties which beset sociological researches, not less formidable are the subjective difficulties. This class of difficulties originates either in the intellectual or in the emotional character of the observer. The want of a faculty adequate in plasticity and complexity to the many-sidedness and complexity of the object of investigation, and the tendency to automorphism, to make self the measure of things, are the principal intellectual obstacles to Sociology. Automorphism is one of the most fertile sources of error. "To understand," says Mr. Spencer, "any fact in social evolution we have to see it as resulting from the joint actions of individuals having certain natures; and this even by care and effort we are able to do but very imperfectly. Our interpretation must be automorphic; and yet automorphism perpetually misleads us."

In Sociology man is at once the observer and the observed; the inquirer is a unit of the aggregate whose laws he is investigating. We may observe a transit of Venus with the impartiality due to the absence of personal concern; we are not impartial observers of a social event with which our own interests are intimately bound up. Accuracy of observation is thus interfered with by sentiment. From the observer's emotional nature spring the various kinds of bias, educational, patriotic, class, political, and theological, described and abundantly exemplified by Mr. Spencer in a succession of chapters deserving of careful study, but to which space prevents more than a reference.

Attention to questions of scientific discipline and method is so rare among scientific men, that Mr. Spencer's book would deserve commendation for this feature, if for no other. Discipline should have reference to the work to be performed. Sociology being the most complex of the sciences, the sociological inquirer needs a discipline capable of producing an adequately powerful instrument of research. Falling back upon his classification of the sciences, into Abstract sciences, which investigate the *forms* of phenomena, Abstract-concrete sciences, which investigate the *factors* of phenomena, and Concrete sciences, which investigate the *products* themselves in their totality, Mr. Spencer shows the need in Sociology of the discipline in the necessities of relation derived from the first; in the distinctness given to the notion of simple causation derived from the second; and in the formation of the conception of continuous, complex, contingent, and fructifying causation derived from the third. Not, of course, that there can be an exhaustive or even a deep study of all or any of these sciences; a disciplinary study is all that is contended for, a study sufficient to enable the sociological inquirer to grasp the cardinal ideas proper to each science. But there is a more intimate dependence of Sociology upon the sciences of physical and psychical life, therefore the sociologist stands in need of a deeper acquaintance with biological and psychological truths. Amongst the most interesting and valuable chapters in the book are those in which Mr. Spencer enforces the need of an adequate preparation in biology and psychology. Positive arguments are supplemented by negative arguments, arguments based upon striking exemplifications of the errors that have arisen in the practical sciences of politics and education from ignoring biological and psychological teachings.

The view taken by Mr. Spencer of the method proper to sociological inquiries seems, as far as can be gathered from his own procedure, to differ little from that advocated and expounded by Mr. Mill. Placing Sociology next after psychology in his System of Philosophy, and asserting, as he does everywhere, the dependence of social phenomena upon psychological facts connected with the social units, Mr. Spencer's method appears to be to trace out deductively the connection of the empirical sociological truths, arrived at by generalisation from the data furnished by historical records, with the ultimate laws of human nature established by psychology. This is essentially Mr. Mill's inverse or historical deductive method applied to sociological inquiry.

In its style the "Study of Sociology" somewhat disagreeably reminds the reader of one of Mr. Spencer's earliest works, "Social Statics." It has two main faults—it is needlessly polemical in its tone, and it is disfigured by numerous unscientific exaggerations of language. Mr. Spencer is undoubtedly right in defending against Mr. Arnold the superiority of the guidance of psychology and logic, over mere linguistic culture, in producing a style clear, forcible, and free from tautology. But there is neither psychological nor logical defence for the two faults indicated. Amongst minor faults of style may be enumerated an occasional laxity in the use of analogies; the degeneration of the psychologically sound practice of prefacing the enunciation of an important truth by a forcible illustration of it into a disagreeable mannerism, some very marked examples of which occur in the opening paragraphs of several of the chapters; the frequent occurrence of words ineuphoniously formed, to say the least of them, such as "re-revenge," "irrelation," "wholesaler;" and the over-abundant formation of compounds, especially noticeable in the compounding of the adjective and its qualifying adverb, as in "logically-conclusive," "profoundly-untrue," "equally-long."

Some of the defects pointed out are probably traceable to a desire to popularise the work as far as possible, in forgetfulness, to some extent, of the necessity to maintain the character which should appertain to it as one of a scientific series. But, while it is to be regretted that there should be such blemishes to mar the general effect of a book so full of suggestive thought and of appropriate illustrative facts, it must be allowed that the "Study of Sociology" forms a valuable addition to sociological literature, and leads the student in this department of human thought to anticipate with pleasure the appearance of the work to which it and the "Descriptive Sociology" are but forerunners.

W H. BREWER

FRITSCH'S "SOUTH AFRICAN RACES"

Die Eingeborenen Süd-Afrika's, ethnographisch und anatomisch beschrieben. Von Gustav Fritsch. (Breslau: Hirt, 1872.)

IT is to be hoped that this work will have a good effect on the Science of Man, as a much-needed example which, once seen, will no doubt be followed. So far as the writer of the present notice is aware, the attempt at a systematic monograph of a race has never yet been made with so near an approach to success. With all our hundreds of volumes full of information as to the lower races of mankind, it is generally a difficult task for the ethnologist to piece together out of them anything like a complete picture of any tribe, with scientific fulness and accuracy of bodily, mental, social, geographical, and historical detail. Where, for instance, could he go for full information as to the two African races of whom Dr. Fritsch's work treats, the Kafirs and Hottentots?

The student's best source has been hitherto the conscientious dictionary-like summary, brief yet tedious, contained in 60 pages (Vol. II.) of Waitz's "Anthropologie der Naturvölker." The chapters in Mr. J. G. Wood's "Natural History of Man" are fuller and more life-like, but they are far too popular in topics as well as in style. Nor had either of these writers ever lived among the races about whom he compiled information. From a study of the descriptions drawn up by travellers, missionaries, and officials, who have known the Kafirs and Hottentots by

FIG. 1.—Zulu of Natal.

personal knowledge, it is possible to get much of the information wanted, but how long will it take even to glance over the volumes of Shooter, Galton, Callaway, Hahn, Casalis, Grout, Maclean, Andersson, and a dozen more? Each other savage or barbaric race of the world demands in like manner the reading through of a small

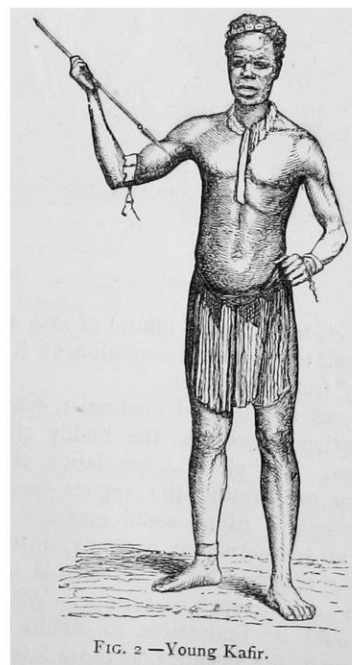


FIG. 2.—Young Kafir.

library, consisting mostly of miscellaneous literary matter, in which the ethnographic information is imbedded. The state of things is briefly this, that anthropological evidence is at present so bulky and so scattered, as to be

unmanageable except by those who can give half a lifetime to it. It is highly desirable to have the whole available knowledge as to each race condensed into a monograph like the present, by a competent ethnographer who knows that race by personal study in its home. It would be a real service to the ethnographers now at work drawing up accounts of native tribes in India and elsewhere, to put into their hands Dr. Fritsch's book as a model. As with all its excellencies of plan and execution, it is in many respects open to improvement, it would serve as a stepping-stone to yet more perfect works.

In popular language, the two indigenous races of South Africa are known as *Kafirs* and *Hottentots*, one the well-known Moslem term for "infidels" picked up by the Portuguese from the Arab traders of the sixteenth century, the other an imitative epithet, "hot-en-tot," given by the Dutch colonists to the tribes using "clicks" in their speech. Neither term is now satisfactory, and Dr. Fritsch is justified in adopting the native names by which the two races denote themselves. For the *Kafir* tribes he

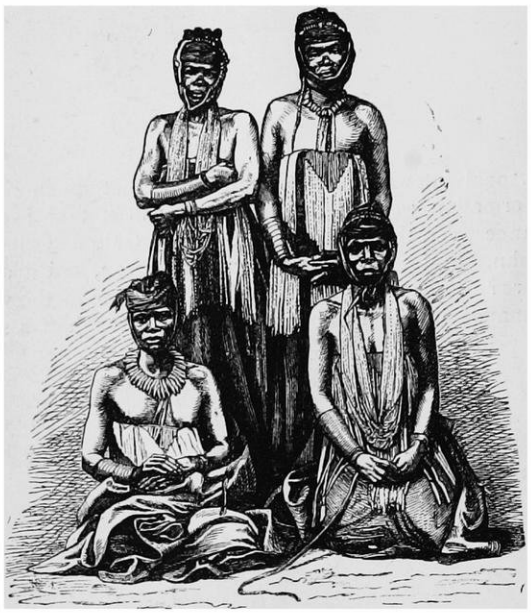


FIG. 3.—Sandili's Wives.

uses the term *Abantu*, *Bantu* (plural of *ntu*, a man), and for the *Hottentot* tribes their designation of *Koi-koin* (*i.e.* "men of men," from *koi*, a man).

Dr. Fritsch, as a professed anatomist, examines with almost exhaustive minuteness the bodily characters of these two races. The closer appreciation of race-types, which is now supplanting the vaguer generalities of twenty years ago, is in no small measure due to the introduction of photographic portraits, instead of the old misleading sketches by artists unable to clear their minds of the artistic types of Europe. Without photography it would be impossible to obtain a collection of portraits such, for instance, as those lately published in Colonel Dalton's "Descriptive Ethnology of Bengal." The portrait engravings from South African photographs in Dr. Fritsch's album (unfortunately arranged on somewhat different dimensions from the volume it accompanies) are at the same high level of truth and art. When race-types are so well-marked as among these South African tribes, even small figures will show their principal physical peculiarities. A selection from the small-scale woodcuts in the main volume, likewise taken from photographs, are here produced from copies of the blocks lent by the publishers.

Figs. 1 and 2, representing a middle-aged and a young Kafir, show the characteristic slimness of the figure, due to the wall-sided chest and narrow hips. The lean forearm, a peculiar conformation of the deltoid and biceps, a somewhat finely-formed hand, and an ungraceful setting back of the lower extremities and inclination of the pelvis, are other points of speciality. The narrow skull is well seen in the figures, with the broad-winged flattened nose showing the nostrils in full face, the fleshy pouting lips, and the hair naturally felted. Add to this the deep-brown colour of the skin, which is shown in No. 1 of the specimen tints given in a table at the end of the volume, with the deep-brown eyes and black frizzy hair, and the total as nearly represents the ideal Kafir of the Ama-Xosa type as ethnologists can conceive it. Fig. 3, representing a group of wives of a chief,* shows with coarse distinctness the typical Bantu features.

In strong contrast with this Kafir type is that of the Koi-koin or Hottentots, including as one of its divisions the Bushmen. Whereas the dark-brown or almost black Zulu stands little short of 5 ft. 8 in., the Hottentot, whose brownish-yellow complexion has been compared to a dry leaf, averages only 5 ft. 3 in., and the tiny dirty-yellow Bushman under 4 ft. 8 in. Bearing in mind their yellow complexion and diminutive size, some idea of the Bushman type may be gained from Fig. 4. The high cheek-bones and pointed chin give the face its peculiar triangular shape, while the characteristic snub-nose is shown in the old Bushman, Fig. 5.

Dr. Fritsch justly observes that the Bantu and Koi-koin races have hardly any essential race-character in common, unless it be the crisped hair; and even this is generally (though not through all varieties) distinct, the Bantu hair being irregularly felted into a mass, whereas the Koi-koin hair grows in little tufts, which have been compared to the bristles of a blacking-brush. The steatopygy of the Hottentot-Bushman women is shown by an extraordinary collection of portraits in Dr. Fritsch's volume; few physical race-characters are more striking than this, and it is unfortunate that illustrations of it cannot be inserted here. As in other parts of their structure, so in cranial proportions the two races in question are markedly distinct, as is fully proved by the set of lithographed skulls with tabulated measurements. The Kafir skull is narrow and high, the proportion of length to breadth being about 100 : 71·9, while the height may be taken at 73·8, being thus slightly greater than the breadth. The Hottentot skull, on the other hand, is narrow and low, the proportion of length to breadth being about 100 : 72·7, while the height of such a skull might be only 71, which is less than the breadth. The Bushman skull shows this character in still more extreme proportions in a cranium whose length is 100, the breadth

* This group illustrates in a curious way the conventional but not irrational development of the ideal of beauty from the ordinary forms of normal life. This ideal once fixed among any nation, there ensues a desire to exaggerate it. In the present instance, in grown-up Kafir women, the tendency of the breasts to become long and pendulous is considered not contrary to beauty, and is accordingly artificially increased by binding down, as shown in the figure.

being 73·8, against a height of 70·2, which gives about double the difference of the Hottentot.

The elaborate anatomical data amassed by Dr. Fritsch may afford the means of more fully working out the ethnological problems of the South African races. The evidence here brought forward of the more extreme characters of the Bushman type as compared with the Hottentot, seems to tell in favour of the view put forward by Prof. Huxley some years ago, that the Hottentots are the result of crossing between the Bushman and the Negroid tribes. Beyond this, there naturally arises another question: do the Kafir tribes, with their complexions varying from dark-brown to blue-black, owe their bodily differences from the Negro of Equatorial Africa to an intermixture of Bushman blood during a long course of ages. The evidence of language is here important. So far as it is concerned, the Kafir of South Africa is essentially a Negro, for his dialects belong to the great series of prefixing languages, the peculiar character of which is so well shown in the formation of the plural. Just as the Mpongwe language of the Gaboon makes the plural of *omamba*, snake; *imamba*, snakes; and farther east the individual inhabitant of *Unyamwezi* is a *Mnyamwezi*, and the people as a whole are *Wanyamwezi*:—so in Zululand *umuntu* is a man; *abantu*, men; and *Amazulu* is the plural name of the nation of whom an individual is *Uzulu*. The Bushman-Hottentot, or Koi-koin group of languages, are on the other hand distinguished by their tendency to monosyllabic words, their suffixes, and the "clicks" which to so extraordinary an extent are used as consonants. According to Dr. Bleek's classification, this family of languages has also relations farther north on both sides of the Continent; but this is a point which requires further examination. Now, though the fundamental types of the Kafir and Bushman languages are so absolutely distinct, it has come to pass that certain of the Kafir tribes, notably the Zulus, use to some extent in their speech clicks of the Hottentot type, whereas nothing of the kind

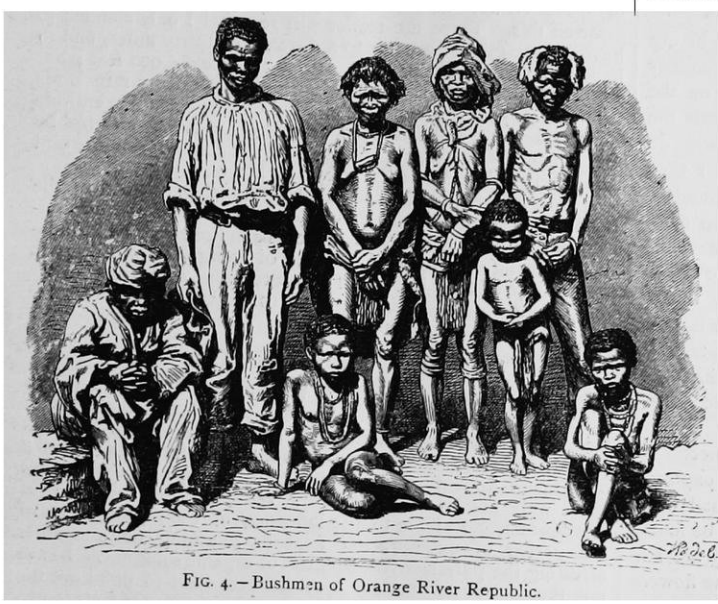


FIG. 4.—Bushmen of Orange River Republic.

FIG. 5.—Bushman of West Colony.

appears in the languages of their Negro kinsfolk of the equator. Did they catch this habit by mere imitation from the Hottentots and Bushmen, or, as seems more in accordance with experience, did Hottentot mothers in past generations teach it to children of a mixed race? This line of argument, it seems to me, may possibly lead to more definite results.

Dr. Fritsch gives a valuable summary of information as to the industrial, social, and intellectual condition of the South African races. The latter is not, however, of such special excellence as the descriptions of physical race-characters. Indeed, Dr. Fritsch is on the whole a better judge of bodies than of minds. His account of the native religions is below his general level, as may be judged from his describing the Zulu religion without mention or apparently knowledge of the remarkable native documents collected by Dr. (now Bishop) Callaway, which throw such clear light not only on the religious ideas of these barbarians, but on the origin and development of religion among mankind at large. That savage theologies show representative stages in the evolution of human thought, and as such deserve and repay the most careful study of their inmost meanings, is a fact which is daily coming into clearer view among ethnologists, but it seems hardly to have entered Dr. Fritsch's mind. While mentioning this weak point of his, it is worth while to notice that a much fuller dissertation on the native languages, such, for instance, as Prof. Steinthal might have drawn up, would have been of interest to students whose wants are only partially supplied by the meagre though valuable classificatory sketch here given, mostly on the authority of Dr. Bleek. Our author also shows glimpses of ill-temper in dealing with authors he dislikes, such as Mr. J. G. Wood, whom he falls upon in season and out of season. An instance of the latter kind of attack is seen where Mr. Wood, speaking in perhaps too enthusiastic terms of the physical beauty of youthful savages, naturally introduced the well-known story of Benjamin West, the Quaker painter, comparing the Apollo Belvedere to a young Mohawk warrior. Dr. Fritsch, quite missing the point of the story, solemnly quotes Mr. Wood as asserting, in proof of the classical beauty of the

Kafirs, that "an American Quaker, West, took the statue of the Belvedere Apollo for the representation of a Mohawk Indian." Having made Mr. Wood talk this extraordinary nonsense, he then reviles him for being illogical. This is not the treatment Mr. Wood merits. No one denies the faults of his work, especially the unhappy straining after the picturesque which has made so many of his artist's illustrations worse than worthless. But his genial and suggestive descriptions of South African native life give a permanent value to his popular volume, while in his special line as a student of savage arts and implements, Dr. Fritsch can hardly expect to rival him.

EDWARD B. TYLOR

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Flowers of the Primrose destroyed by Birds

FOR above twenty years I have observed every spring in my shrubberies and in the neighbouring woods, that a large number of the flowers of the primrose are cut off, and lie strewn on the ground close round the plants. So it is sometimes with the flowers of the cowslip and polyanthus, when they are borne on short stalks. This year the devastation has been greater than ever; and in a little wood not far from my house many hundred flowers have been destroyed, and some clumps have been completely denuded. For reasons presently to be given, I have no doubt that this is done by birds; and as I once saw some greenfinches flying away from some primroses, I suspect that this is the enemy. The object of the birds in thus cutting off the flowers long perplexed me. As we have little water hereabouts, I at one time thought that it was done in order to squeeze the juice out of the stalks; but I have since observed that they are as frequently cut during very rainy, as during dry weather. One of my sons then suggested that the object was to get the nectar of the flowers; and I have no doubt that this is the right explanation. On a hasty glance it appears as if the foot-stalk had been cut through; but on close inspection, it will invariably be found that the extreme base of the calyx and the young ovary are left attached to the foot-stalk. And if the cut-off ends of the flowers be examined, it will be seen that they do not fit the narrow cut-off ends of the calyx, which remains attached to the stalk. A piece of the calyx between one and two-tenths of an inch in length, has generally been cut clean away; and these little bits of the calyx can often be found on the ground; but sometimes they remain hanging by a few fibres to the upper part of the calyx of the detached flowers. Now no animal that I can think of, except a bird, could make two almost parallel clean cuts, transversely across the calyx of a flower. The part which is cut off contains within the narrow tube of the corolla the nectar; and the pressure of the bird's beak would force this out at both the cut-off ends. I have never heard of any bird in Europe feeding on nectar; though there are many that do so in the tropical parts of the New and Old Worlds, and which are believed to aid in the cross-fertilisation of the species. In such cases both the bird and the plant would profit. But with the primrose it is an unmitigated evil, and might well lead to its extermination; for in the wood above alluded to many hundred flowers have been destroyed this season, and cannot produce a single seed. My object in this communication to NATURE is to ask your correspondents in England and abroad to observe whether the primroses there suffer, and to state the result, whether negative or affirmative, adding whether primroses are abundant in each district. I cannot remember having formerly seen anything of the kind in the midland counties of England. If the habit of cutting off the flowers should prove, as seems probable, to be general, we must look at it as inherited or instinctive; for it is unlikely that each bird should have discovered during its individual life-time the exact spot where the nectar lies concealed within the tube of the corolla, and should have learnt to bite off the flowers so skilfully that a minute portion of the calyx is always left attached to the foot-stalk. If, on the other hand, the evil is confined to tais part of Kent, it will be a curious case of a new habit or instinct arising in this primrose-decked land.

Down, Beckenham, Kent, April 18 CH. DARWIN

Signor D'Albertis' and Dr Meyer's Discoveries in New Guinea

HAVING just returned to Europe, I read in NATURE, vol ix. p. 77, a communication which contains an assertion of Dr. A. B. Meyer, to the effect that I did not cross New Guinea at all, and that he claims the honour of having done so himself.

From what Dr. Meyer says, the public are led to believe that I have claimed the honour of crossing this unknown and little-explored island; if he had read "A Month among the Papuans of Mount Arfâk," he might easily have ascertained that I never asserted this. There the reader will see that I only claimed to have penetrated the country to a distance of thirty miles, and to have ascended to a height of between 3,000 and 4,000 feet; but I *was* the first European to see alive and shoot many rare Birds of Paradise peculiar to New Guinea. One of these was entirely new to science, and has been called *Drepanornis albertisi* by Dr. Sclater (NATURE, vol. viii. p. 305); it may be the same bird subsequently described as new by Dr. Meyer.

I have no wish to deprive the last-named gentleman of the honour of having crossed a greater or lesser portion of New Guinea, but I object most decidedly, either indirectly or by insinuation, to being deprived of the credit of being the first European to penetrate into the interior of that interesting country.

April 20 LUIGI MARIA D'ALBERTIS

Spontaneous Generation

MR. RAY LANKESTER'S letter in last week's NATURE affords fresh evidence of his lack of acquaintance with the several stages through which the "spontaneous generation" controversy has passed, or he would not now cite as a "most important result" only made known by recent experimentation, a fact which has been well known and repeatedly verified since the time of Spallanzani. I allude to the influence of the prolongation of the period of exposure to heat in retarding or altogether arresting the putrefactive tendencies of organic solutions. I have not thought it needful on previous occasions to point out the various misconceptions and the apparent ignorance of facts shown by Mr. Lankester in his querulous communications to your columns on the subject of "Spontaneous Generation." There are one or two points, however, to which I will now venture to solicit his attention, and that of your readers generally.

Mr. Lankester says:—"It is probably now familiar to those interested in the matter, that the experiments of Dr. Sanderson have established the fact that in an infusion of turnips and cheese prepared as directed by Dr. Bastian, heating to a temperature of 102° C. is sufficient to prevent the subsequent development of life (Bacteria) in the infusion, even when the exposure to that temperature is only maintained for a few minutes." To this statement I have to add that since the publication of the experiments above alluded to by Dr. Sanderson, I have heated flasks, sealed in the ordinary way and containing the fluid above mentioned, to a temperature of 105° C. for ten minutes in a chloride of calcium bath, and have found these fluids swarming with Bacteria after six days. I have also heated in the same manner simple neutralised turnip-infusion (filtered through cotton-wool instead of filtering paper) to a temperature of 105° C. for ten minutes, and by subsequently keeping these less putrescible fluids at a higher temperature (about 35° C.) they became turbid and swarmed with Bacteria in three days. Neither Dr. Sanderson's experiments nor those of Mr. Lankester and Dr. Pode have, therefore, the cogency which Mr. Lankester imagines them to possess. But, as I have endeavoured to point out on a previous occasion (NATURE, vol. viii. p. 548), experiments of this kind at the present stage

of the controversy can teach us nothing definitely as to the death-point of Bacteria and their germs, though they are of interest with regard to the question of the degree of heat which suffices to check the productivity of the fluids in question.

We are now told that Mr. Lankester himself, and those with whom he sides, are agreed as to the fact that Bacteria are killed at "a temperature a little below 70° C." Of course I cannot tell to what extent Mr. Lankester is in possession of the views of Prof. Huxley and others, but if what he states is really true, the statement is of a reassuring nature; it looks like progress, and leads me to hope that the only remaining doubt may soon be solved. How long does it take for the "through-heating" of certain "possible" Bacteria germs? This is now the knotty problem which, according to Mr. Ray Lankester, seems alone to require solution before we can positively decide as to the heterogenetic origin of Bacteria. Perhaps I may help him on his way to the solution of this difficulty by calling his attention to certain experiments made in Calcutta by Dr. Timothy Lewis, in reference to the existence of living tape-worm germs in cooked meat ("Report of Sanitary Commissioners with the Government of India, 1871"). Dr. Lewis says:—"The temperature of legs of mutton which had been put into the boiler almost as soon as the water was put into it averaged 140° F. (60° C.) in the interior at the moment the water had reached the boiling point (212° F.), and after boiling for five minutes the temperature had reached 170° F. (76° C.)." Now with these facts in his possession, and with some suggestions from physicists of his acquaintance as to the mode of conduction of heat generally, Mr. Lankester may perhaps soon solve his problem, so far as this is practicable. The problem itself may be stated thus:—If the through-heating of several pounds of protoplasm in the shape of a leg of mutton, when immersed in water, takes place at such a rate as to raise the central portions of the joint to a temperature of 60° C. by the time the water has reached 100° C., and if the exposure of the leg of mutton to this heat for the space of five minutes suffices to raise its central portions from 60° to 76° C., how many seconds, minutes, or hours will it take to heat an infinitesimal part of a grain of protoplasm (all through) to the temperature of 76° C.—that is, to a degree of heat decidedly above the death-point of bacterial protoplasm as given by Mr. Ray Lankester? The Bacterium-germ in question, it must be recollected, cannot be supposed to have undergone any extreme amount of desiccation previous to its immersion in the experimental fluid, since such desiccation would have already destroyed its life, according to Dr. Sanderson.

Whilst Mr. Lankester is seeking the solution of the problem above stated, perhaps he might with advantage also reflect a little more closely upon the possible value or otherwise of some of the negative results to which he is so fond of alluding. It is perhaps scarcely necessary for me to remind Mr. Lankester that the obtaining of such negative results is always easy, and may show nothing more than the relative incapacity of the experimenter for performing careful work according to instructions. Not long ago Mr. Lankester, upon the strength of his own negative results, triumphantly announced that he was about to prove to the world the falsity of my views, and so help to justify the opinion which he at the same time expressed as to my being "the mesmerised victim of delusion," "an abnormal psychological phenomenon," and many other fine things. But unfortunately for Mr. Lankester, just about the same time Dr. Sanderson (whose opinions he so much respects) had an opportunity of satisfying himself that I could demonstrate the experimental results which Mr. Lankester failed to obtain. Dr. Sanderson helped to show, in fact, that my positive results were worth more than the many negative results obtained by other workers.

Finally, I think it necessary to add a few words concerning the views of my colleague, Dr. Sanderson, on the subject of heterogenesis, simply because I find his experiments and supposed views frequently quoted by Mr. Lankester, and others, as evidence of the erroneous nature of my conclusions.

I have been led by my experiments to believe in Heterogenesis and also in Archebiosis, but I regard the recognition of the present occurrence of Heterogenesis as of far more importance than the recognition of Archebiosis. Now the controversy between Needham and Spallanzani, and also that between Pasteur and Pouchet was as to the present occurrence or non-occurrence of heterogenesis. This was what they understood, and what the majority of people at the present day still understand, as "Spontaneous Generation." And as to the reality of this process, Dr. Sanderson has been convinced. He admits that Bacteria may appear in flasks, and other situations, where we are warranted in believing that no bacterial matter pre-existed—which is exactly equivalen toa belief in "Spontaneous Generation," in the sense implied by Pasteur and others. In support of this statement I have only to make the following quotations from his papers and reported speeches of the last two years. Referring to experiments made in 1871, Dr. Sanderson says: "Bacteria could not be shown to be present either actually or in germ in the healthy liquids or tissues, or in the products of healthy inflammation" (*British Medical Journal*, May 11, 1872, p. 508). This statement was made with reference to man, and also to the lower animals with which he had experimented. In another part of the same communication as it stands revised in the "Transactions of the Pathological Society," for 1872, Dr. Sanderson says: "If a few drops of previously boiled and cooled dilute solution of ammonia are injected underneath the skin of a guinea-pig, a diffuse inflammation is produced, the exudation liquid of which is found, after twenty-four hours, to be charged with Bacteria." Other chemical agents will act in the same way even when every precaution against external contamination has been adopted; and as a drop of this fluid introduced with equal care into the peritoneum of another animal is always capable of exciting the phenomena of pyæmia, Dr. Sanderson has made known the very important fact that this process "can be proved to be capable of originating from inflammations produced by chemical agents *under conditions which preclude the possibility of the introduction of any infecting matter from without.*" Again, in a speech delivered last month before the Clinical Society, and reported verbatim in the *British Medical Journal* for March 24, Dr. Sanderson insists upon the complete establishment of the truth of this latter proposition both for man and the lower animals. He says: "We must admit that the whole process of pyæmia can originate in the organism independently of external influences." But, as he also says: "In every pyæmic inflammation—whether it be a primary or a secondary one—in every form of pyæmic action, you have always the presence of septic products," that is of Bacteria. Now if Bacteria by their germs do not normally exist in the tissues of animals, and if you can determine their presence there at will under conditions which, as Dr. Sanderson says, "preclude the possibility of the introduction of any infecting matter from without," what must be the mode of origin of the Bacteria in such cases, and how can Dr. Sanderson do other than yield his assent to the doctrine of "Spontaneous Generation," or Heterogenesis, so far as the origin of Bacteria is concerned?

University College, April 6 H. CHARLTON BASTIAN

Earthquake in St. Thomas

ON the morning of the 11th instant at 4.30 A.M., a smart shock, accompanied by a rumbling noise, like that of a waggon rolling over rough pavement, travelling, as is usual here, from east to west, woke up the inhabitants of St. Thomas. It was followed within a few seconds by another shock, to the full as abrupt in its character as the first; the movement appeared to be not so much undulatory as vertical.

The concussion produced was felt still more distinctly within the harbour itself, where the jar communicated to the ships resembled, as one of the captains described it, that which might be produced by a heavy bale falling through the hatchways into the hold. Simultaneously the water of the bay, then perfectly still, assumed a turbid appearance, as though clouded by mud and sand; and a little later the surface was agitated by a strong ripple from the south, lasting some time.

On the same morning early the royal mail steamer *Corsica*, commanded by Capt. Herbert, was at anchor discharging cargo off the harbour of Dominique, about 170 miles distant from St. Thomas, S.E. The harbour is on the side of the island, and sheltered from the swell produced by the trade winds; the weather calm. Just about 5 A.M. a succession of heavy rollers broke in; they lasted for half an hour, and rendered all communication with the shore during that space impossible. No shock was felt on board the *Corsica*, but Captain Herbert caused note to be taken of the marine phenomenon, not doubting that it must have been due to an earthquake, as indeed was evidently the case.

The centre of disturbance would appear to have been in this case under the sea at some distance S.E. from St. Thomas, a direction often indicated in such occurrences. On one occasion only, that of the severe shock of November 1867, did the movement seem to have been propagated from due south, its centre

being in the deep soundings between the islands of St. Thomas and Ste. Croix.

During the same day two other slight shocks, one at about 10 A.M. the other at noon, were felt at St. Thomas; they were unaccompanied by noise. W. G. PALGRAVE

St. Thomas, W. I., March 21

Physical Axioms

CONVINCED that the fulfilment of astronomic predictions can never *demonstrate* the laws of motion, and yet feeling myself quite destitute of intuitive belief in those laws, I have been led to think that in the present controversy truth may lie somewhere between the positions respectively enunciated by Mr. Spencer and his critic.

By reasoning which seems to me equally lucid, ingenious, and unanswerable, Mr. Spencer has shown that certain ultimate mechanical laws are tacitly assumed in every process of experimental verification. But I do not see that this vitiates *completely* the inference drawn from such verifications. The pure empiricists argue that because certain observed results coincide with the results of calculation, therefore the assumptions on which the calculation was based must be true. Now without doubt the *demonstrative* character of this inference vanishes entirely under Mr. Spencer's searching criticism. But it seems to me that a *high probability* remains behind. For were there any but an excessively minute error in the laws of motion, our astronomical observations could agree with the results of calculation only by a conflict of errors—a conflict which Mr. Spencer himself hints at. But there are overwhelming chances that these errors would not be so accurately adjusted throughout an immense variety of cases as exactly to compensate one another in every single instance. Hence I cannot but regard the laws of motion as hypotheses, the truth of which is shown by experiment to be overwhelmingly probable. The doctrine here assumed may be illustrated by an appeal to those old friends of probability students—the dice. If I throw double sixes ten times running I naturally conclude that the dice are loaded. This supposition almost necessarily involves the sameness of the ten throws, whereas the supposition that they were not loaded is consistent with an immense number of other results. Our minds choose the former alternative in obedience to an instinct which might with much show of propriety be formulated into an axiom. We may, however, deduce a justification for it from two ultimate intuitions of our nature—belief in uniformity of sequence and the general doctrine of chances—intuitions by which the mind apprehends respectively the ultimate law of knowledge and the ultimate law of ignorance. Belief in any special fact beyond individual experience can be rationally arrived at only by applying the former law to that knowledge which our individual experience furnishes, and the latter law to that ignorance which our individual experience has failed to enlighten.

It is the *approximate* truth of the laws of motion to which I have throughout referred. That there may be an *excessively minute* error in all physical and even all geometrical principles, Prof. Clifford has long ago shown how unphilosophical it is to deny.

F. W. FRANKLAND

Royal College of Chemistry, April 18

The Fertilisation of Fumariaceæ

Apropos of the interesting discussion on this subject which has appeared in your columns, I should much like to know whether any of your readers have observed the mode of fertilisation in *Corydalis claviculata*. Last summer I spent a considerable time in attempting to find this out, but without success. In every flower which I gathered in the mature state, I found the style broken off at the articulation immediately above the ovary, as if to prevent the possibility of fertilisation after a certain period. As the interior parts are completely concealed by the corolla, it was difficult to determine whether the separation had actually taken place on the flower, or was the result of the dissection, but I believe the former to be the case. In a large number of observations, extending over a considerable time, I never saw an insect visit the plant (this was in Westmoreland), though seeds were freely produced. Müller does not mention this species in his classical work on the subject, "Die Befruchtung der Blumen durch Insekten." ALFRED W. BENNETT

ALLOW me to bring before the notice of readers of NATURE a small point bearing on the fact of the bright hue presented, after fertilisation, by the flowers of *Fumaria capreolata*.

Is it not possible that the pale colour may be more attractive to the fertilising insects than a brighter one would be? May not the drawing-principle be the result of correlation between the art-manifestations of the attracting and the æsthetic susceptibilities of the attracted organism, and not depend solely on gaudiness of the flower? If this be so, we know that these susceptibilities have, at any rate sometimes, a very limited range, as is seen in the bee-orchis, where the similarity of the labellum to the body of a bee is very close, both in colour and in form, and cannot be useless, seeing that a great amount of developmental force is expended in its production. On this view also the rejection of highly-coloured poisonous caterpillars may in part be referred to the non-agreement of their hues with the orthodox colour-notions of birds. On the other hand, if mere gaudiness is aimed at, why should there be such diversity exhibited? why would not one colour answer the purpose in every instance?

The present case is capable of ready explanation on the supposition that it comes under the influence of natural selection; for, as Mr. Spencer has shown, the hue of the flower results from a diminished amount of nutritive material supplied to the coloured parts, so that the least vigorous individuals would have these most highly coloured at the time of fertilisation. But since the pale flowers are preferred by the insects, they would stand a better chance of being fertilised than would the bright ones, so that a process of selection would be set up resulting ultimately in the disappearance of the latter.

If it be established that cross fertilisation is not the rule with the flowers of this fumitory, of course it is a fact which has nothing whatever to do with the present argument, and the explanation given by Messrs. Darwin and Müller is entirely satisfactory. I cannot but think, however, that special attention will bring to light many cases of cross-fertilised flowers becoming more highly coloured after fertilisation, the phenomenon being explained simply as a decomposition-phase in the life-history of the contents of the cells composing the coloured organs.

S. MOORE

I VENTURE to suggest the following as possibly an explanation of the fact observed by Mr. Traherne Moggridge, that the flowers of *Fumaria pallidiflora* attain their brightest colouring when the time for their fertilisation has past.

In plants with a racemose inflorescence the individual flowers do not open simultaneously, but more or less in succession. The flowers lowest in the raceme open first: by the time they have in *Fumaria pallidiflora* attained their brighter colour, those a little higher up on the rachis are just at the stage for fertilisation, and the former may serve to attract insects to the latter, just as in some plants (*e.g.* Poinsettia) we may presume that the highly-coloured bracts attract insects to the comparatively inconspicuous flowers which they surround. The flowers a little way up the raceme would serve in their turn to attract insects to those above them; and these again to those still higher; the process going on for a considerable time in Fumaria, as it is quite common for the pedicels in the lower part of a raceme to be bearing fruit that has attained its full size, while at the top there are flower-buds still unopen.

Quisqualis indica affords another instance of flowers assuming a more intense colour after fertilisation. Its flowers grow in short spikes; on first opening and during fertilisation, are white, very faintly tinged with pink; but subsequently turn a light reddish-orange, and finally a purplish-red. T. COMBER

Newton-le-Willows, April 7

Power of Memory in Bees

ILLUSTRATIONS drawn from experiments or observations made upon animals lower than ourselves in the scale of life must always possess great interest. That impressions received by us in early life are more permanent than those made in after years, and that the memory of the old is less retentive in the reception of new impressions than is that of children, are circumstances universally acknowledged. On October 29, 1873, I removed a hive of bees in my garden, after it was quite dark, for a distance of 12 yards from the place in which it had stood for several months; and between its original situation and the new one there was a bushy evergreen tree, so that all sight of its former place was obstructed to a person looking from the new situation of the hive.

Notwithstanding this change, the bees, every day, flew to the locality where they formerly lived, and continued flying around the site of what had been their home, until, as night came on, they many of them sank upon the grass exhausted and chilled by the cold. Numbers, however, returned alive to their new position,

after having looked in vain for their hive in its old place. At night I picked the exhausted bees up, and, having restored warmth to them (by leaving them for a time upon my coat-sleeve), I returned them to their companions.

Here was an illustration that the faculty of *memory* was superior to that of *observation*; but that was not all. Nearly every bee which I picked up during the twenty-three days through which this effort of memory lasted was an *old one;* as was easily deduced from observing the worn edges of the wings: showing that, whilst the young insects were quick in receiving new impressions, and in correcting errors, the nervous system of the old bees continued *acting in the direction which early habit had affected.* So true is it that "One touch of *Nature* makes the whole world kin."

Marlborough House, Torquay JOHN TOPHAM

Pollen-grains in the Air

WILL you allow me to ask Mr. Hubert Airy, in reference to his interesting paper on the "Microscopic Examination of Air," in NATURE, vol. ix. p. 439, on what ground he refers the "triangular pollen" captured on his slide to the birch and hazel? Observations of my own have led me to the conclusion that the pollen of plants which depend exclusively on the wind for their fertilisation is perfectly spherical, at all events before the form of the grain is disturbed by the emission of the pollen-tubes, and this indeed one might expect from *à priori* considerations. Among the pollen-grains I have especially observed, are those of *Corylus avellana*, *Betula alba*, and *Populus balsamifera*. I shall be much obliged if any of your readers could refer me to any accurate published description of the form of pollen-grains beyond those contained in Fritzsche's "Beiträge zur Kenntniss des Pollen."

6, Park Village East, N.W. ALFRED W. BENNETT

Lakes with two Outfalls

I AM a little surprised to find, by the recent letters in your paper, that Science makes so wide a mouth over this phenomenon, though its exceptional character, and the general correctness of Colonel Greenwood's theory, must readily be recognised. My surprise is occasioned by the fact that Norway, which is now visited by thousands of educated English tourists every year, can supply, not one, but several, I had almost written many, apparent examples of this double outflow. I have not myself passed the watershed at the Lesjeskaagen Lake, though I was close to it in August last, and would have examined it if I had known its importance; but I know enough of the locality to think that Colonel Greenwood is probably right in his explanation of it. But there is another, which I have passed, and which is situated on perhaps the most frequented route in Norway, viz. that from Lærdalsören over the Fille Fjeld, to which I hardly think the same explanation would apply. Between Nystuen and Skogstad is a chain of lakes crossing the watershed, the highest of which (not the one marked on the Vei-cart over Norge, I think) sends its waters to the west, past Nystuen to the Sogne Fjord, at Lærdalsören, and on the east by the Lille Mjösen, and Aadalen to the Tyrifjord, and so past Drammen to the Christiania Fjord. This lake is a small one, and the double outflow is close to the high road. I cannot imagine any commercial object for an artificial cut, and it must be well known to hundreds who annually pass it. The Vei-cart shows several other instances, I know not how authentic, though I have always found it fairly accurate, erring rather by omission than commission. But in lat. 62° N., long. 24° 40′ E. or thereabouts, is a very remarkable watershed, having a complication of outfalls; the Bredals-Vand sending one to the N.W. to the Geiranger Fjord, and a second to the Vaage-Vand and Gudbrandsdalen; which is also joined by a draft from a lake to the S.W., which likewise sends a feeder to the Opstryen Vand, and so W.S.W. to the Nord Fjord. This I have not myself seen, but I was at Merok on the Geiranger for some days last August, and was assured by my landlord that the map was correct in this particular. As the Norwegian peasantry are well-educated, intelligent, and truthful, and this route forms their regular short cut to Christiania, I cannot doubt but that it is the fact. However, I have engaged to go over the track this summer with Captain Dahl, the well-known jolly commander of the *Erknö*, and I will take care to ascertain the truth and report the result. If, moreover, there are any geological or geographical points to be attended to, and Colonel Greenwood will kindly furnish me with instructions, I shall be happy to attend to them.

I have a strong recollection of having passed two or three cases of double outfall on a small scale in my wanderings; but not having been aware of the importance of the point, I did not take notice sufficiently precise to enable me now to put my finger on them with certainty, but my general conviction is strong, that Norway can furnish several, if not many examples, which are the more significant from the fact that it is one of the oldest countries in the world.

Burghley Road W. B. THELWALL

WILL you permit me to correct a mistake as to a matter of fact in NATURE, vol. ix. p. 441. Loch-na-Davie, Arran, has two outlets, as is correctly represented in the Ordnance Map, and also in that in Bryce's "Geology of Arran." In August 1872 I walked up the north stream from Loch Ranza to its outfall from Loch-na-Davie. I think Colonel Greenwood ought at least to have made himself acquainted with the Ordnance Map.

Edinburgh A. CRAIG CHRISTIE

THE "CHALLENGER" EXPEDITION *

IV.

TRISTAN D'ACUNHA

AMONGST the places in the Atlantic marked out by the Circumnavigation Committee as being of especial interest, the small island of Trinidad is noted with those whose vegetation is absolutely unknown, or all but so. From this fact Trinidad became a point of attraction which Mr. Moseley was most anxious to reach. Owing, however, to unfavourable winds and other causes, as well as to a desire of those in command of the ship to proceed south, the visit to this little island was abandoned, with the hope of calling there on the return voyage. After a narrow escape, also, of missing Tristan d'Acunha, the vessel anchored on the north side of the island, and the morning was spent in searching the low lands under the cliffs, 500 feet being the greatest height that was attained during the stay. On this side the island rises in a range of perpendicular cliffs of black volcanic rock, in appearance somewhat similar in structure to that exposed in section in the Grande Cural in Madeira. At the base of the cliffs here are *débris* slopes, and a narrow strip of low shore land of an irregular rocky and sandy nature. The settlement lies on a stretch of low land, broader and more even, and extends westward. The ascent to the plateau above the cliffs is comparatively easy, owing to the deep gullies by which the cliffs are broken.

Though the extent of the island is small, its actual area being not more than 16 square miles, the botanising was confined to the irregular strip of shore land just alluded to, and to the gully immediately above the settlement. Further exploration would have been made, but a sudden squall coming on, the recall was hoisted from the ship, and the party had to leave the island, after a visit of only six hours. Grasses, sedges, mosses, and ferns grow on the cliffs, and occasional patches of *Phylica arborea* Th., a rhamnaceous tree peculiar to the islands, as well as a species of *Empetrum*; these plants, however, are more prominent towards the summit. At the foot of the water-courses under the cliffs are bright green patches of *Rumex frutescens* Th. Mosses and liverworts cover the lower part of the cliffs, and the latter also abound beneath the grass in some situations to such an extent, indeed, as to cover the earth as with a green sheet. *Spartina arundinacea* Carm., grows in rounded tufts amongst the other herbage, and in the clefts of the rocks was seen in abundance *Asplenium obtusatum* Forst., and *Lomaria alpina* Spreng. It is remarkable that the plants of *Lomaria* when found in stony places, and in a comparatively starved condition, were mostly furnished with fertile fronds, whilst those growing in rich vegetable mould were barren. Amongst flowering plants the most common were *Apium australe* Th., *Pelargonium australe* Jacq., *Sonchus oleraceus* L. our common annual sow-thistle, *Hypochœris glabra* L. a closely allied plant to the sow-thistle, and also found in many parts of England. A cinchonaceous plant, *Nertera depressa* Banks, was very abundant, and

* These Notes are founded on letters sent home by Mr. H. N. Mosely.
Continued from p. 451.

Oxalis corniculata L., with its yellow flowers, was likewise seen, but not in any quantity.

An interesting plant—*Chenopodium tomentosum* Th.—grows abundantly on Tristan as well as on Inacessible Island; it is known as the tea plant, and the leaves, which are strongly scented, are used for making a decoction which is drunk with milk and sugar.

In the gully above the settlement, shrubs of *Phylica arborea* commence at an elevation of about 400 ft. No trees are found in this locality, having all been cut down at different times for fire-wood, but on other parts of the island there is abundance of wood. The diameter of the trunks of the trees on the upper plateau, it is said, reach to 18 in. On some fresh-water ponds close to the sea was a quantity of confervæ, but no chara was seen, a species of *Isolepis* also grew on the edges of these ponds which was not seen on the other two islands. A few willow bushes grew in a sheltered situation in a ditch near the cottages, and seemed to be thriving. Growing round the island is a belt of *Macrocystis pyrifera* Ag., a gigantic sea-weed, abounding in the southern temperate zone, and stretching up from thence along the Pacific to the Arctic regions. It occurs in immense lengths, single plants of from 100 to 200 ft. being common, and it is said that they are sometimes seen from 700 to 1,000 ft. in length, forming cable-like masses nearly as thick as a man's body, and having the appearance of huge buoys.

The surf on the rocky coast of Tristan is so heavy that the more delicate sea-weeds stand no chance, but are dashed and torn into numerous pieces.

The temperature of the fresh-water ponds at the sea-level gave a result of 54° F. while the water of the streams running down the cliffs stood at 50°, the difference being due evidently to the influence of the snow-water from above.

FUNERAL OF THE LATE DR. LIVINGSTONE

ON Saturday last the remains of David Livingstone, which left Central Africa now nearly a year ago, were interred in Westminster Abbey, in presence of a multitude such as was probably never collected therein on any similar occasion. The funeral procession, which started from the Geographical Society's Rooms, Savile Row, was of great length, though of the plainest description possible under the circumstances; we have not learned whether this was in accordance with the wishes of the late traveller's relatives, or whether it arose from scarcity of funds. Every mark of respect was shown to the procession along its route, and at several advantageous points considerable crowds had collected to witness the last journey of the great explorer.

Men of all ranks and of all pursuits in life formed part of the procession, and stood around the grave during the service in the Abbey. The patriarchal Dr. Moffat, Livingstone's father-in-law, and the traveller's two sons, Thomas and Oswell Livingstone, Mr. James Vavasseur, Sir F. Steele, Dr. Kirk, Mr. W. F Webb, the Rev. Horace Waller, Mr. H. M. Stanley, Mr. E. Young, Sir W. Fergusson, the Duke of Sutherland, Sir Bartle Frere (President of the Royal Geographical Society), Sir H. C. Rawlinson, Vice-Admiral Baron de la Roncière le Noury (President of the French Geographical Society), Dr. Hooker (President of the Royal Society), Mr. C. R. Markham, Mr. R. H. Major, Mr. H. W. Bates, Dr. Houghton, Mr. J. Young of Kelly, are the names of some of those who followed the body to the grave; there were besides, deputations from Edinburgh, Glasgow, and other places, and the carriages of Her Majesty the Queen, the Prince of Wales, and of many other noble and distinguished persons formed part of the procession. Among those who were waiting inside the Abbey were men of every shade of thought, political and religious, men distinguished in every walk of life, deputations from many religious bodies, from the establishment outwards, and representatives of various scientific Societies. The bearing of the crowds both outside and inside the Abbey showed that they were brought together from genuine admiration and sincere respect for the memory of the simple-minded hero.

We think the character of the assemblage which gathered to do honour to Livingstone's remains is one proof that he has done a work calculated to call forth the admiration and gratitude of those whose suffrages constitute fame of the highest and most enduring kind. If to conceive a great and noble purpose and to carry it out even unto death, with indomitable energy, determination, and the greatest skill, in the face of every possible discouragement, discomfort, and obstacle, be a mark of greatness, his contemporaries have certainly made no mistake in raising David Livingstone to the lofty pedestal which he at present occupies. He has probably added more largely to the sum of exact geographical knowledge than any other explorer has hitherto done. As Dean Stanley eloquently said in his funeral sermon on Sunday afternoon:—"By his indomitable resolution we have now revealed to us, for the first time, that vast tract of Central Africa which, to the contemplation of the geographer, has been literally transformed from a howling wilderness into the glory of Lebanon. The blank of unexplored regions which in every earlier map formed the heart of Africa is now disclosed to us adorned with those magnificent forests, that chain of lakes 'glittering'—to use the native expression—'like stars in the desert;" those falls more splendid, we are told, even than Niagara, which no eye of civilised man had ever before beheld. And to his untiring exertions, continued down to the very last efforts of exhausted nature, we owe the gradual limitation of the basin within which must at last be found those hidden fountains that have lured on traveller after traveller, and have hitherto baffled them all."

A deputation of gentlemen interested in the family of the late Dr. Livingstone waited on Monday upon the Chancellor of the Exchequer and the Secretary of State for Foreign Affairs, for the purpose of representing to Her Majesty's Government the very general anxiety that was felt throughout the United Kingdom that some substantial recognition, in the shape of an adequate provision for his family, should be made of the services of the great traveller. A requisition to the Prime Minister, asking him to confer a pension on the family of Dr. Livingstone, was on Monday night circulated among members of Parliament at the House of Commons. A large number of signatures has already been attached by gentlemen on both sides.

About three years ago, Her Majesty, at the recommendation of Mr. Gladstone, conferred a pension of 300*l.* a year upon Dr. Livingstone, who, however, it is sad to think, never knew that his services had been so recognised by the Government. Upon the death of Livingstone the pension ceased, but it was deemed by Mr. Gladstone a matter of sheer merit, due to the great explorer, to confer some pecuniary benefit upon his children, and the figures on the civil list were thereupon reduced from 300*l.* to 200*l.*, which is actually the amount that will henceforth be paid by the Government to those he has left behind him. Though Dr. Livingstone made a large sum of money out of the first book he published, still he disbursed more than half that amount in his promotion of the exploration of the Zambesi.

Livingstone's devotion to the cause of science and of philanthropy has thus been the means of leaving his family very inadequately provided for; but as he has added so greatly to the glory of his native land, and as he spent his life in the service of civilisation, we feel confident that those for whom he was therefore unable to provide will be well cared for.

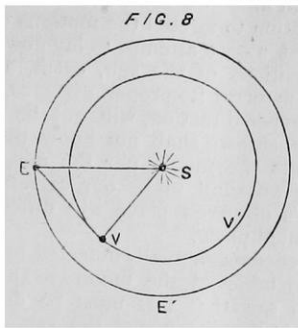
From a letter in yesterday's *Times* we see that the Diary kept by Jacob Wainwright for nine months after Livingstone's death will shortly be published.

THE COMING TRANSIT OF VENUS *

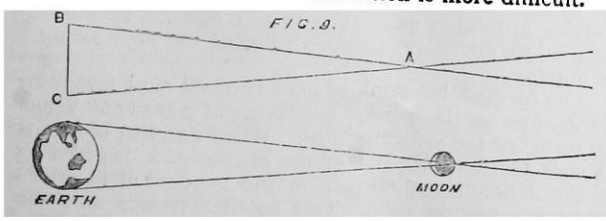
II.

THERE is perhaps no problem which has been so constant a source of interest to the learned in all ages as the solving of the mystery of the solar system. The labours of Copernicus, Tycho Brahé, Kepler, and Newton have given us a general knowledge of the nature of the planetary motions; and the investigations of later mathematicians have enabled us to predict, with wonderful accuracy, the future positions of the planets. But the dimensions of the solar system are not known with the same precision.

It is true that we know the *relative* distances of all the planets from the sun with tolerable exactness. This problem has been attacked in two totally different methods. The first is by measuring directly the changes that are



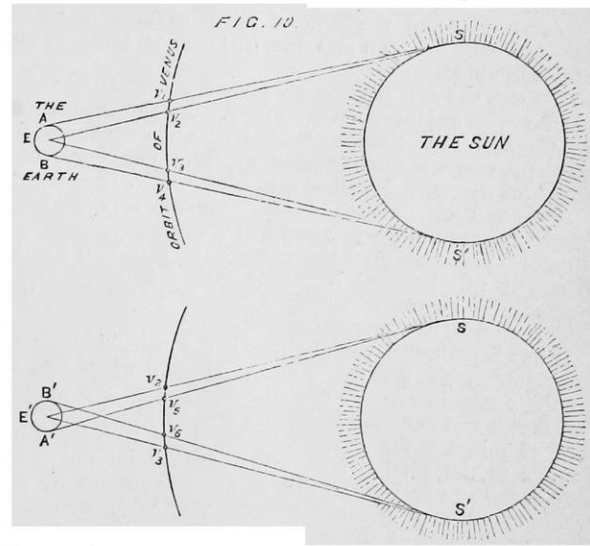
produced in the motions of the planets when the earth has moved through a certain portion of its orbit. In the case of the planets Mercury and Venus, which move in smaller orbits than that of the earth, the direct observation can easily be made. For let us suppose VV' and EE' (Fig. 8) to be the orbits of Venus and the earth, and S to be the sun. Let us watch the position of Venus night after night until she is as far away from the sun as possible. If we measure her apparent distance from the sun by astronomical means, we shall know that the sun, Venus, and the earth occupy positions such as S, V, and E; the directions ES and EV being known from our observations. By measuring off the distances SV and SE on the diagram, we actually find the relation between the earth's distance from the sun and that of Venus. The same can be done with Mercury; but for the superior planets the direct mode of observation is more difficult.



But there is an indirect method which is much more easy to apply. Kepler's three laws have been shown to be necessary consequences of Newton's theory of gravitation. Now Kepler's third law tells us how to find the relative distances of two planets from the sun when we know the relation between their periods of revolution. The exact law is this:—Multiply the number of years taken by a planet to go round the sun, by the same number. This gives us a first number. Then find a second number which, multiplied by itself twice, gives us the first number; this second number is the distance of the planet from the sun (the earth's distance being called 1). To take an example: Jupiter takes about 11 years to go round the sun; 11 multiplied by 11 gives us a first number, 121. Now if 5 be multiplied by 5 we get 25, and if this be again multiplied by 5 we get 125, which is almost the same as the first number, 121. Hence we are right in saying that Jupiter is about five times as far from the sun as the earth. If we had used the exact number of years we should have got the exact distance. Now it is very easy to find the period of revolution of a planet. For we can easily measure the interval between two dates when Jupiter and the earth, for example, are in the same line with the sun; in other words, we can measure the "synodical revolution" of Jupiter; and from this it is easy to calculate the time of Jupiter's revolution round the sun.

By applying these methods to all the planets we can lay down their orbits upon a plan; *all we wish now is to find the scale upon which our plan is drawn.* If we knew the distance of the earth from the sun, or if we knew the distance between any two of the planetary orbits, we should know the scale upon which our plan is laid down. Various methods have been adopted for this, but the one which makes use of a transit of Venus has generally been considered to be the most accurate.

One method which has successfully been applied to measuring the moon's distance is that used by surveyors. The surveyor chooses two spots, B, C, whose distance he measures. Suppose it to be one mile. He draws this distance, say, to one inch on a sheet of paper. He then



takes a telescope, mounted so as to enable him to measure any angle through which it is turned. He places the telescope at B, pointing towards C. He then turns it till it points at the distant object, and finds what the angle of B is. He then draws the line BA upon the paper, and he knows that the distant object lies somewhere on the line BA. He then does the same with C, and thus he knows that the remote object lies on CA. But A is the only point lying both on BA and CA; hence A corresponds to the distant object. If on measuring CA he finds it to be 30 inches, then since CB, which is 1 inch, means one mile; CA, which is 30 inches, means 30 miles, and this is what he wanted to find out.

If, instead of taking a base-line (as it is called) of one mile, the diameter of the earth, or 8,000 miles, be taken; then, if the moon be the distant object, we can determine its distance in almost the same way. It is in this manner that the moon's distance has been measured. It is easy to see that if the angle at A (Fig. 9) were very small, a slight error in measuring either of the angles B or C would make a great difference in the distance deduced for the remote object. Hence, if the moon's parallax were very small, this method would be unsuitable. But the parallax of the sun is very small, and

Continued from p. 449.

hence we cannot find the sun's distance with any exactness by this method.

But if any one of the planets ever came so close to the earth as to make its parallax tolerably large, then we could determine the scale upon which the solar system is built up. Now Venus and Mars are two planets which at certain times come closer to the earth than any other planet. But, unfortunately, when Venus is most near to the earth she is generally invisible, because the whole of her illuminated side is turned away from us. Mars, however, is a planet that gives us a very favourable opportunity for determining its distance. The advantage is increased by this peculiarity, that every fifteen years Mars is at its shortest distance from the sun, at the same time that the earth is at its greatest distance, the two planets being also in the same line with the sun, so that they are closer than we might have thought possible. In fact, on these occasions Mars is nearer to the earth by $\frac{1}{25}$th part than she is if the conjunction take place when both the earth and Mars are at about their mean distances from the sun. Suppose then that under such circumstances two observers, one at Greenwich and the other at the Cape of Good Hope (where there is a fine observatory), observe the position of Mars as compared with that of a star at the same time. The position of Mars will be displaced by parallax; and by comparing the apparent distance of the planet from the fixed star at these two places we can find the sum of the parallaxes in these cases. Hence we can find the distance of Mars, as already explained.

This was the first method to give a value of the solar parallax with anything like accuracy. At the suggestion of Cassini, the French sent out an expedition to the Cape, under the astronomer Picard. The value obtained for the sun's parallax was 9"·5. Prof. Henderson in 1836, and Mr. Stone, in 1862, utilised this method. Another opportunity will occur in 1878.

Before proceeding to the method of the Transits of Venus, it will be well briefly to allude to some other methods by means of which the solar parallax, or the sun's distance, has been estimated.

It has been found that light takes a sensible time to propagate itself through space. Hence, when one of Jupiter's satellites passes into the shadow of the planet, this fact is not communicated to our vision for something like 38 minutes, the time taken by light to pass from Jupiter to the earth. Now, when we are on the same side of the sun as Jupiter, this distance is shorter by the whole diameter of the earth's orbit than when we are at the opposite side of the sun. Hence, in the former case, the eclipses will seem to take place sooner than the predicted time, and in the latter case later. The difference in either case is about 8 minutes, and as we know that light travels over 298,500 kilometres per second,* this tells us that our distance from the sun is about 91,000,000 miles.

But our knowledge of the velocity of light has been utilised in another manner to solve the same problem. You see that if we know the earth's velocity in miles, we can find its distance from the sun. For if it goes 1½ million miles in one day, it must go over 365 times that in a year, and *that measures in miles the circumference of our earth's orbit*, and hence we can get our distance from the sun. How then are we to find the velocity of the earth in miles. This depends on a curious property of light. In a steady down-pour of rain you hold your umbrella upright if you are standing still, but incline it forward if you are walking fast. This is to make the umbrella catch the rain-drops. The amount of inclination you give it depends upon the rate at which you are walking compared with the velocity with which the drops fall. The same thing happens with light. We have to incline our telescopes forward a little in the direction in which the earth is moving to catch the rays of light; and at opposite seasons of the year the earth is moving in contrary directions, and the telescope has to be pointed in sensibly different directions. The inclination that a telescope receives is known, and the velocity of light being known, we can find the velocity of the earth, and hence, as I have shown, the distance of the earth from the sun.

There is another method of peculiar interest depending upon the motions of the moon. The law of gravitation says that the attraction of each body for each other one depends upon the distance between them. The moon is attracted to the earth by a force, depending upon the distance of the moon, which is known in miles. But the moon is caused to deviate from its natural course on account of the sun's attraction. This depends upon the distance of the sun from the earth, and if this be not known exactly in miles we shall see that it is impossible to apply calculation to foretell the motions of the moon; for, if upon any scale we attempt to lay down upon paper the relative positions of the sun, earth, and moon, we shall place the moon at its proper distance, and the sun, though in its proper direction, will not be placed at the proper distance, and we shall not know the direction in which it attracts the moon, nor the magnitude of this attraction, and we shall make our calculation wrongly, and the moon's observed place will differ considerably from its calculated place.

Such a difference was actually detected by the illustrious Hansen, whose tables of the moon are the best we possess. Hansen saw that this must be due to a wrong assumption as to the distance of the sun, and communicated his doubts to the Astronomer Royal* in the year 1854. This led to a re-discussion of our knowledge of the subject which has confirmed Hansen's views, and which leads us to see the importance of knowing accurately the sun's distance, if we wish ever to have our tables of the moon so accurate that we may determine the longitude by their aid. This method for investigating the solar parallax was first used by Laplace.†

More recently, M. le Verrier has suggested a new method that promises in time to be the best.‡ In the lunar theory, an equation appears connecting the relative masses of the earth and sun with the solar parallax, so that if we know the one we can find the other; and from a peculiarity in the equations, a small error in determining the relative masses will affect only very slightly the deduced parallax. Le Verrier finds the ratio of the masses of the earth and sun by determining the effect of the earth's attraction upon Venus and Mars. This being applied to the lunar theory, a value of the solar parallax is obtained.

The method, however, which has found most favour up to the present time, is the employing of transits of Venus to measure the sun's distance. When a transit of Venus occurs, the first evidence of the phenomenon is given by a slight notch being made in the contour of the sun's edge at a certain spot. This notch increases until the full form of the planet is seen. The first appearance of a notch is called the time of first external contact. But when the planet appears to be wholly on the sun, her black figure is still connected with the sun's limb by a sort of black ligament, of which we shall say more hereafter. When the whole of the planet is just inside the sun's edge, the time of first internal contact has arrived. The breaking of the ligament is a very definite occurrence, and was, until lately, taken to indicate the true moment of internal contact. The second internal and external contacts take place as the planet leaves the sun.

In 1663, the celebrated James Gregory, in his famous work the "Optica Promota," *prop.* 87, *Scholium*, alludes

* As determined by Foucault, *Comptes Rendus de l'Acad. des Sciences*, vol. lv. p. 502; also by Cornu, *Comptes Rendus*, Feb. 10, 1873.

* *Monthly Notices, R.A.S.*, vol. xv., Nov. 1854.
† *Système du Monde*, t. ii. p. 91.
‡ *Comptes Rendus*, July 22, 1872.

to the possibility of determining the sun's parallax by means of the transit of an inferior planet. He has been showing methods of finding the parallax of a planet by comparison of observations made at different parts of the earth upon the position of the planet compared with that of a star. He then takes, in place of a fixed star, another planet, the two being in one line, as seen from the earth. The application of this to the case of Mercury or Venus and the sun, was obvious.

But Halley was the first to see clearly what a powerful means of determining the sun's parallax an observation of contact really is. So far as I can discover, he first mentions the method in a letter to Sir Jonas Moore, written at St. Helena in 1677,* just after having seen a transit of Mercury. The exactness with which he believed the time of contact to be determinable, led him frequently afterwards to urge his countrymen to make every effort to utilise the method on the occasion of the transits of 1761 and 1769, when he should be dead.† And thus, in addition to his celebrated prediction of a comet, he left a second legacy to his successors, who, as Englishmen, might be entitled to be proud of his foresight though he could not live to reap the glory of it.

It is a matter of some difficulty to show, in an elementary manner, the way in which the value of the sun's parallax can be found from observations of contact. We will try, however, to put it in a light which anyone, with a little attention, will understand.

1. It must be thoroughly understood, from what has already been said, that if we know the amount of the sun's parallax we know its distance. In other words, if we know the angle subtended by any known distance on the earth's surface at the distance of the sun.

2. We know that the relative positions of the earth, Venus, and the sun, are given by supposing the earth to go round the sun in 365 days, and Venus in 224 days. Or, if we please, we may take no account of the earth's revolution, but suppose it fixed, in which case the revolution of Venus *relatively* to the earth (*i.e.* the synodical revolution) is 584 days.

3. If, then, Venus moves round the sun through 360° relatively to the earth in 584 days, she moves through $\frac{1}{584}$ of that in one day, and through $\frac{360}{584 \times 24}$ of a degree in one hour; which is at the rate of about $1\frac{1}{5}$ seconds of arc in a minute of time.

Now we are ready to understand Halley's reasoning.

Let A (Fig. 10) be the position of an observer on the earth at the time of 1st internal contact. S is the sun, and V_1 is now the position of Venus. This observer sees the contact earlier than a hypothetical observer at the earth's centre would see it, by the time Venus takes to move over V_1V_2. If we knew by calculation the instant when an observer at E would see it, and the observer at A saw it 8 minutes sooner, then, since Venus moves over $1\frac{1}{5}''$ in a minute, she has moved over $8 \times 1\frac{1}{5}$ or $9\frac{3}{5}''$ of arc in this time, and hence we learn that the angle A S E = $9\frac{3}{5}''$.

Suppose that by the time of the last contact the point A on the earth's surface has been carried by her rotation to B: the time of the last contact will now be too late by 8'; since the whole duration of the transit as seen by this observer is 16' too long, and the angle moved over by Venus in 16' is the sum of the sun's parallax as seen from A and from B.

But we cannot calculate with absolute accuracy the duration a transit would have when seen from E, because we should require to know more accurately than we do the values of Venus' and the sun's diameters.

Halley got rid of this by taking another station which should be in the position A at the beginning of the transit. In the case we have been considering the time of the first contact would here be too late by 8 minutes; and if this place had reached B' by the end of the transit, the time of contact would be too soon by 8 minutes. Hence in this case the whole duration would be shortened by 16 minutes; but in the former case it was lengthened by 16 minutes. Hence 32 minutes is the time taken by Venus to pass over an angle equal to the sum of the parallaxes in the four cases considered. This difference of duration, whether it be 32 minutes or anything else, is a quantity which can be observed. Now Venus moves over about $1\frac{1}{5}''$ of arc in a minute, or $38\frac{2}{5}''$ in these 32 minutes. Hence one-fourth of $38\frac{2}{5}''$ or $9\frac{3}{5}''$ would appear, from the above hypothetical observation, to be the value of Venus's parallax.

It must be noticed that we have here supposed that the transit takes exactly twelve hours, whereas the longest transit cannot exceed 8 hours. We have also supposed that two stations had been selected which were exactly situated so as to bring out the full effect of parallax at the time of each observation. These suppositions have been introduced only to simplify the understanding of the method. Anyone who has followed the above explanation will see how the method may be applied to actual cases that may occur.

Halley saw (what many people fail to see even now) that the great accuracy of the method consists in this, that in one second of time Venus moves over about 0''·02; and if we can determine the time of contact, with an error of no more than a second, we are measuring the sun's parallax with an error of no more than ·02 of a second of arc.

Halley even pointed out the best stations for observation. We may consider the earth to be at rest if we suppose Venus to move with the velocity she has relative to the earth. He supposed that the planet would cross near the sun's centre, and that the transit would occupy about eight hours. An observer in India would see the commencement of the transit four hours before mid-day, and the end of the transit four hours after mid-day. But, in the meantime, the part of the earth where he is has been moving from west to east, and Venus has moved from east to west, hence the duration of transit will have been shortened. But at Hudson's Bay the transit begins just before sunset and ends just after sunrise, that part of the earth having moved in mean time from east to west so as to lengthen the transit; and thus at one place the duration of transit is lengthened, and at the other shortened, and the difference of time depends upon the parallaxes of Venus and the sun * at the two stations, and after finding these parallaxes we can calculate the equatorial horizontal parallax.

GEORGE FORBES

(*To be continued.*)

* Hooke's "Lectures and Collections," 1678.

† "Catalogus Stellarum Australium;" also "Phil. Trans.," 1694 and 5.

THE LECTURES AT THE ZOOLOGICAL SOCIETY'S GARDENS

I.

ON Tuesday, April 14, Mr. P. L. Sclater, F.R.S., gave the Introductory of the twelve lectures which are to be continued during the spring. His remarks on that occasion were chiefly confined to the subject of Zoological Gardens in general. After an interesting account of the most important continental gardens, including those of Paris, Amsterdam, Antwerp, Berlin, and Hamburg, he

This lengthening or shortening of the time of transit will be rendered more evident by an analogy. A person standing still sees a carriage pass between him and a distant house. The carriage will take a certain time to pass the house. But if he be also moving, and in the same direction with the carriage, the transit of the carriage will take longer; but if he move in the opposite direction to the carriage, the transit will take a shorter time. If, then, two persons be seated at opposite sides of a merry-go-round, so that at the time the carriage seems to be passing the distant house, one observer is moving with the carriage and the other in the opposite direction; then one observer will see the time lengthened, and the other shortened. Now, the world is such a merry-go-round, and the positions of these two people correspond to the positions of India and Hudson's Bay, as pointed out by Halley.

went on to speak of the different animals which thrive best in captivity, taking each order of each of the great classes of the vertebrata separately, and pointing out that whilst some, as the Carnivora, thrive well in confinement, others, as the Insectivora, can hardly be kept in a menagerie at all.

On the following Friday Mr. Sclater commenced the first of four lectures On the Geographical Distribution of Mammalia. A fauna constituting the animals inhabiting a country, and a flora its plants, the lecturer went on to illustrate the fundamental law that the animals and plants found in far distant countries are usually different, and that those of near countries closely resemble one another. We find the animals in France much like those in England, those in Ceylon much less so, and those in Australia as different as possible. It might at first sight be thought that difference of climate caused the differences that are observed in geographical distribution, but that such is not the case is proved without difficulty by taking different countries in the same latitude and with a similar climate and comparing them. For instance, on and near the equator we have Borneo, part of Africa, and the country bordering the Amazons; nothing can be more different than their faunas, and yet they are similarly circumstanced, so far as temperature and climate are concerned. So the polar seas of the northern and southern hemispheres are very different as regards their animals, although nearly identical in climate. The auks and seals of the one are replaced by the sea lions and penguins of the other. The faunas of the Himalayas and of the Andes, mountains both in hot countries, are very different also.

The meaning of the terms "specific area" and "generic area" was then explained. A species, the aggregate of similar individuals, has an habitat or area of distribution which is definitely circumscribed. In some animals this area is large, as in the case of the lion; in others, as in the case of the aye-aye of Madagascar, it is extremely limited. Among birds this limitation, strange as it may appear, is sometimes extreme; on each of the two nearly adjoining mountains of Pichincha and Chimborazo there are species of humming-birds found, which occur nowhere else. The area which includes all the areas of the species of a genus forms a generic area. These areas are continuous, or were so at one time; physical changes having sometimes intervened to produce an apparent interval.

From these observations it is evident that the locality in which an animal is found is as important a fact in estimating its individuality as are its internal structure and general configuration. This point is frequently but too little taken into account.

The lecturer, having said thus much on the general subject, proceeded to show how the class of Mammals was to be distinguished from the other classes of Vertebrates, and stated that for geographical purposes the mammalia, or those animals which suckle their young, might be most conveniently divided into terrestrial and aquatic. Our knowledge respecting the former of these sections is, as might be imagined, much greater than of the latter; nevertheless, within the last few years the aquatic mammalia have received considerable attention, and have become much better known.

(*To be continued.*)

NOTES

THE magnificent bequest of 10,000*l.* has been made by the late Mr. E. R. Langworthy to the Owens College, Manchester, for the purpose of developing the chair of Experimental Physics. A splendid opportunity is thus afforded to the Professor of Physics in Owens College not only to advance original research in connection with that subject, but also of teaching the students of his class in the only effectual way by which physics can be taught. Physics, in short, can now be placed on the same footing in that University as chemistry. The terms in which the bequest is made are so forcible and clear that they deserve to be quoted here:—"I bequeath to the trustees of the Owens College ten thousand pounds, and I desire that the same may be applied by them as they may think best in order to establish in connection with that institution a professorship of Experimental Physics. It being my wish that students may be instructed in the method of experiment and research, and that Science may be advanced by original investigation. And I also desire that the professor from time to time appointed may be selected on account of his knowledge having been especially obtained by original investigation, and that his appointment shall be contingent upon the continuance of such investigation. And I declare that the above desire shall not be construed as a trust and bind the trustees to establish a professorship; but in case it shall be deemed advisable such money may be applied in such other way as the trustees for the time being may think fit, provided such money is only used for the purpose of promoting Science." The late Mr. Langworthy deserves credit not only for his liberality, but for the sound and advanced views he held as to how Science should be taught, and as to the necessity of encouraging original research in connection with the chairs of Science in our Universities. Mr. Langworthy has also bequeathed 10,000*l.* each to the Salford Library and Museum, and to the Manchester Grammar School, in the latter case for the purpose of founding twenty scholarships.

THE Chair of Chemistry in the University of Glasgow is vacant. We hope the Home Secretary in filling up the vacancy will, in the spirit which urged the late Mr. Langworthy to make the magnificent bequest above referred to, show by the appointment he makes the appreciation in which he holds original research. It is now high time that it should be distinctly understood that no man deserves to be appointed to a Chair of Science in any of our Universities unless he has shown that he has that knowledge of his subject which can only come from original investigation.

THE Professorial Chair of Physiology in University College, London, has become vacant by the resignation of Dr. Sharpey, who has held it since the year 1836.

SIGNOR L. M. D'ALBERTIS, the distinguished Italian traveller, who has lately penetrated into the mountains of New Guinea, and discovered the remarkable Bird of Paradise which bears his name (*Drepanornis albertisi*), has just returned to this country from Sydney, *viâ* San Francisco, bringing with him his large collection in every department of natural history which he formed during his expedition.

WE would call attention to the Swiney Course of Lectures on Geology which are at present being delivered by Dr. W. B. Carpenter, F.R.S., in the Middle Class School, Cowper Street, Finsbury. The course was commenced last Thursday, and will be continued on Mondays and Thursdays at 8 P.M.; there will be twelve lectures in all. We are sure that many of our London readers, on being made aware that such a course of lectures is being delivered by such an authority, will be glad to take advantage of the opportunity, especially as the lectures are free to the public.

THE first of the course of lectures at the Zoological Gardens given in pursuance of the provisions of the Davis Trust, was delivered on Tuesday the 14th, by Mr. P. L. Sclater, being an Introductory Lecture on the animals in the Gardens, of which he gave many particulars that seemed greatly to interest the audience. Last Friday Mr. Sclater gave the first of his course of four lectures On the Geographical Distribution of Mammals, in which he dealt with the general laws of the distribution of animals on the globe. Both lectures were well attended, the picture gallery being nearly full.

AT the annual election to Mathematical and Physical Science Postmasterships in Merton College, Oxford, early in October an election will be made to two Physical Science Postmasterships, each of the value of 80*l.* a year, and tenable for five years from election, provided that the person elected do not accept any appointment interfering with the full course of academical studies. There is no limit of age, but candidates, if already members of the University, must not have exceeded six Terms from Matriculation. The persons elected, if not members of the University, will be required to pass the University Examination for Responsions within a year of election. The subjects of examination will be Chemistry and Physics. There will be a practical examination in Chemistry. Candidates will have opportunities of giving evidence of a knowledge of Biology; but it must be borne in mind that in such cases the examiners will look for evidence of an acquaintance with the principles of Chemistry and Physics equal in extent to that which is required in the Preliminary Honour Examination in the Physical Science School. A paper will be set in algebra and elementary geometry, which, *cæteris paribus*, will be of weight in the election to Postmasterships. Further information may be obtained from the Tutor in Physical Science.

MR. R. HIND, writing to the *Times*, sends the positions of two telescopic comets, discovered within the last ten days. He says:—"The first was detected by Prof. Winnecke, at Strasburg, on the morning of April 12. It is a diffused nebulosity, about four minutes in diameter, somewhat extended on the side opposite the sun. Our observations during the past night give the following place:—April 21, at 3h. 22m. 9s. A.M., mean time at Twickenham—right ascension, 20h. 50m. 41·6s.; polar distance, 88° 10′ 50″; present diurnal motion about 5′ in R.A., and 1° 5′ in P.D., both decreasing. The second comet was found by M. Coggia at Marseilles, on April 17. It is much smaller than the above, but has a strong nuclear condensation. Last evening its observed position was:—April 20, at 9h. 47m. 15s. mean time—right ascension, 6h. 25m. 15·6s.; polar distance, 20° 15′ 23″. Its motion is slow, towards the south-west.

THE instruments used by Dr. Livingstone in his last journey, a sextant, thermometer, and chronometer, are still exhibited in the map room of the Royal Geographical Society, together with some of his maps made in 1856-7. Those who have not before seen any of the maps will be interested in noticing the great care and neatness with which the work is done, and the amount of information crowded into them. There are also several portraits of the traveller taken at different periods.

AT the last meeting of the Linnean Society, Dr. Masters and Messrs. Hiern and Maw were appointed to represent the Society at the forthcoming congress of botanists in Florence.

THE removal of the Library of the Geological Society from Somerset House to Burlington House, has been completed.

MR. LEONARD LYELL, B.Sc., has been appointed Professor of Natural Science in the University College of Wales.

THE Brothers Henry, astronomers at the Paris Observatory, have invented a modification of Leon Foucault's process for testing his telescopic glass mirrors. They are using that process at Secretan's in the construction of lenses used for dioptric astronomical instruments. One instrument constructed by them has been tried at the observatory and proved highly satisfactory; an object of an inch is equal to one of two inches when the surface has been worked under their optical supervision. They reject every part of glass which is not perfect. The first *lunette astronomique* so constructed has been sold.

IN the last sitting of the Academy, M. Becquerel, senior, one of the greatest electricians of the age, was presented with a medal in commemoration of the Fiftieth Anniversary of the Academy, of which he became a member four years afterwards. In 1824 the sittings were private, and only open to a very few learned persons. The admission was considered to confer a great honour, and was a step preliminary to membership. It was only in 1834 that the secrecy was removed on the proposition of Arago; Biot raised an opposition to it, but was outvoted. The publicity of sittings was coupled with the publication of *Comptes Rendus*, a weekly journal, exclusively devoted to the papers read before the Academy, and which has rendered immense services for a period of thirty-nine years.

WE very much regret that Sir John Lubbock's bill for the Preservation of Ancient Monuments was thrown out of Parliament last week by a very considerable majority. Patriotism seems to be at a discount in the House of Commons.

PROF. BASTIAN, of Berlin, has received favourable news from the German expedition on the west coast of Africa. Dr. Gussfeldt, who is at the head of the expedition, has advanced into the interior, and reached the Fangela country, which, it is believed, is the right point for further advance into Central Africa. The travellers at the latest dates were at the station of Chinchato, and were busy with the preparations for the more important expedition.

THE German exploring expedition into the Libyan Desert, under the leadership of Gerhard Rohlfs, returned to Cairo on April 17.

MM. ANDRE and Rayet are at present publishing, at Gauthier Villars', a work on "The History of Astronomical Observatories." The first part which is on sale is devoted to British observatories. The learned astronomers remind their countrymen that at the end of the last century France had a greater number of astronomical establishments than all other countries. The same thing can now be said of Great Britain.

MR. HARRISON, as President of the Institution of Civil Engineers, will give a *conversazione* on Tuesday, May 19, in the west galleries of the International Exhibition at Kensington, which have been kindly placed at his disposal by H.M.'s Commissioners. As in the two preceding years, models of engineering works and of recent scientific inventions will be transferred to the west picture galleries from other portions of the Exhibition, and these will be supplemented by similar objects specially lent for the occasion.

DR. CARPENTER has replied to Mr. Carter's letter to Prof. King on the structure of the so-called *Eozoon canadense*. He complains that Mr. Carter makes his charges without having, according to his own admission, read what has been written in favour of the view of the organic origin. In support of this view the examination of specimens by Prof. Schultze at the end of last year is referred to, by which he was completely satisfied as to the Foraminiferal character of Eozoon. Dr. Carpenter says he does not pretend to affirm that the doctrine of the Foraminiferal nature of Eozoon can be *proved* in the demonstrative sense; but he does affirm that the convergence of a number of separate and independent probabilities all accordant with that hypothesis, while a separate explanation must be invented for them on any other hypothesis, gives it that *high probability* on which we rest in the ordinary affairs of life, in the verdicts of juries, and in the interpretation of geological phenomena generally.

The Society for Promoting Christian Knowledge has begun to issue a series of "Manuals of Elementary Science." Is it to be regarded as a sign of the times that this Society as a publishing body is devoting to the spread of a knowledge of Science funds which have been avowedly collected for the purpose of "promoting Christian knowledge"?

THE re-mapping of England by the Geological Survey, giving the drift in its various divisions is steadily progressing, and in a short time a large part of Lancashire will be published. The quarter sheets, numbered by the survey 81 N.W., 88 S.W., 89 S.E., 90 S.E., 91 S.W. are engraved and in the hands of the colourist, and the work for 91 S.E., 90 N.E., 89 N.W. has been completed and the maps are in the engravers' hands. The sheet N.E. Somerset, and the London district have been ready some time. The old maps giving the rock mapping will continue on sale, for information that cannot be so readily gained in any other way arises from a comparison of the mapping of the rock with that of the surface drift.

ACCORDING to the Abbé David, the Chinese river Hangkiang, until lately almost unknown, is an important river of commerce, traversed by vessels of every size. A considerable portion, however, is difficult of navigation, owing to the existence of numerous rapids and many rocks.

THE death of Rev. John Bachman is announced as having taken place at Charleston on February 24. In the decease of this gentleman, Science loses one of the oldest of American naturalists, and one who has been quite prominent in the history of American zoology. He is well known from his association with Mr. Audubon in the preparation of the great work on the North American mammals, of which one edition was published, in folio, at 400 dols., and another, in quarto, at 40 dols. This, as far as its illustrations and biographies are concerned, still forms the standard treatise on the subject, although the systematic portion has been in a measure superseded by later and more critical investigations. It was, however, preceded by several monographic papers upon squirrels, hares, shrews, and other species, and also by papers upon the seasonal and other changes in colour in birds and mammals. Dr. Bachman's friends claimed for him the distinction of having been the first person in the United States to practise the art of artificial impregnation of fish, although this is stoutly contested by Dr. Garlick and other writers.

MR. R. B. WALKER writes from Corisco Bay, in Western Africa, in regard to a young gorilla which he had alive for some time, and hoped to forward to the Zoological Society of London. Contrary to the usual assumption in regard to this species, the specimen in question proved to be extremely docile and perfectly tame. When first purchased it was shy and suspicious, but not spiteful. At the expiration of about a week it was led around without resistance, and it ate whatever eatable thing it could lay its hands on, including a basin of condensed milk with a raw egg beaten up in it. It was quite tame, eating, sleeping, and playing with a large bull-terrier, the two animals being constantly together. It unfortunately disappeared one night, and was supposed to have fallen overboard.

THE forthcoming number of Petermann's *Mitth:ilungen* will contain the conclusion of the account of the return journey of Count Wiltschek's Arctic expedition through North-east Russia, and some remarks on the geognostic survey map of the coast of the Waigatt Strait in North Greenland, between Disco Island and the mainland, by M. Steenstrup. The number will also contain an account of Gosse and Warburton's travels through West Australia (recently referred to in NATURE), accompanied, of course, by an excellent map.

A ROMAN COMPANY, we learn from *La Nature*, proposes to lay a railway between Naples and Mount Vesuvius.

WE would direct the attention of our physiological readers to a short paper which has just appeared in the "Proceedings of the Royal Society," by Mr. E. A. Schäfer, on the Intracellular Development of Blood-Corpuscles in Mammalia, in which he shows, in the subcutaneous tissue of the new-born rat, how the red corpuscles, statically developed together with the primitive capillaries, become the dynamically circulating blood-discs of the older animal, as in the *area vasculosa* of the embryo chick.

WE are glad to see that the Leeds Naturalists' Field Club and Scientific Association has just concluded the most successful year of its existence, its operations during the past twelve months having been attended by most gratifying and steady progress. We have received the syllabus of a number of lectures (by Mr. L. C. Miall) and excursions to take place during the present and next months, illustrative of the geology of the West Riding. There will be four lectures, illustrated by seven excursions.

WE have received a short and carefully compiled sketch of the Geology of the County of Suffolk, written by Mr. J. E. Taylor, of the Ipswich Museum, a gentleman who, by the popularity of his lectures and the large audiences which he draws, is doing more than anyone to develop a genuine and lasting love for natural history in that part of the country.

MESSRS. LONGMANS & Co. have in the press a "Manual of Industrial Chemistry." It is a translation of Profs. Stohmann and Engler's German edition of Payen's "Précis de Chimie Industrielle," by Dr. J. D. Barry. It will be edited and supplemented with chapters on the chemistry of the metals, by Dr. B. H. Paul, and will be copiously illustrated. The same publishers also have nearly ready an "Introduction to Experimental Physics, Theoretical and Practical," by Adolf F. Weinhold, Professor in the Royal Technical School at Chemnitz, translated and edited by Benjamin Loewy, F.R.A.S.; it will also have a preface by Prof. G. C. Foster, F.R.S., and be illustrated with numerous woodcuts.

THE additions to the Zoological Society's Gardens during the past week include a Mourning Kangaroo (*Halmaturus luctuosus*) from the south of New Guinea, deposited by Signor L. M. D'Albertis; two Gold Pheasants (*Thaumalea picta*) from China, presented by the Rev. A. B. Frazer; a White-cheeked Flying Squirrel (*Pteromys leucogenys*) from Japan, presented by Mr. A. Gower, H.B.M. Consul at Kobe; a Common Fox (*Canis vulpes*) from Russia, presented by Mr. J. W. Ouchterlony; a Long-nosed Crocodile (*Crocodilus cataphractus*) from West Africa, presented by Mr. H. T. Cooper; and a Red Kangaroo (*Macropus rufus*), born in the Gardens.

SCIENTIFIC SERIALS

THE *Geographical Magazine*, No. 1, April.—Such is the title of the successor to *Ocean Highways*, which a "Notice" informs us, "has been discontinued," Mr. C. R. Markham, C.B., F.R.S., "having taken the editorship of the *Geographical Magazine*, issued under new proprietorship." We certainly prefer the outside appearance of the new magazine to that of its predecessor, the cover being much more tasteful and business-like; it has made an excellent start also as to contents. The first article, accompanied by a map, is on "The Basin of the Helmund," which includes all the streams that flow down into the great lake or swamp of Sistan, and lies athwart the line of advance from the north towards India. A large part of this area is still entirely unknown, and the article gives an account of the existing materials whence a knowledge of the region can be obtained. The next article gives an interesting account of the Russian Staff-Captain N. M. Prshevalski's Travels in Mongolia in 1870–73. Captain Prshevalski "has acquired most valuable scientific information which, combined with the map he intends shortly to publish, will shed a flood of light on the geography, zoology, and botany of Mongolia and Northern Thibet." This is succeeded by an article on "The Hydrographical Department of the Admiralty," giving a brief history of this most important department of the naval service, and a sketch of its labours. The article contains some valuable hints as to how the department might be made more efficient than it is if Government would only be a little more wisely liberal. An article on the Island of Hormuz, by Lieut. A. W. Stiffe, gives an account of the present state of the island and of the remains of its ancient grandeur. We can only name the other original

articles :—"A Highway to Bolivia," by Mr. Alfred A. Geary; "The Kashgar Mission," of Mr. Forsyth and party; "Dr. Beccari's Travels," in which Prof. H. H. Giglioli gives the latest news of the Italian traveller and naturalist, who has left Makassar for Kandari, an unexplored region of S.E. Celebes, where he hopes to secure specimens of the great Anoan antelope (*Anoa depressicornis*); "Geographical Progress in India in 1873;" and "the Products of West Africa," by M. W. Robinson. There are, besides the usual Reviews, Correspondence, Proceedings of Societies, &c.

Bulletin de l'Academie Royale de Belgique, No. 2, 1874.—The principal paper in this number is one by M. Montigny, in which it is sought to show that "the frequency of variations of the colours of stars in scintillation is generally in relation with the constitution of their light, according to spectral analysis." The author's observations embrace two distinct periods—one from Oct. 1870 to end of March 1871 (47 nights of observation), and the other from June to Dec. 1873 (19 nights). After referring to Secchi's three types of star-spectra, he gives a table of the stars observed, indicating the type of spectrum, the scintillations observed in a second at 60° zenith distance, the size, &c. It is found (1) that the stars scintillating most belong to the first type, or those with four spectral lines, while the stars showing weak scintillation are generally in the third group or type of nebulous bands and dark lines; (2) that the average, 86 (scintillations per second), of the first type exceeds considerably that of the third, which is 56. The average of the second group (the spectra resembling that of the sun) is 69, and thus intermediate, though a little nearer that of the third; (3) while some stars little differing in size resemble each other also in numerical intensities of scintillation (especially in the first type), no marked connection appears between the frequency of scintillation and the order of size of the stars; the last two types even present equal mean sizes, though their scintillations differ considerably. The average scintillations of the three types are in proportion of the numbers 14, 11, and 9. The author points out how his researches not only confirm M. Dufour's law that the red stars scintillate less than the white ones, but affords an explanation of it. The more frequent scintillation of the white stars is due to the fact, that, with equal distance of the observer, the total separation of the coloured bundles of rays, dispersed by the atmosphere, and which have emanated from a white star, is greater than in the case of a red star; the original rays of the white star being more numerous and more exposed to undergo frequent interception by the passage of aerial waves.—M. d'Omalius d'Halloy contributes a note on the Devonian system, and MM. Quetelet and Terby give accounts of auroræ boreales observed in January and February.

Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie, March 1.—This number opens with the concluding part of a paper by M. Mühry in orographic meteorology. The author adduces evidence from hygrometric phenomena, that the permanent equatorial ascending-current forms the transition of the polar, into the returning anti-polar, current; he also proposes a new classification of clouds, according to ascent or descent. Some particulars are furnished, in a note, as to the climate in southern parts of Europe—Gibraltar, Tarifa, and San Francisco: and M. Jelinek translates a paper by Mr. Kingston of Canada, treating of the most suitable arrangement of thermometers in determining the temperature of the air.

March 15.—The beneficial effect of Alpine health-resorts has been attributed to the greater abundance of ozone in the mountain air. Dr. Haller here communicated the result of observations on the subject in July 1872 and 1873, made at Fusch Bad, in the Alps, at a height of 1,179 metres. Comparing data obtained at the meteorological central observatory of Vienna (194 metres), it appears, that in the bright and warm July of 1873, the ozone-contents of the air at Fusch Bad were considerably greater; by night about 2°·3, and by day 2°·6. In July of 1872, which was cold and rainy, the average of ozone was by night somewhat less (0·6) at Fusch Bad than at Vienna; by day, however, it was 2° greater. It seemed likely that, on further ascent, an increase of ozone would be met with, but after climbing to 23,000 metres, there was no marked difference.—This paper is followed by an account of M Poey's recent observations (French Academy), on the relation between sun-spots and cyclones in the Antilles.—From a study of meteorological phenomena at St. Louis, Dr. Wislizenus finds that the electricity of the atmosphere shows a three-fold periodicity, daily, yearly, and secular (or cyclical). As to the second, the quantity of positive electricity increases in the colder months, reaches its maximum in January, and diminishes with increase of temperature to a minimum in July. The cyclical periodicity is probably one of ten years.—Among other subjects treated in this number are the formation of rain-stations in Bohemia, the inadequacy of the ozonometer at present in use, the decrease of water in springs, rivers, and streams.

Gazetta Chimica Italiana. Fasc. I. e II. 1874. These numbers contain the following papers :—Studies in Toxological Chemistry. I. Search for solanine in cases of poisoning. II. Extraction of the alkaloids from the viscera, and search for nicotine, brucine, and strychnine. III. Detection of hydrocyanic acid in cases of poisoning, by Prof. F. Selmi.—Old and new Reactions of ordinary Phenol, by E. Pollaci.—A product of condensation of Oxalic Aldehyde, by H. Schiff. The substance obtained is formed according to the equation $6C_2H_2O_2 + H_2O = C_{12}H_{14}O_{13}$.—Action of Amides upon the Phenols, by Dr. J. Guareschi. The author has tried the following reactions :—paracresol and benzamide, methyl salicylate and benzamide, and ethyl salicylate and benzamide.—Concerning the action of Sulphur upon Calcium Carbonate, by Prof. A. Cossa.—Reduction of Silver Chloride by means of Sodium Hydrosulphite, by G. Scurati Manzoni. The chloride is reduced according to the equation $Na_2SO_2 + 2AgCl = 2Ag + 2NaCl + SO_2$.—On the Expansion of Fused Sulphur, by G. Pisati.—Upon the Reactions of Phenol, by G. Tasca-Lanza. The remainder of these numbers is principally devoted to abstracts from foreign journals. There is also a complete translation of Prof. Clerk-Maxwell's lecture on molecules, which has already appeared in our columns.

Journal de Physique, March.—This number commences with a paper by M. Bertrand, in which several known theorems relating to static electricity are demonstrated in a new and simple manner, which reduces them to a common principle.—M. Chautard describes an improvement on Mayer's acoustic pyrometer.—M. Lespiault calls attention to a new method proposed by M. Galle for estimating the height of the corona of aurora borealis. As applied to the aurora of February 1872, it gave 56 geographical miles (or 415 kilometres) for the absolute height. The agreement between results obtained from four different stations appears to confirm the principle on which M. Galle's method is based.—An ingenious mode of sending signals in opposite directions simultaneously, in a telegraphic apparatus of compressed air, is described by M. Deprez.—M. Gripon gives an account of some experiments made with a tuning-fork; referring to movement of cords or wires connected with it, vibration of wires in liquids, movement of liquid in a tube vibrated by fork, &c.—We further note a useful summary, by M. Violle, of MM. Favre and Valson's recent researches in crystalline dissociation, and an account of Prof. Tyndall's investigation as to acoustic transparency and opacity of the atmosphere.

Reale Istituto Lombardo di Scienze e Lettere. Rendiconti: t. vii. Fasc. iv.—In this number we find the continuation of Prof. Lombroso's researches on anthropometry and physiognomy of criminals. The results arrived at, from an extensive range of observation, are worthy of study. Among other things, the author concludes that criminals have, in general, a greater stature and weight, more ample chest, and darker hair than the normal; that they present a series of sub-microcephali (53 to 51) double the normal; that the index of the cranium tends to the brachicephalic, especially in assassins; that there is frequent cranial asymmetry; that, tested by the dynamometer, criminals show less force than the normal, but greater than lunatics; that, more often than in sane people, the eyes are chestnut or dark, and the hair is thick and black (especially in murderers); that incendiaries, and, still more, thieves, have very often the iris grey, and always a stature, weight, muscular force, and cranial capacity less than assassins or homicides. In concluding his paper, Prof. Lombroso remarks that prognathism, abundance and curliness of hair, scarcity of beard, frequent dark colour of skin, oxycephalus, obliquity of the eyes, smallness of cranium, development of jaws, retiring forehead, large size of ear, similarity of the two sexes, and scant muscular force, are points of resemblance between the European criminal and the Austral or Mongolian man.—Dr. Polli traces the recent progress of the doctrine of zymotic disease, and of the treatment of it with sulphurised preparations. Figures are given which show the largely increased production of sulphite of magnesia and sulphite of soda by certain chemical works in Italy, for medicinal purposes alone, within the last ten years.—MM. Bizzozero and Manfredi contribute a note in patho-

logical anatomy, On the Development of Contagious Molluscum.—The Architecture of Ants forms the subject of a communication from Prof. Maggi, who has been studying the habits of *Formica fuliginosa* Lat.—M. Tessori furnishes a geometrical demonstration of the error of representations given in many treatises on physics, as to deviation of the plane of oscillation of the pendulum.—In the department of moral and political science, Prof. Bucellati has a paper on central military prisons.

Archives des Sciences Physiques et Naturelles, March 15.—This number commences with a *resumé* of spectroscopic observations of the sun, made at Geneva, by M. Emile Gautier during the last three years. The results of this work (carried on under much less favourable climatic conditions than in Italy), are mainly a confirmation of those got by other observers. The protuberantial phenomena are classed under three heads; eruptions, exhalations, and detached formations; all of which the author illustrates with drawings. Like P. Secchi he was often struck by the fact (which has been doubted), that when a protuberance is observed near a pole, there is generally one symmetrical with it, at the other end of the corresponding solar diameter, and near the opposite pole. The decrease in the number and dimensions of protuberances appeared during these years (from 1869) to precede and exceed that of the spots. M. Gautier adheres to the hypothesis of spots being formed by scorial matters resulting from cooling of the surface by radiation.—In the next paper M. Humbert gives a useful summary of what has hitherto been done by the *Challenger* expedition.—The *Bulletin Scientifique*, which follows, is larger than usual. Among other notes in it, we find an account of some instructive researches by Dr. Macaluso, on polarisation of electrodes, by chlorine and hydrogen. There is also a notice of an important geological map of the Austro-Hungarian Empire, recently completed by M. de Hauer, whose name it bears. The publication, directed by Heidenhain from 1850 till 1863, represents at least twenty years' labour (under considerable difficulties), of a large number of eminent geologists. Each plate is accompanied with detailed explanations. We further note a *résumé* of some recent researches on the minute structure of the eye; and another paper on physiological antagonism of poisons, in which are described some observations by MM. Martin-Damourette, Rossbach and Fröhlich, and others, with regard to the effects of physostigmine, the active principle of Calabar bean, and atropine.

SOCIETIES AND ACADEMIES

LONDON

Mathematical Society, April 9.—Prof. Cayley, vice-president, in the chair.—Mr. G. H. Darwin read a paper On Probable Error in Statistics. He stated that he had been at work at a statistical inquiry, and was desirous of forming some idea of what degree of accuracy he had a right to expect from the collection of a given number of cases. He put the problem into the following form:—A bag is known to contain a very large number of black balls and white balls, mixed at hazard; on drawing a large handfull of n balls, I find p are white and the rest black. What is the probable error in asserting that $\frac{p}{n}$ of all the balls in the bag, are white? n and p, though large numbers, are supposed to be small compared to the number of balls in the bag. Mr. Darwin then made some further remarks On the Combination of Statistics. The question he considered was the following:—If X and Y are measurements or estimations of quantities such that the errors are distributed according to the exponential law, what is the "probable error" of XY and $\frac{X}{Y}$ in terms of the moduli c and c' of X and Y respectively? M. J. W. L. Glaisher made some remarks on the papers, drawing the author's attention to the fact that the two questions had been treated of by Laplace and De Morgan.—Mr. Merrifield then gave a sketch of his paper entitled Determination of the Form of the Dome of Uniform Stress. He remarked that the general question of the equilibrium-figure of a thin dome is indeterminate, even when the law of thickness or density is given, and it thus differs from the question of the arch, by requiring the assumption of a further condition in order to render its form determinable. If the two following conditions are introduced simultaneously into the general equations, he stated that a very remarkable simplification occurs in the analysis:—(1) that the thrust along a meridian hall equal the thrust along the parallel per unit of area at every point; (2) that the normal thickness shall vary in such a manner that the area under compression shall be proportional to the thrust. These seem to be the conditions necessary to the economical use of building materials of homogeneous character, for the maximum stretch is evidently least when the stress is equally distributed through the whole of the material. The form obtained bears a general resemblance to the upper half of a claret bottle, and the dome evidently required a heavy lantern.—Mr. A. J. Ellis gave an explanation of his theory that ordinary (commutative) algebra is the calculus of similar triangles upon one plane. Taking two fixed points O and I, any third point A determines a triangle, so that if B be a fourth point, it is immediately possible to find a fifth point C, such that the triangle BOC shall be similar to the triangle IOA, and have the angles thus named turned in the same direction. Marking this operation by a, as being determined by the position of the point A, and terming it a *clinant*, he showed that clinants obey every law of commutative algebra, so that it was possible to consider any and every existing algebraical expression as a clinant, and hence as determining a point in a plane. Clinants thus embraced not only the integers and fractions of ordinary arithmetical algebra, but incommensurables, negatives, and imaginaries. Hence also if x and y be any clinants, and $f(xy) = o$, if x be determined by taking X anywhere, a corresponding point Y would be determined. Hence arose a complete calculus of the correspondence of points in a plane, which Mr. Ellis calls *stigmatic geometry*, and which he showed comprehended under one set of equations and greatly generalised, not only the algebraical geometries of Descartes and Plücker, but the homographic geometry of Chasles, and from a single general principle gave a perfect geometrical representation of all the imaginary cases as part of one conception with the real cases. The actual algebraical work, though having the old form and obeying the old laws of operation, is greatly simplified by the clinant signification attached to the symbols, and in especial the expression and determination of direction is rendered easy and certain. (A more detailed explanation will be given, the speaker said, in his "Algebra Identified with Geometry," at the present time in the printer's hands.)—Prof. H. J. S. Smith made a short further communication in reference to his former paper On the Higher Singularities of Plane Curves.—A paper by Mr. H. M. Taylor, On Inversion, with special Reference to the Inversion of an Anchor-ring, was taken as read. Some of the properties given in the paper have been already given by Maxwell (Quart. Journ. Math., vol. ix.) where excellent stereoscopic views of four species of cyclides are given, and by Cayley in the same journal, vol. xii., and in a paper in the Phil. Trans. by Casey. The novelty of the paper consisted in the point of view from which the properties of the cyclides are investigated, viz. as the inverse figures of the anchor-ring, many of whose geometrical properties are as easily seen as those of the circle.

Linnean Society, April 16.—H. Trimen, M.B., in the chair.—A number of papers were read, being Nos. 3-14 of the series of contributions to the botany of H.M.S. *Challenger* Expedition, as follows:—Notes on Freshwater Algæ collected in the boiling springs at Furnas, St. Michael's, Azores, and their neighbourhood, by H. N. Moseley.—Note on the foregoing communication, by Prof. Thiselton Dyer.—Notes on some collections made at Furnas, by M. Archer. The diatoms belong to species of most frequent occurrence in fresh water, and appear to be in no way affected by the high temperature. The other Algæ are mostly common species, several of them British, belonging to the genera *Spirogyra*, *Mesocarpus*, *Bulbochæte*, *Œdogonium*, &c.—Notes on plants collected at St. Vincent, Cape de Verdes, by H. N. Moseley—Enumeration of Algæ collected by Mr. Moseley at the Cape de Verdes, by Dr. G. Dickie.—Enumeration of the fungi collected during the expedition of H.M.S. *Challenger*, Feb.-May 1873, by the Rev. M. J. Berkeley.—Note on plants collected at St. Paul's Rock, by H. N. Moseley. The only aërial plant found on the island was a *Chlorococcus*.—Enumeration of the Algæ collected by Mr. Moseley at St. Paul's Rock, by Dr. G. Dickie.—Notes on plants collected at Fernando Noronha, Cape de Verdes, by H. N. Moseley.—Enumeration of Algæ collected by Mr. Moseley at Fernando Noronha, by Dr. G. Dickie.—Enumeration of Algæ collected by Mr. Moseley in 30 fathoms of water at Barra Granda, Pernambuco, by Dr. G. Dickie.—Enumeration of Algæ collected by Mr. Moseley at Bahia, by Dr. G. Dickie.

Chemical Society, April 16.—Prof. Odling, F.R.S., pres.,

dent, in the chair.—Dr. A. W. Tilden read a paper On Aqua Regia and the Nitrosyl Chlorides. He finds that when the gases evolved on gently heating aqua regia are passed into concentrated sulphuric acid, a product is obtained which, at a low temperature, deposits crystals of nitrosyl sulphate, $NOHSO_4$. Both these crystals, and the liquid producing them, when mixed with sodium chloride and gently heated, evolve nitrosyl chloride NOCl, an orange-yellow gas which may be condensed to a deep orange-red liquid boiling at – 8° C. The author could not obtain the dichloride $NOCl_2$, which Guy Lussac supposed to exist, but which he believes to be merely a solution of chlorine in the monochloride.—Dr. C. R. A. Wright then read a paper On Isomeric Terpenes and their Derivatives, Part IV. § 1. On Cajeput Oil, by C. R. A. Wright and C. Lambert. It was found that the cajeputol, $C_{10}H_{18}O$, boiling at 176°—179° C., obtained from oil of cajeput, combines with bromine forming the compound $C_{10}H_{18}Br_2O$. On heating this it splits up into cymene, $C_{10}H_{14}$, hydrobromic acid, and water. § 2. Action of Pentasulphide of Phosphorus on Terpenes and their Derivatives, by C. R. A. Wright. When cajeputol is treated with the pentasulphide, it yields a mixture of terpene and cymene, the latter being formed by a secondary action of the pentasulphide on the terpene. This was shown really to be the case by treating the terpene from oil of turpentine and hesperedene with the pentasulphide, when cymene was formed in both cases.

Anthropological Institute, April 14.—Prof. Busk, F.R.S., president, in the chair.—Mr. John Brent exhibited and described a series of flint implements from Canterbury and Reculver.—A description, by Mr. Howorth, was read of an Ashanti fetish letter, or curse. The document, which was lent by Capt. Gordon for exhibition, was written in the Arabic character and in the language of the Barbu tribe, on a sheet of rough paper of large foolscap size, folded about two inches square and tied with green thread. The letter contained a prayer that the English might fight among themselves and return to the coast, and that pestilence might overtake them. The Ashanti grievances were enumerated, and it stated that the white man came with covetous eyes and seized the land, and that covetousness brought down the curses of Suleiman the high priest. It was thought by the English scouts that it was Suleiman himself who endeavoured to stay the British troops on their approach by throwing down the fetish, and that his failure would probably cost him his life.—Capt. S. P. Oliver, R.A., contributed a series of papers On the Non-historic Stone Relics of the Mediterranean. The series comprised full accounts, with ample illustrations, of the Torre dei Giganti, Malta; Tumuli near Smyrna; Dolmen-mounds of the Albegna; Sardinian Nuraggls; and the Sepolture de is Gigantes of Sardinia.

Meteorological Society, April 15.—Dr. R. J. Mann, president, in the chair.—On the Climate of Patras, Greece, by Rev. H. A. Boys. The author shows that the climate of Patras is naturally mild and relaxing, seldom disagreeably dry, and not often very damp, being indeed drier by a good deal than any part of England.—Remarks on the Atlantic Hurricane of August 20 to 24, 1873, by W. R. Birt.—On the Meteorology of December in the southernmost part of the Southern Indian Ocean, by Robert H. Scott, F.R.S. This paper has been prepared for the purpose of giving information on the climate of Kerguelen Island to those gentlemen who are going out to observe the Transit of Venus in December next.—On the Diurnal Variations of the Barometer, by J. K. Laughton. Whilst it has long been well known that barometric maxima and minima occur daily with unfailing regularity, especially within the tropics, the cause of this recurrence is yet unknown; and though it has been attributed to the different temperature and humidity at different times of the day, such explanation is far from satisfactory, for the maxima occur at the times of mean temperature and humidity without regard to the direction of the change, and the minima occur indifferently at the times of both greatest and least temperature and humidity. It seems that an explanation is rather to be found in the inertia of the atmosphere, which in the first instance permits its elastic force to be increased by a rapidly increasing temperature before the inertia of rest can be overcome sufficiently to allow it to enlarge its volume in due proportion, but when that inertia of rest is overcome, then the inertia of motion permits it to move away from the place of observation in excess of what is due to the increased elasticity; the nocturnal maximum and minimum being caused by the resilient power of the air, which gives it alternately an inward and outward motion, and each way in excess of what is due to the decrease or increase of elasticity by reason of the inertia of motion. If this explanation is correct, we ought to find a certain tendency of the wind towards east in the morning and towards west in the evening; and this tendency does seem to be shown in the very few published observations which permit a comparison to be made. Further observations, as confirming or disproving the proposed theory, are much to be desired.

Victoria Philosophical Institute, April 13.—Mr. Edmund W. Gosse, of the British Museum, read a paper On the Ethical Condition of the Early Scandinavian Peoples, in which he illustrated the peculiar features of the civilisation of Scandinavia in pagan times, and showed in what salient points that civilisation differed from the spontaneous developments of morality in other cultivated heathen races—the Elder or Poetic Edda of Sœmund Sigfussen being taken as the text.

MANCHESTER

Literary and Philosophical Society, March 24.—Rev. William Gaskell, vice-president, in the chair.—On some of the Perplexities which the Art and Architecture of the Present are preparing for the Historians and Antiquarians of the Future, by the Rev. Brooke Herford.—A Few Observations on Coal, by E. W. Binney, V.P., F.R.S. From his observations the author was led to conclude that soft or cherry coal was chiefly composed of the bark, cellular tissue, and vascular cylinders of coal plants with some macrospores and microspores. That caking coal had much the same composition, except that it contained a greater proportion of bark in it. That splint coal had a nearly similar composition, but with a great excess of macrospores. That cannel coal, especially that yielding a brown streak, was formed of the remains of different portions of plants with a great excess of microspores, which had long been macerated in water. These conclusions were arrived at merely as to the composition of the different kinds of coal. No doubt each seam would be materially affected by the nature of the roof, whether the latter was an open sandstone or a close and air-tight black shale or blue bind, for the former would allow the free escape of gaseous matter, and the latter would prevent its escape. It is well known that the character of the roof has a deal to do with the quality of the coal under it.

April 7.—E. W. Binney, F.R.S., vice-president, in the chair.—The chairman exhibited to the meeting some portion of the cast-iron roof from the Salford Station of the Lancashire and Yorkshire Railway, which after having been up for a period of four years was so much corroded and damaged that it had to be taken down. He attributed the effects to sulphuric acid and soot arising from the combustion of the coal used in the locomotives passing under it, aided by the action of steam and vibration.—On the Action of Nascent Hydrogen or Iron, by William H. Johnson, B.Sc. In a paper read before the Society last year, the author showed that a piece of iron immersed in hydrochloric, sulphuric, or other acid which evolves hydrogen by its action on the metal, on breaking gives off bubbles of gas from the surface of the fracture. It subsequently occurred to the author that these bubbles might be produced by subjecting the metal to the action of nascent hydrogen for some time, and without the aid of acid at all. To test this he connected two pieces of iron wire ·07″ diam. respectively with the copper and zinc plates of a battery of 50 Daniell's cells and immersed them in a vessel of Manchester town's water at a distance of one inch apart. On closing the current, bubbles of hydrogen were given off from the wire connected with the zinc, but none from the wire connected with the copper, the oxygen liberated at the pole apparently forming oxide of iron which in 12 hours formed a thick smudge at the bottom of the vessel After 24 hours the surface of the wire connected with the zinc was unchanged, but on moistening the fracture bubbles were given off abundantly just as if it had been immersed in acid. The other wire, on the contrary, though much oxidised and eaten away, did not give off bubbles when broken. A variety of experiments were made in the same way with similar results. The author concludes that if the oxidation of the surface of iron be as a rule accompanied by the absorption of nascent hydrogen into the interior of the iron, then the diminution of strength and toughness consequent on this will affect iron ships, telegraph cables, and other structures in which iron is largely used and which are constantly immersed in water.

EDINBURGH

Geological Society, March 13.—Mr. Andrew Taylor exhibited a specimen of coal converted by a recent explosion in

a Lancashire pit into anthracite, and even in some parts into graphite.—A paper by Mr. Payne was read, On the Oolitic coalfield of Brora, Sutherlandshire. One of the coal-seams, about 3 feet 6 inches thick, is being worked at a depth of from 720 to 300 feet.—Mr. Taylor then read three short papers on (1) An analysis of various coals and peats. (2) Specular iron recently discovered in New South Wales. (3) Shale recently discovered at Waitata, New Zealand.—Mr. Peach stated that, in the course of preparing these sections, he had made a discovery which may yet prove to be of some service in the Fine Arts, viz., that the pounded dust of such shale as this, an enormous bed of which occurs in New Zealand, yields a colouring material closely resembling sepia, a costly substance.

April 16.—Mr. David Milne Home, F.G.S., president, in the chair.—The first paper was read by Dr. Ramsay H. Traquair, Keeper of the Natural History collection in the Edinburgh Museum of Science and Art, On the Structure and Affinities of the genus Cheirolepis. Dr. Traquair submitted the following conclusions at which he had arrived on the matter:—(1) That Agassiz was correct in ascribing branchiostegal rays and irregular dentition to the cheirolepis, but the larger teeth are placed in a distinct row internal to the smaller ones, not in the same line as Agassiz described them. (2) That the plates described by Powrie as principal jugulars belong to the shoulder girdle, being in fact the interclavicular plates of Parker; and that cheirolepis has no jugular plates. (3) That the osteology of cheirolepis shows it to be so closely allied to Palæoniscus that it ought to be included in the same family, notwithstanding the minuteness and non-overlapping character of the scales.—Mr. George Lyon read a paper On a Species of Griffithides (Trilobite) from a limestone quarry south of Dalkeith, near Edinburgh, and which belongs to a genus extremely rare.—Mr. David J. Brown read a paper On a new Theory of the Formation of Till, or Boulder-clay. The author submitted that till is in reality formed by glaciers, after they enter the sea, tearing up the rocks that form its bed, and grinding them to boulders and mud, and that this mud deposited along with the boulders forms boulder-clay.

Vienna

Geological Institute, Jan. 7 (anniversary meeting). The Director, Fr. v. Hauer, read the annual report, which states, that during the last year the palace of Prince Liechtenstein has been purchased for the collections, the library, laboratory, and the working rooms of the institute. The staff has been reorganised, and now consists of the Director, Fr. v. Hauer; Vice-Director, Fr. Foetterle; Chief Geologists, D. Stur, G. Stache, and E. v. Mojsisovics; Chief of the Chemical Laboratory, K. v. Hauer; Geologists, H. Wolf and K. Paul; two adjuncts, O. Lenz, the second at present being vacant; two assistants, A. Redtenbacher and K. John; two practitioners, C. Doelter and R. Hörnes.—After mentioning the share which the institute took in the general exhibition of last year, the report announces that geological explorations have been carried on during the last summer in the Bukovina as well as in the Tyrol, whence the examination of the northern chain of the Austrian Alps was finished with the Bregenzer-Wald (Vorarlberg), whilst that of the central chain was continued in the environs of the Oetz valley and the Ortler mountains, and that of the southern chain was begun in the environs of Lienz, in the valley of the Drau. Grateful allusion is also made to the liberal foundation of a capital of 12,000 florins in bonds of the Southern Railway Company, the gift of Albert Schloenbach, of Salzgitter, Hanover, in memory of his late son, the eminent geologist, Urban Schloenbach. The annual interest of this sum will be given to officers or friends of the Geological Institute, to enable them to travel in foreign countries to compare geological observations made in the Austrian dominions with those abroad. The first to whom it has been granted is D. Stur, whose studies on the exact geological position of the Bohemian coal-beds are likely to lead to very interesting results; results, however, which require a comparative study of other coal basins, and chiefly of the rich collections of fossil plants in the Museum of Dresden, for their secure confirmation.—The following specimens have been newly arranged in the museum of the Institute:—The silurian fauna of Galizia; the Devonian fauna of Moravia; the carboniferous flora of Ostrau-Orlau-Karwin, of Schazlar-Schwadowitz, of Kladno-Schlan, of Swina, of Stradonitz, of Radnitz and its environs, of the Pilsen basin, of the Rossitz basin, the flora and the fauna of the old red in Austria, Moravia, and Bohemia; the cretaceous flora of Moravia and Bohemia; the flora of many tertiary deposits in Bohemia, and of Wieliczka and Swaszawicæ, in Galizia. In the chemical laboratory, more than 300 analyses and assays have been performed, the library has been augmented by 661 volumes, and the collection of maps by 194 sheets. The progress of the publications appears very satisfactory: besides the periodicals, the *Jahrbuch*, the *Mineralogische Mittheilungen* and the *Verhandlungen*, four sheets of the "Memoirs," were edited, viz., Vol. V., No. 4, On a Fossil Saurian from Lesina, with 2 plates, by Prof. A. Kornhuber; No. 5, On the Cephalopods of the Gosau beds of the north-eastern Alps, with 9 plates, by Dr. A. Redlenbacher; No. 6, Fauna of the beds of Aspidoceras acanthicum, with 13 plates, by Prof. M. Neumayr; and Vol. VI., No. 1, The Fauna of the Flambach and Halstatt beds, with 32 plates, by Dr. E. v. Mojsisovich. Also, a Geological Map of the Environs of Vienna, on the scale of 1 : 28800, with explanations by Th. Fuchs, and a Catalogue of the Objects exhibited by the Institute at the General Exhibition, have been published. Finally, the most important work has been the completion of M. v. Hauer's large geological map of the Austro-Hungarian empire, printed in colours on the scale of 1 : 576000, the last four sheets of which were published last year. Further communications were made by T. Hirschwald, On the Transformation of Wood into Brown Coal, in the Mine Dorothee, on the Ober-Starz; by S. Nedeljkovic, On the Sanidin-Trachytes of Syrmia; Dr. A. Redlenbacher, Remains of *Ursus spelæus* from a cavern near Wildalpe, Upper Styria; Dr. G. Stache, On the Fauna of the lower eocene beds of Cosina, in Istria; Dr. C. Doelter, On some Eruptive Rocks in the Transylvanian Erzgebirge.

Göttingen

Royal Society of Sciences, Jan. 3.—M. Wielen communicated the results of an examination of Greek names of makers inscribed on ancient earthenware lamps in several archæological collections in Athens, Corinth, and Smyrna.—M. Lolling presented a paper on the Theseion and the Hephaisteion in Athens.

Riga

Society of Naturalists, Nov. 5, 1873.—M. Russwurm furnished some interesting particulars as to the seal-fishing on the Russian coasts. The Baltic supplies annually about 12,000 animals, with a value of 125,000 roubles (the rouble = 3*s.* 1½*d.*); the White Sea and neighbouring parts, 18,000 animals, worth 212,000 R.; the Caspian Sea, 100,000 animals, worth 900,000 R. The Russians (unlike the Finns, &c.) do not eat the flesh of seals, but throw it away. The various species met with, as also the mode of capture, were described.

Nov. 19.—Dr. Gutzeit gave an account of a new official map of Russia, just completed at St. Petersburg.—M. Teich communicated some observations on the power of scent in butterflies; he thinks they are greatly guided by the sense of smell, which has its seat in the feelers.

Dec. 3.—Prof. Petzholdt read a paper on structural relations of ice and axes of crystals.—Prof. v. Sivers made some observations on driftwood collected in the Arctic regions by the recent German expedition.

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