THURSDAY, JULY 6, 1871

SENSATION AND SCIENCE

THE morbid craving for excitement, which is characteristic of mental indolence, as well as of effete civilisation, has led to the introduction of Sensation (as it is commonly called), not merely into our newspapers and novels, but even into our pulpits. It could not be expected that our popular scientific lectures would long escape the contamination. We have watched with regret its gradual introduction and development, and have often meditated an article on the subject. But now, when a splendid opportunity has come, we feel how unfit we are for the task. None but a Spurgeon can effectively criticise a Spurgeon; none but a *Saturday Reviewer* could be expected to tackle with delicacy and yet with vigour the gifted author of the "Girl of the Period." So we must content ourselves with the spectacle of the Rev. Prof. Haughton as criticised by himself. We have not been able to attend his recent lectures at the Royal Institution, but we have it on excellent authority that they were racy (*i.e.* sensational) in the extreme. Happily we find in the *British Medical Journal* what is described as an authorised version of them. A few extracts from this will enable us to dispense with a great deal of comment. We shall first take the Science, and then permit the Sensation to speak for itself.

Prof. Haughton's subject is *The Principle of Least Action in Nature;* and we are told that he believes he has succeeded in discovering in this the true principle on which the Science of Animal Mechanics must be founded, and has been enabled to sketch out the broad outlines of its foundation.

Maupertuis's Principle of Least Action is indeed "well known to mathematicians," but is by no means easy of explanation to the ordinary reader. We can, therefore, sympathise with the lecturer in his repeated failures to make it intelligible. But we cannot admit any justification of the constant use of the same words, sometimes in one sense, sometimes in a totally different one. To a mathematician (Prof. Haughton speaks as at once mathematician, anatomist, medical man, natural philosopher, "expert" at shot-drill, the crank, and the treadmill, clergyman, &c., &c., and even as potential farmer and landlord-shooter!) we should have thought that, when once x, y, z, or whatever else, is introduced, it has and continues to have a definite meaning, until *in a new problem* it comes to be applied to something possibly quite different. How then can we account for such sentences as the following?—

"The great problem—the problem of doing a given amount of work *with a minimum of effort*."

"Nature aims at producing a given quantity of work *with the least quantity of material*."

"I could show that these [tendons of the legs and arms of animals] are constructed *with a wonderful economy of force* of the same kind as that with which the bee constructs its cell"

"By what force, or by what intelligence, do the limbs of animals describe their proper path? Who places the socket of each joint in the exact position (which can be calculated with unerring certainty by mathematics) which enables the muscle to perform its allotted task *with the least amount of trouble to itself?*"

"The Principle of Least Action is that the arrangement and mutual position of all muscular fibres, bones, and joints must be such as to produce the required effect *with the minimum amount of muscular tissue*."

"Before proceeding to apply *this principle of least action or least trouble* to nature," &c.

In all these extracts the italics are ours. If the reader but glance them over, he will not require to read the lectures to see what a very Proteus is this so-called principle. There is no knowing where to have it. It is a minimum, an economy, a least quantity, and what not; sometimes of effort, sometimes of material, then of trouble, and anon of muscular tissue, or of force of the same kind as that with which the bee constructs its cell! But the most curious feature about it is that in none of its metamorphoses does it in the slightest degree resemble the least action of Maupertuis, with which it would seem throughout to be held as identical.

Even in his remarks on this perfectly definite mathematical question, Prof. Haughton commits a grave error, for he says:—

"If I take the points A and B in the planet's path, S representing the sun, I only require to know those points A and B, and the sun S, to calculate for you, from the Principle of Least Action—which I can do to the millionth part of an inch at each point of this orbit—the path that the planet must describe, on the supposition that it is a lazy, intelligent animal, trying to swim round the sun in such a manner as to give the least trouble to itself."

It seems to us that all that the principle of least action can tell us, is that, supposing the sun's attraction to vary inversely as the square of the distance, the planet will describe *some conic section or other*, whose focus is S, and which passes through A and B. Which it will be of the innumerable conics satisfying these conditions, ellipse, parabola, or hyperbola (or possibly circle) there is nothing to indicate, within quadrillions of miles—yet we are told it can be done to the millionth of an inch!! As to what a "lazy, intelligent animal" (of course, not acted on by gravity) would do in "trying to swim [in what?] round the sun," we unfortunately possess no information. But this is merely another proof that we are dealing with Sensation where we looked for Science.

Here we have caught our instructor in a palpable and inexcusable blunder, and we could easily point out many others of a similar kind in his remarks on light, &c. It is not so easy to do so, or rather to make the general reader aware that we have done so, when he leaves strictly mathematical applications, and plunges headlong into a wild sea of speculation *without previous careful definition of his terms*. These terms are, in fact, as he employs them, so elastic, that it is only by contrasting (as we did above) portions of his lectures with other portions in which the same words acquire other and different meanings, or in which different words are employed for the same meaning, that we see how excessively loose and slipshod is the whole affair. Another little group of quotations will admirably illustrate this:—

"The law of *least action* is attended to in every

department of nature *down to the most minute details. . . . . Not even one grain of material is ever used*, when less would suffice for the purpose."

This is, no doubt, admirable, and would suit the most frantic of the mischief-making teleologists. But, alas! like the Editor of the *Little Pedlington Observer*, "What in one line we state we retract in another." For there follows—

"We can demonstrate by mathematics that in the use of every such muscle [triangular, &c.] *there is a necessary loss of force*. . . . I have always maintained that beauty of form . . . was one of the pre-existing conditions in the mind of the Contriver of the universe, as well as economy of force."

As intermediate to these two quotations, and in itself amusing from its *bonhommie* and condescension, we may take the following:—

"Nature, according to my principle, is entitled to employ these two forms of muscles whenever she pleases."

The reader may take our word that these are but single gems, selected from among many similar and often richer ones, mainly on the Principle of Least Trouble (in copying out for press).

As to really scientific matters, occasionally referred to in these lectures, we need merely mention that the author is ignorant of, or ignores, Dr. Pettigrew's extraordinary researches on wings and other adaptations for progression; researches which ought to be thoroughly mastered by any one who attempts to write on the subject of animal mechanics; and that, in his remarks on the strength of the uterine muscles, he seems to have entirely forgotten to notice how thoroughly least action theories (at least as applied by him) have been upset in a late number of the *Dublin Quarterly Journal of Medical Science*.

We promised Science first and Sensation afterwards. In attempting to collect the Science we have got hold of little but Sensation: so we need give only one extract more. Would it have been considered possible (till the 23rd of last May) that a Dublin professor, an M.D., a D.C.L., an F.R.S., and a clergyman of the (till lately) Established Church, should, even in jest, speak as follows in the Royal Institution in London?—

". . . . A brilliant idea came across my mind . . . . What in the world is to hinder me from taking a farm in Westmeath, deliberately and wilfully refusing to pay my rents, and in due time shooting my landlord, and, instead of using him as a New Zealand tenant would, dissecting him at my leisure?"

We have only to add that the *British Medical Journal*, in publishing the above, conspicuously prints the remark:—

"In reproducing the *ipsissima verba* of the lecturer, and giving them a permanent place in scientific literature, an enduring service will be rendered to Science."

Which means, we hope, that all men, scientific or otherwise, will, once for all, take warning from this terrible example. If such be the result, Prof. Haughton will, indeed, not have lectured in vain. But if the *British Medical Journal* intends its remarks to signify approval, we can say of it and of Prof. Haughton, in the language of Cervantes—

No rebuznaron en valde
El uno y el otro Alcalde.

BASTIAN ON THE ORIGIN OF LIFE

The Modes of Origin of Lowest Organisms: including a Discussion of the Experiments of M. Pasteur, and a Reply to some Statements by Professors Huxley and Tyndall. By H. Charlton Bastian, M.A., M.D., F.R.S., &c. (Macmillan and Co., 1871.)

IT may be as well to state at the outset that the present volume is not Dr. Bastian's long-promised work on "The Beginnings of Life;" and it would have been better had some title been devised to prevent the confusion that will inevitably be caused by its appearance at this juncture. We have here, however, a condensed sketch of the whole controversy on Spontaneous Generation, and a statement of some very important researches conducted by the author since the discussion which followed Prof. Huxley's Presidential Address at Liverpool last September. It will be remembered that the objections to Dr. Bastian's experiments and to the results he deduced from them were twofold. It was said that we have no proof that these minute organisms (*Bacteria*, &c.), or their germs cannot resist the heat to which they were subjected. It was also said that no proof was given that the supposed organisms found by Dr. Bastian in these boiled and hermetically sealed liquids were alive. The motions exhibited might be "Brownian" motions, and the experimenter probably found nothing in his vessels but what he put into them. The answer to these objections is now given. The test of vitality is said to be, not movement, which is admitted to be uncertain, but the *power of reproduction*. It is found that if a portion of liquid containing *Bacteria* is divided into two parts, one of which is boiled, and a drop from each of these portions is mounted as a microscopic object, under a covering glass surrounded by quickly-drying cement, the unboiled specimen exhibits a marked increase from day to day in the quantity of imprisoned *Bacteria*, while the boiled specimen continues unchanged during the same time. Making use of this test of vitality, it was next ascertained what degree of heat was fatal to these low organisms. By using a lower and lower temperature, it was found that exposure to 140° F. for ten minutes destroyed *Bacteria*, while after exposure to 131° F. for the same time they rapidly multiplied. Somewhat higher organisms—*Vibrios*, *Amœbæ*, *Monads*, *Vorticellæ*, &c., were, however, killed by exposure to 131° F. for five minutes. It was subsequently ascertained that a four hours' exposure to a temperature of even 127° F. destroyed *Bacteria* and *Torulæ*. It is argued that, as in all these experiments the solutions used swarmed with *Bacteria*, &c., in various stages of increase, their hypothetical "germs" cannot be supposed to have been entirely absent; and that we may therefore conclude that the "germ" has no greater power of resisting heat than the animal itself.

Dr. Bastian also criticises many of the experiments of Pasteur, and the arguments founded on them. He maintains that the corpuscles found by the latter to exist in the atmosphere, and which "resemble" spores of fungi, have never been proved to be such; and even if they were so proved, it would not account for the constant occurrence of *Bacteria* and other low organisms, whose "germs" are quite unknown, and which there seems no reason to believe could retain their vitality in a dry state

in the atmosphere. The fact that vessels with bent necks or with plugs of cotton-wool do not produce organisms, while other vessels not so protected produce them in abundance, is shown, by numerous experiments, not to be universal. The evidence now adduced is held to prove that a variety of conditions hitherto not attended to affect the result, such as temperature, the strength of the solution, and especially the presence of particles of organic matter, other than "germs," derived from the atmosphere. A summary is given of sixty-five comparative experiments, which are believed to show, among other things, that the non-production of *Bacteria*, &c., in infusions and other suitable liquids, is so common an occurrence that the negative experiments of Pasteur and others have no weight as compared with the positive results obtained by a considerable number of observers, to whom the author refers, as well as by himself.

Some of these comparative experiments are very suggestive. Hay infusion, for instance, exposed to air, produced abundance of *Bacteria* in forty-eight hours, and these had increased considerably in sixty-eight hours. A similar infusion, sealed up after the fluid had become cold, behaved in a similar manner. The same in a flask with neck two feet long and having eight acute flexures, remained unchanged for twelve days. A similar infusion, hermetically sealed during ebullition, on the other hand, showed turbidity in forty-eight hours, which subsequently increased, and *Bacteria*, *Vibriones*, *Leptothrix*, and *Torulæ* were found in abundance. Here, then, whatever inference may be drawn from the first three experiments is entirely negatived by the fourth. Other experiments show that ammonia-tartrate solution sealed *in vacuo* at a temperature of 90° F. produced in eighty-four hours abundance of *Bacteria;* while the same solution, if boiled at 212° F. and exposed to the air in flasks covered with paper caps, remained quite clear for nine days; yet as soon as it was inoculated with living *Bacteria*, they increased rapidly and produced turbidity. These, and a number of other equally suggestive experiments, indicate that the conditions favourable to the *origin* and to the *increase* of these low forms are not always identical. Both are very complex, and we cannot avoid the conclusion that the advocates of the universal germ theory have been somewhat hasty in founding their doctrine upon insufficient data, for the most part of a negative character.

We have here, undoubtedly, an important addition to the experimental evidence by which alone the question can be decided, and we are glad to observe the unprejudiced and philosophical spirit with which Dr. Bastian discusses this most interesting and important problem.

A. R. WALLACE

THE WORKSHOP

The Workshop. Edited by Prof. W. Baumer, J. Schnorr, and others. (London: J. Hagger, 67, Paternoster Row.)

EVERY year of our national progress strengthens the national appreciation of the wisdom expressed in those words of the late Prince Consort, when he told the manufacturers of Birmingham that "the introduction of Science and Art as the *conscious* regulators of productive industry is destined to play a great and important part in the future development of this nation, and the world in general." I take the liberty of italicising the word "conscious," remembering well the emphasis with which it was spoken, and being strongly impressed with the vast importance of this qualification.

Science of some sort, and art of some sort, have always regulated the operations of productive industry. The club of the savage is not uncommonly carved with much art, and shaped and poised with sound practical knowledge of the whereabouts of the weapon at which will be concentrated the whole force of the blow when it swings through the curve which the stroke of the arm will give it. The savage artisan is, however, utterly unconscious of the dynamical principles upon which the centre of oscillation or percussion is determined, and upon which his own skill depends. He follows a blind instinct but one degree higher than that which impels the bee to construct its honey-comb upon sound statical principles. The more civilised workman who merely proceeds according to the "rule of thumb" and the traditions of his trade, is in a similar intellectual condition to that of the bee and the savage. In his daily occupation his specially human faculties are scarcely exercised. The constructive instinct which he possesses in common with the beaver or the wasp is sufficient to guide his muscles in doing such work in such a manner. To talk of the "dignity of labour" when labour is thus conducted is merely to indulge in senseless and vicious phrase-mongering.

The whole life and being of the artisan becomes changed immediately his daily work is *consciously* regulated by science and art. It then becomes an elevating instead of a brutalising occupation; the "dignity of labour" is removed from the sphere of platform verbiage to that of practical fact, and the workshop becomes a school of intellectual and moral culture.

We must always remember that the character of a man is formed by the daily, hourly, and continuous habits of his life, that no quantity or excellence of mere Sunday sermons, or occasional evening meetings, can overpower these. The philanthropist who would practically influencce the character of the workman must operate upon him in and through the workshop; and it appears to me that there are no conceivable means so effectual for this purpose as the converting his bread-winning work from a mere mechanical brutal drudgery into a moral and intellectual exercise. To understand thoroughly the scientific principles involved in all the operations of any common handicraft is to know a great deal more than our greatest philosophers are yet acquainted with, and therefore the field of the consciously scientific artisan is wide enough for the intellectual effort of a life time. If, in addition to the physical science of his trade, he is conscious of his own social relations and functions, if he knows the part which he is playing in the great machinery of society, the motive to his industry will not be that of a merely sordid grubbing for wages, but the sense of duty and the chivalry of reciprocal beneficence will be introduced, and will perpetually operate as necessary results of this scientific consciousness of his own social functions.

If soldiers and sailors can be taught to glorify their work, and rise to heroism in their efforts to do their duty and serve their country, why should not the spinner, the weaver, the tailor, the agriculturist, the miller, and the

baker do the same? Surely it is as noble and as glorious and as serviceable to one's country, to be engaged in clothing the naked and feeding the hungry, as in shooting and drowning our fellow creatures?

I have referred above only to the artisan, but have chosen him and the workshop merely for the sake of typical illustration; the remarks apply equally to all who are engaged in useful industry, to the distributor as well as to the producer, to the capitalist and organiser of labour as well as to the labourer himself. The grocer, for example, who should understand and take intelligent interest in the natural history of the products that cross his counter, and the social machinery that brought them there from all the corners of the earth, would be a very different being from the mere parcel-tying and change-counting machine that usually weighs our tea and coffee.

I have thus dwelt upon some of the grounds for giving special emphasis to the word "conscious," believing that the advocates of Technical Education are too apt to regard the subject from a merely technical point of view. It is of the utmost importance that we should be convinced of the perfect harmony which naturally and necessarily exists between moral and material welfare, when the best and soundest means of obtaining either one or the other are followed, especially as there does exist in the minds of a certain class, both of workers and dreamers, a foolish prejudice and misconception, leading them to regard the advocates of Technical Education as a set of cold-blooded materialists, who look upon the workman as a mere productive engine which they seek to improve only in order to get more out of him. My opportunities of learning the opinions and feelings of the better class of self-improving workmen have been rather extensive, and I have met with this idea more frequently than one might suppose were possible. Certain flashy and trashy hollow-headed writers, who are constantly babbling about "the materialistic tendencies of the age" have encouraged these ideas, and as the arts of smart writing and showy oratory are so very easily acquired, this class of sentimentalists is very numerous.

The work above-named, which has suggested these remarks, is published in shilling parts, each containing a large number of well-selected and well-executed illustrations of art workmanship, a supplementary sheet of detailed working drawings, and essays on art-industry and miscellaneous technological subjects. Most of the illustrations are representative of continental art, and the character of the whole work is essentially German, including the typography, and some clerical errors in the English. As the chief use of such a work is to supply the English manufacturer with ideas that may help to emancipate him from slavish adherence to mere trade customs and models, this feature is advantageous, provided it does not foster the too common fallacy of believing that our continental neighbours have a monopoly of artistic taste—a fallacy which is sometimes carried to the length of an extravagant prejudice.

I have little doubt that if an equal amount of industry and taste were exerted in selecting models from the English fittings, English furniture, and English ornaments of English mansions, another and retaliatory "Workshop" of equal intrinsic merit, and equally suggestive to the continental workman, might be compiled.

There are several designs for German porcelain stoves, which are especially worthy of the attention of the English manufacturer. Their value is not confined to their artistic merits; the introduction to this country of such stoves would add much to the comfort and economy of English households, by taking the place of our barbarous open fire-places which give 90 per cent. of their heat to the clouds, and with the residue roast us on one side while the other is exposed to the cold blasts that converge from all sides towards the chimney, round which we are compelled to huddle whenever we have any really cold weather, such as that of last winter. The contrast between the genial, well-diffused warmth of the sitting-rooms of a well-ordered North German household and those of English houses of a corresponding class is anything but favourable to "the Englishman's fireside;" and as reason has so little power against prejudice, it may be well to call in art to the aid of science, in order to try whether the elegant designs of some of the German fire-places may have some effect upon those who reply to all demonstrations of the inefficiency and wastefulness of the English fireplace, that they must have an open fire "to look at," or on account of its "cheerful appearance."

A work of this kind, that a man may purchase or borrow from a library, and thus deliberately study at home, has a special value over and above that of Art Museums and International Exhibitions, though of course in these he has the great advantage of seeing the objects themselves.

The great fault of the work is the want of direct connection between the letter-press and the engravings. There are essays on various branches of art-manufacture, and illustrations of these; but the illustrations are distributed at random throughout the work, which, although published in separate parts, has no part complete in itself. A re-arrangement and proper classification of the materials of this book would greatly increase its value. The publishers may possibly suppose that by devoting certain shilling parts to knockers, hinges, gates, railings, and other ironmongery illustrations, another part to jewellery, another to mantelpieces, others to cabinet-work, &c, they would be holding out an inducement to their customers to buy only isolated numbers, while by the present arrangement, which sprinkles each man's special requirements throughout the work, they compel their subscribers to take the whole series. Whatever be the motive or origin of this arrangement, or want of arrangement, the commercial result must be to prevent many practical men from purchasing it at all, who would be glad to possess those parts relating to their own trades. As a mere picture-book, the confused miscellaneous arrangement may be the most popular, it gives great variety to the contents of each number; but in reference to higher usefulness this is a serious drawback to the merits of an otherwise valuable work. W. MATTIEU WILLIAMS

LETTERS TO THE EDITOR

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

A New View of Darwinism

I AM much obliged to Mr. Howorth for his courteous expressions towards me in the letter in your last number. If he will be

so good as to look at p. 111 and p. 148, vol. ii. of my "Variation of Animals and Plants under Domestication," he will find a good many facts and a discussion on the fertility and sterility of organisms from increased food and other causes. He will see my reasons for disagreeing with Mr. Doubleday, whose work I carefully read many years ago.

CHARLES DARWIN

Down, Beckenham, Kent, July 1

THE very ingenious manner in which Mr. Howorth first misrepresents Darwinism, and then uses an argument which is not even founded on his own misrepresentation, but on a quite distinct fallacy, may puzzle some of your readers. I therefore ask space for a few lines of criticism.

Mr. Howorth first "takes it" that the struggle for existence "means, in five words, the persistence of the stronger." This is a pure misrepresentation. Darwin says nothing of the kind. "Strength" is only one out of the many and varied powers and faculties that lead to success in the battle for life. Minute size, obscure colours, swiftness, armour, cunning, prolificness, nauseousness, or bad odour, have any one of them as much right to be put forward as the cause of "persistence." The error is so gross that it seems wonderful that any reader of Darwin could have made it, or, having made it, could put it forward deliberately as a fair foundation for a criticism. He says, moreover, that the theory of Natural Selection "has been expressively epitomised" as "the persistence of the stronger," "the survival of the stronger." By whom? I should like to know. I never saw the terms so applied in print by any Darwinian. The most curious and even ludicrous thing, however, is that, having thus laid down his premisses, Mr. Howorth makes no more use of them, but runs off to something quite different, namely, that *fatness* is prejudicial to fertility. "Fat hens won't lay," "overgrown melons have few seeds," "overfed men have small families,"—these are the *facts* by which he seeks to prove that the *strongest* will not survive and leave offspring! But what does nature tell us? That the strongest and most vigorous plants *do* produce the most flowers and seed, not the weak and sickly. That the strongest and most healthy and best fed wild animals *do* propagate more rapidly than the starved and sickly. That the strong and thoroughly well-fed backwoodsmen of America increase more rapidly than any half-starved race of Indians upon earth. No *fact*, therefore, has been adduced to show that even "the persistence of the stronger" is not true; although, if this had been done, it would not touch Natural Selection, which is the "survival of the fittest."

ALFRED R. WALLACE

Our Natural History Museum

IN a few days the country will be called upon to vote 30,000*l.* or 40,000*l.* towards the erection of the new Natural History Museum at Kensington. 7,000*l.* were voted last year for the purpose of drawing up estimates and preparing the site, and our present one at Bloomsbury has become such a crying evil that we can scarcely anticipate a refusal of the grant.

So liberal a sum being offered at the shrine of Science, the community at large will necessarily expect great things of her, and first among all a radical redress of all existing grievances Yet, if rumour whispers true, the prospects of the future are scarcely so brilliant or pregnant with promises of better things to come as they should be. Plans have been drawn up and decided upon, and the chiefs of the present Natural History Departments have been subsequently consulted as to the amount of space required for the several collections under their charge.

This is itself a faulty commencement, for the building should be constructed for the requirements of the collections, and not the collections cut to the size of the building, and, as might have been anticipated, such policy already threatens to prove productive of disappointment and dissatisfaction. Some departments will profit by the change, while others, including the one mostly needing an elargement of its borders, will absolutely have less than the present amount of space awarded it. We refer to the zoological one, whose present overcrowded and semi-arranged condition is a disgrace to he nation. And yet, on the completion of the present plans, this cramming process is threatened to be still further carried out, though it is to be hoped the voice of opposition and common sense will save us yet from so unfortunate a catastrophe. We hear again that no consideration whatever has been devoted to the subject of a library for the new building, nor a single foot of space allotted to the purpose of constructing one. Such a blunder as this surpasses the first one. The scientific volumes in the present library are in constant requisition by the officers of the various departments to assist them in the determination and arrangement of the specimens. Many of these again are unique or only replaceable at a great cost, and the inconvenience and loss of advantages that will arise to the official staff on being separated from the collection of works they now have access to, cannot be over-estimated. If the Natural History collections must be removed, an edifice suitable for their thorough utilisation, and replete with every convenience for prosecuting scientific research, including efficient laboratories, should be erected.

But to commence at the root of the evil. No progress can be expected under present auspices, or so long as the chief administration of the establishment, and the appointment and promotion of all officers, is vested in the hands of some fifty or sixty trustees, out of whom not more than two can be said to take a direct interest in the promotion of Natural Science. Nor, again, so long as such little discrimination is exercised in the distribution of these officers. Curiosity has prompted inquiries which have elicited anything but satisfying discoveries. We find men with talents for one branch of natural history stationed in departments where their particular talents cannot be utilised; recent zoologists in the geological department, palæontologists in the recent botanical one, and men peculiarly gifted for literary pursuits and without the slightest taste for scientific research, in the former. Taking next the department of Recent Zoology, the inadequacy of the present staff and the ill proportioned attention that is devoted to particular sections, to the entire neglect of the remaining ones, are painfully apparent. In the Vertebrate division, though abundant room for improvement, there is not so much cause for censure; but on descending to the lower and far more bulky one of the Invertebrates, what do we find? Of a staff of five, two are conchologists, and the remaining three entomologists, while the Crustacea, Arachnida, and the whole of the old group of the Radiates, including the Echinodermata, Mollusco-ida, Cœlenterata, and Protozoa, are left to shift for themselves, and make way for the necessities of the others. Have we no men in England capable of superintending the arrangement of these neglected classes? or is it that the present remuneration for scientific work, for all but those highest in authority—so slender as to necessitate their utilising every leisure hour in eking out other means of subsistence, and taxing their brains, to the detriment of the amount of work discharged in official hours—deters them from coming forward? At any rate, the evil should be attended to, and the present glaring incongruities abolished. Whether new buildings are erected at Kensington, or the existing ones enlarged, it is absolutely incumbent that the administration shall be thoroughly reorganised. A permanent committee of some dozen eminently scientific men should supply the place of the present host of uninterested trustees, and the staff of officers should be distributed in accordance with the plan adopted in the Paris and various Continental Museums. Each zoological section should have its superintendent, with a number of assistants varying according to its requirements, while one governing mind should assume the responsibility and direct the machinery of the whole; and until such reformation is accomplished, there is no hope of any practical improvements. We do not see why the two large wings of the present establishment, now occupied as residences by the superior officers, should not be converted into exhibition rooms; space enough being reserved for one official residence on either side; and if necessary, additional suitable ones might be rented in the immediate neighbourhood, and the collections thus saved the unavoidable wear and tear of removal, and at the same time preserved in their present convenient position of access to the general public. But the exodus has been decided upon, and the question itself is of secondary importance compared with that of administration. On a future occasion I would direct attention to a few other points.

BATHYBIUS

Steam Lifeboats

THE *Globe* of Friday last contained a report of the proceedings of the Committee of the Steam Lifeship Fund, from which it would appear that the subject of the construction of a steam lifeship is seriously contemplated. As one who has for several years given great attention to this most desirable object, perhaps you will allow me to give the results of my labours.

It has already appeared to me that the object to be attained was not the construction of a lifeship, but rather the fitting of lifeboats with steam machinery, thereby improving their efficiency and diminishing the risk of life, as a boat so constructed could be worked, and that more efficiently, by at most three men, instead of the large number now required to man them. The only means of propulsion which can be applied is, in my opinion, the hydraulic propeller, as, the turbine being enclosed, all risk of fouling pieces of wreck, weed, &c., is thereby avoided. To attempt to use a lifeboat fitted with a screw or paddle would only be courting danger and disaster. Such being the case, the boat designed by me consists of three tubes, the outer ones being circular, and the centre one in which the propeller works being semicircular, and placed underneath the platform grating connecting the two circular tubes. The three tubes would be turned up and unite at the ends, and would somewhat resemble a whaleboat. The peculiar advantage of the hydraulic propeller when applied in this manner is, that the boat could be turned round on its own centre, and sent ahead or astern by the man in charge by simply turning a handle, without issuing an order to any one, an advantage which I need hardly say is of the very greatest moment under such circumstances as those in which lifeboats are usually employed.

The system of towing lifeboats by means of steam tugs to some point as near as possible to the site of the wreck, is one attended with danger, and the lifeboat, when cast off, is deprived of its means of propulsion at the very time when engine power would be most effective in enabling it to contend with the broken water round a wreck. I remember a case at Bombay, when a lifeboat proceeding to a wreck was towed right under, and the Chinese crew swept out of the boat and nearly all drowned.

Tubular lifeboats, I need hardly say, are no novelty, and the addition of a centre tube to carry the propeller and the steam engine and boiler will certainly not diminish their efficiency.

JOHN FELLOWES

Naval and Military Club, Piccadilly, July 3

The Internal Stucture of the Earth

ARCHDEACON PRATT'S letter in NATURE for June 22 calls for some remarks on my part. He communicates a few marginal notes written by Mr. Hopkins on a copy of the second part of my "Researches in Terrestrial Physics," which appeared in the "Philosophical Transactions," and seems seriously to regard these curt expressions as judicial utterances beyond which there can be no appeal.

In the first place, I am accused of incorrectly stating the nature of Mr. Hopkins's hypothesis as to the non-existence of friction between the fluid nucleus and solid shell of the earth. The words quoted from my paper as incorrect immediately follow a symbolical expression presented by Mr. Hopkins as the final result of his analysis, and my remark distinctly refers to this mathematical expression, and to nothing else. Remembering that the whole of Mr. Hopkins's mathematical investigations on the internal structure of the earth culminated in the deduction of this very expression, it is well to examine what are the words he uses in the course of his investigations which refer to the existence of friction between the shell and nucleus.

In his first memoir, "Philosophical Transactions," 1839, he says, "and since there will be no friction with the assumed perfect fluidity of the interior matter," p. 386. In his second memoir, I do not recollect that anything about friction is mentioned; but in his third, which summarises the whole of his preceding labours, after presenting the formula already alluded to, he states that it was established on the supposition of "the transition being immediate from the entire solidity of the shell to the *perfect* fluidity of the mass." He afterwards gives reasons for believing that a stratum of imperfect fluid probably exists between the shell and the perfect fluid, and he further uses the words, "Consequently *the assumption made in our investigations of the absence of all tangential action between the shell and fluid* will not be accurately true," p. 43. As my remark refers to these investigations and their immediate result, it is unnecessary to say to whom the charge of inaccuracy may justly apply. In affirming the existence of friction between the shell and nucleus to such an extent as to cause both to rotate as one solid mass, friction between the particles of the fluid is clearly implied; for if no such friction existed, the film of liquid touching the shell and moving with it might slip over the remainder of the nucleus. I have, therefore, been all along at issue with Mr. Hopkins on this point, when I concluded that the rotation of the shell and nucleus must take place as if the whole were solid. Mr. Hopkins declares this conclusion to be "a mechanical impossibility." It is this "impossibility" which has been reaffirmed by M Delaunay in stronger terms than those I used. It has been shown to be not merely possible, but rigorously true, in a particular case, by an experiment of M. Champagneur, which I have myself recently verified, and it has been further so clearly illustrated in these pages by two correspondents A. J. M. and A. H. Green (May 18, p. 45) as to require no further observation. The coincidence of the axes of instantaneous rotation of the shell and nucleus necessarily follows if the whole moves as a solid mass; and to charge me with implying the coincidence in one of my formulæ is equivalent to charging me with being strictly consistent On this point Mr. Hopkins is of course at issue with M. Delaunay as well as with myself. The next important question referred to on which I totally differ from Mr. Hopkins is that of the form of the inner surface of the shell. If the shell has been gradually formed by solidification from a fluid mass, it is evident that the rate of progressive solidification at the interior of the shell must depend on the rate of refrigeration of the surface of the nucleus. This takes place, and has probably taken place for ages, at an almost insensible rate of slowness, and therefore also the successive additions of matter to the shell's inner surface. Between the perfectly solidified and comparatively rigid part of the shell and the fluid nucleus, the matter on the point of becoming solidified is probably in a pasty or imperfectly fluid state (as Mr. Hopkins has admitted), and it is this matter which is subjected to a moulding action by the changes of shape of the nucleus, as I pointed out in the publication already alluded to. This pasty matter becoming slowly impressed with the shape of the nucleus, and freely yielding to the impression as it passes to the solid state, the more rigid part of the shell, precisely as the outer case of a mould, is saved from strain, and cannot undergo a corresponding change of figure. In the discussion which followed the reading of my communication to the French Academy of Sciences on March 6, it appears from the *Comptes Rendus* that M. Elie de Beaumont made some remarks which illustrate and support this view of the process of formation of the shell. The conclusion to which I was thus led, that the inner surface of the shell could not be less elliptical than its outer surface, was reaffirmed soon after the publication of my researches by an eminent mathematician, the late Baron Plana, of Turin. All this Mr. Hopkins considers as quite inadmissible, and very reasonably, too, in the opinion of Archdeacon Pratt, and all the results deduced therefrom are judicially pronounced to be "valueless." But my conclusion as to the interior ellipticity of the shell is only a necessary deduction flowing from the fundamental principles from which my inquiries start, a principle upon which I am as much at issue with Mr. Hopkins as upon anything referred to in his marginal notes. As this is the really vital divergence between us, a few words of explanation are desirable

The hypothesis of the entirely fluid state of the earth anterior to its present state forms the groundwork of mathematical inquiries as to the earth's figure. The problem, as hitherto treated, always involved an additional hypothesis either openly or tacitly implied, namely, that the distribution of the particles composing the earth underwent no change by the earth's transition from a completely fluid condition to its present state. While Mr. Hopkins tacitly assumed this second hypothesis throughout his investigations, I have reason to believe that it was for the first time rejected in my paper on the "Figure and Primitive Formation of the Earth," which forms the first of my "Researches in Terrestrial Physics." By this step we are at liberty to investigate, with the aid of mechanical and physical laws and the known properties of the earth's materials, the probable arrangement and laws of density of the interior strata of the shell and nucleus. In attempting to do so, I was led to conclusions as to the earth's internal structure widely differing from those of Mr. Hopkins. I have great difficulty in believing that the crude comments on my researches communicated to Archdeacon Pratt, could have been intended to meet the public eye. Long before Mr. Hopkins sent these remarks to Archdeacon Pratt, he wrote to me promising to comment publicly upon my conclusions; and since then an opportunity occurred for pointing out in his presence at a meeting of the British Association what I conceived to be the inconclusive character of his results. Mr. Hopkins promised to reply, but neither this

nor his former promise was ever realised. He avoided public discussion, whil as it now appears he *privately* depreciated results incompatible with his own. To Archdeacon Pratt I am grateful for producing evidence of the kind of weapon which I had long suspected to have been employed by my distinguished adversary. HENRY HENNESSY

Dublin, July 1

Oceanic Circulation

MR. LAUGHTON treats an experiment which was only intended to be illustrative as if it had been advanced as probative, and tests it by a doctrine of "thermometric gradients" which does not correspond to the facts of the case. A uniform reduction of the temperature of ocean-water from the Equator to the Pole would doubtless give a "thermometric gradient" of infinitesimal minuteness. But the water of the circumpolar area, on which what Sir John Herschel truly designated the intense action of polar cold is exerted, brings with it so much of equatorial heat that a very decided increase of its specific gravity must be produced by the cooling process to which it is subjected within the polar area. This increase will be adequate, as I have attempted to show, to produce a continuous downward movement of the whole mass of water subjected to the cooling process; and such a movement, however slow, will make itself perceptible in a continuous outflow of the chilled dense water along the deepest floors of the great oceanic basins, and in a continuous indraught of warmer surface water into the polar area. The proof that such is the case seems to me to be afforded by the fact that temperatures not much above 32° seem to be uniformly met with at depths exceeding 2,000 fathoms, even under the equator; a fact of which Mr. Laughton and those who think with him have not, so far as I am aware, offered any account. That there is nothing in depth, *per se*, which produces this depression is shown by the absence of it in the Mediterranean.

It would be difficult, if not impossible, to carry out a probative experiment that should represent the actual conditions of the case. Taking the distance from the pole to the equator at 6,250 miles, and the average depth to which the chilled water would descend at 2½ miles, we should require a trough having a proportion of 2,500 to 1 between its length and its depth, or (in round numbers) a length of half a mile to a depth of a foot. Let it be supposed that cold were continuously applied by a powerful freezing mixture to the surface of the water occupying one extremity of the trough as far as one-tenth of its length, and that heat were applied to the surface of the water occupying the opposite extremity to a corresponding extent, the intervening water being neither heated nor cooled artificially, would, or would not, a continuous circulation from the one end of the trough to the other come to be established? To me it seems that what Sir John Herschel calls the "common sense of the matter" teaches that the continuous descending movement given to the water at the polar end of the trough must in time propagate itself to the equatorial, provided only that the conducting power of the sides and floor of the trough were sufficiently bad to prevent the chilled stratum which falls to the bottom at one end from losing its cold before it reaches the other.

When such masters of Thermotics as Pouillet and Herschel consider that the doctrine of a general oceanic circulation sustained by differences of temperature is conformable to the facts at present known, I would suggest whether it would not be wise if those who are interested in the subject, instead of attempting to controvert their views on theoretical considerations, were to use their endeavours to collect additional data for practically testing them. By the kindness of the Hydrographer to the Admiralty I hope, in the course of the present season, to obtain some further information of a reliable kind; and I am doing my utmost to urge upon our Government a systematic inquiry into what the Secretary of the Scottish Meteorological Society has truly designated (in a recent letter to me) as "the most important problem in Terrestrial Physics."

July 3 WILLIAM B. CARPENTER

I SHOULD need Mr. Laughton's hint if I had ever supposed that the cause of the vertical circulation of the ocean could be determined by such an experiment as I suggested. The experiment was specially intended to throw light on the easterly and westerly oceanic movements. For this purpose it is only necessary that the rate of rotation of the shallow cylinder should be duly adjusted to the observed rate of the vertical motions. But even in this respect the experiment would afford but an illustration, not a demonstration.

The subject of oceanic circulation is altogether too wide and too difficult for discussion in letters. Every point touched on by Mr. Laughton requires many columns for its full discussion. I just note that the infinitesimal nature of the thermometric gradients scarcely seems a sounder objection to the temperature theory of oceanic circulation than to the temperature theory of atmospheric circulation. In one case, as in the other, we must integrate the effects of the solar light on tropical and subtropical regions. RICHARD A. PROCTOR

Day Auroras

LAST evening, about eight o'clock, being in the grounds belonging to the Radcliffe Observatory, I was exceedingly surprised at seeing what I *have no doubt* of being true auroral streamers, forming a little to the east of the south meridian, reaching an altitude of about 25°, and after travelling some distance in a westerly direction, vanishing. This lasted at least ten minutes, when the sky, which had been overcast nearly all day again became so. I pointed the streamers out to several people who were near me, some of whom watched them with me, as a proof of what I had before doubted, namely, that auroras are visible by daylight. JOHN LUCAS,

Assistant at Radcliffe Observatory

Radcliffe Observatory, Oxford, June 28

The Solar Parallax

I REGRET that I have misinterpreted the severity of Prof. Newcomb's remarks respecting my chapter on the Solar Parallax. The fact is, that so far back as February 1 I was warned by an eminent astronomer that Prof. Newcomb had vowed here last November that he would annihilate all who upheld the finality or correctness of Mr. Stone's researches.

Prof. Newcomb must be sensible that his offer to supply information as to the history of inquiries into the solar parallax during the last few years is a very generous one; and that it will be immensely to my advantage to profit by his exceptional familiarity with the subject. I thank him very earnestly. I have an especial distaste for inquiries into the historical parts of scientific subjects, and shall rejoice to be saved the labour of looking up authorities, &c., in this particular matter. If I find my account requires alteration, I shall admit the fact without a particle of hesitation. It is indeed most desirable (though not, perhaps, for students of science, for whom I specially write, and who need trouble themselves little on the matter) that to each worker in the subject of the solar parallax his due proportion of credit should be assigned; and as in this case not only I, but Sir John Herschel, as well as the Council of the Astronomical Society, would seem to have done Prof. Newcomb less than justice, the sooner recantation is made the better.

Prof. Newcomb refers to "the kind spirit in which I have taken his remarks;" meaning rather, perhaps, the appreciative way in which I have spoken of his labours. His critique, regarded as a whole, was not, I take it, kindly meant; and though I by no means feel annihilated by it, I should be speaking untruly if I seemed to admit its justice. If I failed to note how I viewed his comments, it was only because I found a pleasanter subject to speak about in those important researches whereby he has advanced astronomy. RICHARD A. PROCTOR

P.S.—I take this opportunity of noting that the remark in my former letter respecting the work of Mr. De La Rue and F. Secchi in 1860 must not be understood as implying that the account in F. Secchi's book *Le Soleil* is incorrect. On the contrary, I have no doubt it is strictly accurate. I was fortunate in securing a copy of *Le Soleil* before Paris was beleaguered, and derived considerable assistance from its perusal.

Lee Shelter

PERHAPS it is worth noting that a lee shelter is almost as effectual as a screen to the windward. The fact may be quite well known and understood; but I did not become aware of it till I was on Bognor Pier, when a strong gale was blowing directly on the broadside. There are seats backed and covered overhead and on the sides, alternately, on the one or other side of the pier, and on this occasion all the seats to the windward were occupied, so that, wanting a rest, I had to put up with one

of those directly facing the gale. I naturally expected to have it strong in my face; but, on the contrary, I found I had almost as perfect a shelter from the wind as if I had been on the other side.

C. M. INGLEBY

Malvern Wells, July 3

AFFINITIES OF THE SPONGES

MR. H. J. CARTER is devoting much attention at the present moment to the study of the Protozoa. In March last he published in the *Annals* and *Magazine* of *Natural History* the results of his investigations on Coccoliths and Coccospheres, stating his opinion that these minute bodies are of vegetable and not animal organisation, as hitherto supposed. Should his supposition prove correct, it will materially modify the theory of the mode of support of animal life at great depths, advocated by many recent deep-sea explorers. In the pages of the same journal for this month (July), Mr. Carter lays before us the results of his more recent researches into the ultimate structure of the marine calcareous sponges, and which entirely harmonise with those already arrived at by Prof. James Clark, of Boston, U.S. The sum total of these are that the Spongiadæ, as a group, are most closely allied to the Flagellate Infusioria; the animal portions of the genera *Leuconia*, *Grantia*, and *Clathrina* among the calcareous sponge-forms, and *Spongilla*, *Isodictya*, *Hymeniacidon*, and *Cliona* among the silicious representatives examined by Mr. Carter, being found by him to consist, for the most part, of aggregations of the same peculiar funnel-bearing ciliated cells characteristic of the new Flagellate Infusorial genera *Codosiga*, *Salpingœca*, *Bicosœca*, &c., introduced by Prof. Clark. The only point at issue between these two explorers in the same field is, whether each separate cell possesses a distinct mouth, or is capable of engulphing food, after the manner of an ordinary Rhizopod, through any portion of its body. Mr. Carter here adopts the latter view.

The most important result of Mr. Carter's investigations is, however, the additional evidence he brings forward in refutation of Ernst Haeckel's no longer tenable hypothesis, that the sponges are most closely allied to, and should even be collated in the same primary group as, the Cœlenterata. Prof. Haeckel's opinions have already been strongly opposed by myself (See *Ann.* and *Mag. Nat. Hist.* for March and September 1870); and Mr. Carter's recent investigations practically deprive Prof. Haeckel and those supporting his views of their last foot-hold. The Calcispongiæ is the group on which Ernst Haeckel and his collaborateur Mickluco-Maclay have more particularly concentrated their attention; it is the especial one, again, they have made choice of, as demonstrating in their opinion, more closely than any, the relationship they would seek to establish. Prof. Clark and Mr. Carter, however, prove beyond doubt their bond of union with the Flagellate Infusoria, the addition of a general investing sarcode layer and a spicular or horny supporting skeleton being, indeed, the only clearly defined characters that separates them from the group.

In seeking to establish other affinities, Mr. Carter is scarcely so happy. In his opinion, the Spongiadæ are more closely allied to the compound Tunicata than to the Cœlenterata, but he allows himself to be led further away here by analogous or general external resemblances than even Prof. Haeckel. To effect his purpose, he proposes that the branchial openings in the gelatinous mass of *Botryllus* "are analogous if not homologous" with the pores of the Spongiadæ, while the common cloacal cavity and fæcal orifice are respectively analogous to the excretory canal system and vent. Fascinating as these external resemblances may appear at first sight, we must penetrate a little beneath them, and before Mr. Carter can hope to substantiate the affinities he would establish, he must demonstrate to what extent the individual zooids of the Ascidian colony can be correlated with the single or aggregated ciliated cells of the sponges. In the former we have highly-organised animals, possessing a well-developed neural, hæmal, digestive, and respiratory system, while in the latter, simple uniciliated cells and undifferentiated sarcode are the only materials to be dealt with. Mr. Carter, again, would institute comparisons between the tough, gelatinous, or albuminous mass in which the Ascidian zooids are embedded, and that sarcode layer more or less generally diffused throughout all sponge structures; but in the first we have formed matter, like bone, horn, or shell, no longer possessing vital properties, while in the sarcode of the sponge we have living substance constantly altering its conditions of relationship, secreting the supporting skeleton, and contributing to the general welfare of the sponge community. Mr. Carter's inference in support of his proposition, drawn from the presence of calcareous bodies resembling spiculæ being met with in certain compound Ascidia, is but of little importance, considering that comparisons on the same grounds might be made between the sponges and the Nudibranchiate Mollusca; these latter likewise frequently secreting calcareous spiculæ in the substance of their integument.

The hiatus between the Spongiadæ and the Tunicata is far too wide to admit of such an institution of homological comparisons; the group of the Cœlenterata is evidently the nearest related to the former, but even here there are at present too many important links wanting to justify our uniting the two in one sub-kingdom, as proposed by Haeckel. *Inter se*, the sponges constitute a very natural division of the Protozoa, intimately related on the one hand through their special ciliated cells to the Flagellate Infusoria, and by the remaining sarcode layer, or skeletal secreting portion, to the simpler Rhizopoda.

In the paper here alluded to, Mr. Carter describes, under the name of *Trychogypsia*, a new calcareous sponge form differing from all others with which he is acquainted in possessing linear fusiform and no triradiate or quadriradiate spicules. The genus *Aphroceras*, described by Dr. Gray in 1858 (see Proc. Zoo. Soc., pp. 113, 114), is recognised by the same characters.

W. SAVILLE KENT

ON RECENT MOA REMAINS IN NEW ZEALAND

IN January 1864 a remarkably perfect specimen of *Dinornis robustus*, Owen, found on the Manuherekia Plains in the interior of the Province of Otago, was transmitted to the museum at York, and formed the subject of a memoir by Prof. Owen in the Transactions of the Zoological Society for 1869. These remains were considered unique on account of the well-preserved condition of some parts of the skeleton, portions of the ligaments, skin, and feathers being still attached to some of the bones, whereas Moa bones in the condition in which they are usually found are partially fossilised, or have at least undergone a sufficient change to deprive them not only of all ligamentous appendages, but to some extent of their proper proportion of organic matter. The discovery in the following year of the unique specimen (now in the museum) of a Moa's egg containing the bones of an embryo chick and attached membranes—within twenty miles of the same locality—was recorded by me in 1867 (Proc. Zool. Soc. p. 991.) I have now to announce the acquisition of another interesting specimen from the same district, being the cervical vertebræ of a Moa, apparently of the largest size, upon the posterior aspect of which the skin, partly covered with feathers, is still attached by the shrivelled muscles and ligaments.

I saw the specimen in question in the possession of Dr. Thomson, of Clyde, who obtained it from a gold miner. It was discovered in a cave formed by an over-

hanging mass of mica schist, but the particulars of the locality have not yet been accurately ascertained, or whether any other parts of the bird are still to be found. Dr. Thomson has kindly undertaken to prosecute a further search, and to forward the specimen already obtained to the museum for examination.

These interesting discoveries render it probable that the inland district of Otago, at a time when its grassy plains and rolling hills were covered with a dense scrubby vegetation or a light forest growth, was where the giant wingless birds of New Zealand lingered to latest times. It is impossible to convey an idea of the profusion of bones which, only a few years ago, were found in this district, scattered on the surface on the ground or buried in the alluvial soil in the neighbourhood of streams and rivers. At the present time this area of country is particularly arid as composed with the prevalent character of New Zealand. It is perfectly treeless; nothing but the smallest-sized shrubs being found within a distance of sixty or seventy miles. The surface features comprise round-backed ranges of hills of schistose rock with swamps on the top, deeply cut by ravines that open out on basin-shaped plains formed of alluvial deposits that have been everywhere moulded into beautifully regular terraces to an altitude of 1,700 feet above the sea level. That the mountain-slopes were at one time covered with forest, the stumps and prostrate trunks of large pine trees, and the mounds and pits on the surface of the ground which mark old forest land, abundantly testify, although it is probable that the intervening plains have never supported more than a dense thicket of shrubs or were partly occupied by swamps. The greatest number of moa bones were found where rivers debouch on the plains, and that at a comparatively late period these plains were the hunting grounds of the Aborigines can be proved most incontestably. Under some overhanging rocks in the neighbourhood of the Clutha river, at a place named by the first explorers Moa Flat, from the abundance of bones which lay strewn on the surface, rude stone flakes of a kind of stone not occurring in that district were found associated with heaps of Moa bones. Forty miles further in the interior, and at the same place where the Moa's neck was recently obtained, Captain Fraser discovered in 1864 what he described to me as a manufactory for such flakes and knives of chert as could be used as rough cutting instruments in a cave formed by overhanging rocks, sheltered only from S.W. storms, as if an accumulation by a storm-stayed party of natives. With these were also associated Moa bones and other remains. Again, on the top of the Carrick Mountains, which are in the same district, but at an altitude of 5,000 feet above the sea, the same gentleman discovered a gully, in which were enormous heaps of bones, and along with them native implements of stone, among which was a well-finished cleaver of blue slate, and also a coarsely-made horn-stone cleaver, the latter of a material that must have been brought from a very great distance.

Still clearer evidence that in very recent times the natives travelled through the interior, probably following the Moas as a means of subsistence, like natives in other countries where large game abounds, was obtained in 1865-6 by Messrs. J. and W. Murison. At the Maniototo Plains, bones of several species of Dinornis, Aptornis, Apteryx, large Rails, Stringops, and other birds, are exceedingly abundant in the alluvium of a particular stream, so much so that they are turned up by the plough with facility. Attention was arrested by the occurrence on the high-ground terrace which bounds the valley of this stream, of circular heaps composed of flakes and chips of chert, of a description that occurs only in large blocks along the base of the mountains at about a mile distant. This chert is a very peculiar rock, being a "cement" or "water quartz," or sand and gravel converted into a hard quartzite by infiltration of silicious matter. The resemblance of the flakes to those they had seen described as found in the ancient Kitchen-Middens, and a desire to account for the great profusion of Moa bones on a lower terrace-shelf nearer the margin of the stream, led the Messrs. Murison to explore the ground carefully, and by excavating in likely spots, they found a series of circular pits partly lined with stones, and containing, intermixed with charcoal, abundance of Moa bones and egg-shells, together with bones of the dog, the egg-shells being in such quantities that they consider that hundreds of eggs must have been cooked in each hole. Along with these were stone implements of various kinds, and of several other varieties of rock besides the chert which lies on the surface. The form and contents of these cooking-ovens correspond exactly with those described by Mantell in 1847 as occurring on the sea-coast, and among the stone implements which Mantell found in them, he remembers some to have been of the same chert, which occurs *in situ* at this locality fifty miles in the interior. The greater part of these chert specimens found on the coast are with the rest of the collection in the British Museum. There are other circumstances which incidentally support the view that while the Moas still existed in great numbers, the country was open and regularly traversed by the natives engaged in hunting. Near the old Maori ovens on the coast Mantell discovered a very curious dish made of steatite, a mineral occurring in New Zealand only on the west coast, rudely carved on the back in Maori fashion, measuring twelve by eight inches, and very shallow. The natives at the time recognised this dish by tradition, and said there should be two of them. It is very remarkable that since then the fellow dish has been discovered by some gold diggers in the Manuherikia Plain, and was in use on a hotel counter at the Dunstan township as a match-box, till lately, when it was sent to England, and, as I am informed, placed in a public museum in Liverpool.

The manner in which the Maoris use their cooking ovens suggests to me an explanation of the mode in which these flakes of chert came to be found in such profusion, while only a few of them show any signs of having been trimmed in order to fit them for implements. The native method of cooking is to heat the hardest stones they can find in the fire, and then placing the food to be cooked on top, to cover the whole with leaves and earth, and through an opening pour in water, which coming in contact with the hot stones, causes the formation of steam by which the food is cooked. If masses of the white chert be heated and quenched with water in the manner described, the result is the formation of flakes of every variety of shape with sharp cutting edges. It is natural to suppose that when one of these flakes was found of shape convenient for a particular purpose, such as a knife, cleaver, or spear-head, it was trimmed and dressed in the manner of a gun-flint, when the edge became defective, rather than thrown away, and favourite forms might be preserved and carried even as far as the coast. This suggested explanation of how a race advanced probably far beyond the period of such rude-looking implements might yet find it convenient to manufacture and use these, is supported by the circumstances that along with the trimmed chert flakes the Messrs. Murison found finished adzes of aphanite and even jade, which shows that the hunting natives had the same implements as those which are so common among the natives at the present day, though their use is now superseded by iron.

In the ovens on the coast, besides flakes and rough knives of chert and flint, are found flake-knives of obsidian, a rock which only occurs in the volcanic district of the North Island, and also adzes and stone axes of every degree of finish and variety of material. Although there is no positive evidence in the latter case that more highly finished implements were in use by a people contemporaneous with the Moa, whose remains, collected by

human agency, are so abundant in the same place, nevertheless the fact of a similar association occurring far in the interior affords strong presumptive evidence on this point, as the finely-finished implements must have been carried inland and to the same spots where the Moa remains occur, to be used at native feasts, of which these bones are the only other existing evidences.

So far I have been dealing with evidence gathered in the South Island of New Zealand of the recent co-existence of Man and the Moa, but in the North Island there is no lack of similar proofs. During the summer of 1866, H.E. Sir George Grey, K.C.B., made a fine collection at Waingongoro on the west coast of this island, being the same locality from which Mantell gathered the magnificent series of bones which he forwarded to Europe in 1847. At this place, along with the bones of the Moa and other extinct birds, were found those of dogs, seals, and many species of birds that are common at the present day, such as the albatross, penguin, nestor, and porphyris, and notably the notornis, a gigantic rail, which till a comparatively recent date, was supposed, like the Moa, to be extinct, and of which as yet only two living examples have been obtained. Associated with these remains Sir George Grey obtained artificially formed stone flakes of a very peculiar kind, being chips from rolled boulders of hard crystalline sandstone, produced by a single blow, probably when the stone was heated and quenched in water. The stones from which these chips were obtained had evidently been used, in the first instance, for cooking, as the ancient *Umus*, or cooking-ovens, are chiefly formed of them; and, indeed, in the sandy tracts on the west coast, where stones are rare, the identical stones that in former days were used for cooking Moas are still in use by the natives of the district for cooking pigs and shell-fish. Here again we find that the same necessity and circumstance which suggested the use of the chert flakes in the South, gave origin to a similar adaptation of the chips from the sandstone boulders. It is of some interest to find that native tradition points to the sandy flat at Waingongora, called Te Rangatapu, as the spot where the first Maori immigrants to the district originally settled; and there appears to be nothing in the abundant traces which they have left of these great feasts, which we must refer to that period, that would indicate any difference in their domestic habits from those of the Maoris now existing, and who, no doubt, are their direct descendants.

What has been advanced affords strong presumptive evidence that the Moas, although belonging probably to a race that was expiring from natural causes, was finally exterminated through human agency; and on this subject Mr. Murison has suggested how infallibly the wholesale consumption of the eggs, which were evidently highly prized as an article of food, must have led to their rapid extinction, without its being necessary that the birds themselves should have been actually destroyed. That wide-spreading fires contributed, in some instances, to the destruction of these wingless birds, is rendered probable from the occurrence of little heaps of bones, in spots where flocks of them would be overtaken when fleeing before the destroying element. At the south-west extremity of a triangular plain, by the side of the Wakatipu Lake, in 1862, I counted thirty-seven of such distinct skeleton-heaps, where the steep rocky slope of the mountain, covered with fallen blocks and tangled shrubs, meets the lake, and would, therefore, stop the progress of the fugitives in that direction. From what we know of habits of birds akin to the Moas, we may fairly infer that they did not frequent heavily-timbered country, but roamed over coppice-covered plains and mountain slopes. This view is supported by the comparative rarity of Moa remains in forests, the few exceptions being easily accounted for.

The whole of the eastern district of the South Island of New Zealand back to the Southern Alps was completely surveyed and mapped as early as 1862, and had been thoroughly explored at least ten years before that date, without any of these gigantic birds being met with; but there is a large area of rugged mountainous country, especially in the south-west district of Otago, which even to the present time is only imperfectly known. The mountain sides in this region are clothed with open forest, in which Kiwis, Kakapos, and other expiring forms of apterous birds are still to be found in comparative abundance, but where we could scarcely expect to meet with the larger species. Nevertheless, owing to the lofty tabular configuration of this district, the mountains afford very extensive areas above the forest limit—which are covered with Alpine shrubs and grasses—where it is not impossible that a remnant of this giant race may have remained to very recent times. The exploration, however, to which the country has been subjected during the last few years, by parties of diggers prospecting for gold, forbids any reasonable hope that any still exist. I may here mention that on one of the flat-topped mountains near Jackson's Bay, visited in January 1863, I observed, at an altitude of 4,000 feet, numerous well-beaten tracks about sixteen inches wide intersecting the dense scrub in all directions, and which, owing to the height of the scrub (two to four feet) could only been formed in the first instance by the frequent passage of a much larger bird than either the Kiwi or Kakapo, which, judging from the droppings, were the only birds that now resorted to them. On the sides of the tracks, especially near the upper confines of the forest, are shallow excavations, 2ft. to 3ft. in diameter, that have much the appearance of having been scraped for nests. No pigs or any other introduced animals having penetrated to this part of the country, it appears manifest that these were the tracks of some large indigenous animal, but from the nature of the vegetation it is probable that such tracks may have been for a very long period in disuse, except by the smaller ground birds, without becoming obliterated.

The above facts and arguments in support of the view that the Moa survived to very recent times, are similar to those advanced at an early period after the settlement of the colony, by Walter Mantell, who had the advantage of direct information on the subject from a generation of natives that has now passed away. As the first explorer of the artificial Moa beds, his opinion is entitled to great weight. Similar conclusions were also drawn by Butler, who is personally familiar with the facts derived from the North Islands, in an article which appeared in the *Zoologist* for 1864. The fresh discovery therefore of well-preserved remains of the Moa only tends to confirm and establish these views; and it would have been unnecessary to enlarge on the subject by the publication of the foregoing notes, which for the most part were written several years ago, but for the entirely opposite conclusions advanced by Dr. Haast in a recent address, which, from the large amount of interesting and novel matter it contains, will doubtless have a wide circulation. JAMES HECTOR

ON THE GASEOUS AND LIQUID STATES OF MATTER

A DISCOURSE was delivered on Friday evening, June 2, at the Royal Institution in Albemarle Street, by Dr. Andrews on the "Gaseous and Liquid States of Matter," from which we make the following extracts:—"The liquid state of matter forms a link between the solid and gaseous states. This link is, however, often suppressed, and the solid passes directly into the gaseous or vaporous form. In the intense cold of an arctic winter, hard ice will gradually change into transparent vapour without previously assuming the form of water. Carbonic acid snow passes rapidly into gas when exposed to the air, and can with difficulty be liquefied in open tubes. Its boiling point, as Faraday has

shown, presents the apparent anomaly of being lower in the thermometric scale than its melting point, a statement less paradoxical than it may at first appear, if we remember that water can exist as vapour at temperatures far lower than those at which it can exist as liquid. Whether the transition be directly from solid to gaseous, or from solid to liquid and from liquid to gaseous, a marked change of physical properties occurs at each step or break, and heat is absorbed, as was proved long ago by Black, without producing elevation of temperature. Many solids and liquids will for this reason maintain a low temperature, even when surrounded by a white hot atmosphere, and the remarkable experiment of solidifying water and even mercury on a red hot plate, finds thus an easy explanation. The term spheroidal state, when applied to water floating on a cushion of vapour over a red hot plate, is, however, apt to mislead. The water is not here in any peculiar state. It is simply water evaporating rapidly at a few degrees below its boiling point, and all its properties, even those of capillarity, are the properties of ordinary water at 95°·5C. The interesting phenomena exhibited under these conditions are due to other causes, and not to any new or peculiar state of the liquid itself. The fine researches of Dalton upon vapours, and the memorable discovery by Faraday of the liquefaction of gases by pressure alone, finished the work which Black had begun. Our knowledge of the conditions under which matter passes abruptly from the gaseous to the liquid and from the liquid to the solid state may now be regarded as almost complete.

"In 1822 Cagniard de la Tour made some remarkable experiments, which still bear his name, and which may be regarded as the starting point of the investigations which form the chief subject of this address. Cagniard de la Tour's first experiments were made in a small Papin's digester constructed from the thick end of a gun barrel, into which he introduced a little alcohol and also a small quartz ball, and firmly closed the whole. On heating the gun barrel with its contents over an open fire, and observing from time to time the sound produced by the ball when the apparatus was shaken, he inferred that after a certain temperature was attained the liquid had disappeared. He afterwards succeeded in repeating the experiment in glass tubes, and arrived at the following results. An hermetically sealed glass tube, containing sufficient alcohol to occupy two-fifths of its capacity, was gradually heated, when the liquid was seen to dilate, and its mobility at the same time to become gradually greater. After attaining to nearly twice its original volume, the liquid completely disappeared, and was converted into a vapour so transparent that the tube appeared to be quite empty. On allowing the tube to cool, a very thick cloud was formed, after which the liquid reappeared in its former state.

FIG. 1—Cloud below critical point

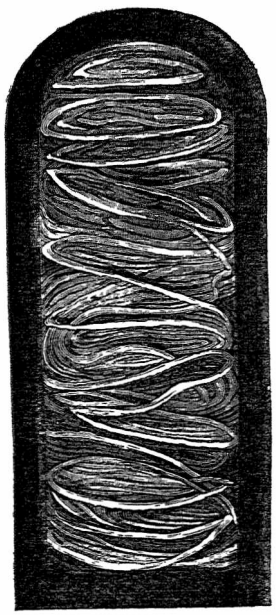

FIG. 2—Striæ above critical point

"It is singular that in this otherwise accurate description Cagniard de la Tour should have overlooked the most remarkable phenomenon of all—the moving or flickering striæ which fill the tube, when, after heating it above the *critical point*, the temperature is quickly lowered. This phenomenon was first observed by the lecturer in 1863, when experimenting with carbonic acid, and may be admirably seen by heating such liquids as ether or sulphurous acid in hermetically sealed tubes, of which when cold they occupy about one-third of the capacity. The appearances exhibited by the ascending and descending sheets of matter of unequal density are most remarkable, but it is difficult to give an adequate description of them in words or even to delineate them.

"These striæ arise from the great changes of density which slight variations of temperature or pressure produce when liquids are heated in a confined space above the critical point already referred to; but they are not formed if the temperature and pressure are kept steady. When seen they are always a proof that the matter in the tube is homogeneous, and that we have not liquid and gas in presence of one another. They are, in short, an extraordinary development of the movements observed in ordinary liquids and gases when heated from below. The fact that at a temperature 0°·2 above its critical point carbonic acid diminishes to one-half its volume from an increase of only $\frac{1}{37}$ of the entire pressure is sufficient to account for the marked characters they exhibit.

"If the temperature is allowed to fall a little below the critical point, the formation of cloud shows that we have now heterogeneous matter in the tube, minute drops of liquid in presence of a gas. From the midst of this cloud

(as shown in Fig. 1) a faint surface of demarcation appears, constituting the boundary between liquid and gas, but at first wholly devoid of curvature. We must, however, take care not to suppose that a cloud necessarily precedes the formation of true liquid. If the pressure be sufficiently great, no cloud of any kind will form."

After describing the results obtained by the lecturer with carbonic acid under varied conditions of temperature and pressure, of which a full account has already appeared in NATURE,* Dr. Andrews remarked that it would be erroneous to say that between liquid and gas there exists one intermediate state of matter, but that it is correct to say that between ordinary liquid and ordinary gas there is an infinite number of intermediate conditions of matter, establishing perfect continuity between the two states. Under great pressures the passage from the liquid to the gaseous state is effected on the application of heat without any break or breach of continuity. A solid model, constructed by Prof. J. Thomson, from the data furnished by the experiments of the lecturer, exhibited very clearly the different paths which connect the liquid and gaseous states, showing the ordinary passage by break from the liquid, as well as the continuous passages above the critical point.

After referring to the experiments of Frankland on the change produced by pressure in the spectrum of hydrogen, and to those of the same able chemist and Lockyer on the spectrum of the spark in compressed gases, Dr. Andrews described the remarkable change from a translucent to an opaque body, which occurs when bromine is heated above the critical point; and then drew attention to the general fact that when the critical point is reached, the density of the liquid and gas become identical.

In order to establish the continuity of the solid and liquid states, it would be necessary in like manner, by the combined action of heat and pressure, to obtain the solid and liquid of the same density and of like physical properties. To accomplish this result would probably require pressures far beyond any which can be reached in transparent tubes, but future experiment may show that the solid and liquid can be made to approach to the required conditions.

ON AN ADDITIONAL TRUE RIB IN THE HUMAN SUBJECT

THE almost absolute rule that there are seven true ribs in the human subject has, like every other rule, its exceptions. Occasionally instances are met with in which there are eight sternal ribs on one or both sides. But Nature does not effect her evolutions by *per saltum* transitions between extreme points, but steadily makes progress by degrees almost imperceptible to human intelligence. So in the matter of rib transition, there are various grades met with between the presence of a complete eighth sternal rib on the one hand, and its absence on the other. In the sternum of a female subject recently dissected at the Royal College of Surgeons, the right seventh and eighth rib cartilages blended together about a quarter of an inch distant from the mesosternum. On the left side the eighth rib cartilage was arrested about an inch and a half from the mesosternum. The latter was free at its sternal end. In another subject—a moderately muscular male—the eighth rib cartilage on the right side extended within an inch of the mesosternum, its extremity being free. On the left it was aborted at the distance of two and a half inches from the mesosternum. In the latter subject the sternum was exceedingly large; all the rib cartilages, especially the seventh on the left side, were well developed, and the xiphisternum was very much elongated, spatulate, and curved in an anterior direction. Occasionally specimens are met with in which the sixth rib cartilage is implanted upon the distal extremity of the mesosternum (rather than upon its distal lateral aspect), lying in front of the xiphisternum, and separated from its fellow of the opposite side by a small interval. In the receding angle formed by their divergence, the seventh sternal ribs are placed, lying directly upon the xiphisternum, and articulating with it, barely attaining an attachment to the mesosternum. This closely simulates the arrangement met with when the eighth sternal rib is present.

In another adult male skeleton, I found a complete specimen of an eighth sternal rib, but only on the right side. It articulated with the xiphisternum, and not with the mesosternum. On the left side the seventh sternal rib cartilage was larger than the corresponding one on the right side, and articulated with both the mesosternum and xiphisternum.*

On examining the skeletons (human) in the Hunterian Museum, I noticed another instance of an eighth sternal rib in an adult male African negro, occurring on the right side only. It was in every respect similar to the preceding. This is the only instance out of the fifteen skeletons (human) contained in the museum which deviated from the average standard number of seven true ribs. It is just possible that it may be more frequently present and remain undetected. In maceration the cartilages are very frequently removed, and articulators prepare artificial ones in their place corresponding to the average seven.

On examining the higher quadrumana, &c., I noticed that this additional true rib was present only in one young chimpanzee, but not in the gorillas and orangs. It was present in the gibbon and silvery gibbon, the pig-tailed monkey, *Macacus Rhesus*, Galeopithecus, and Indri. The aye-aye, the slender lemur, and the squirrel monkey, have each nine true ribs. The grand galago, the awantilo, the slender loris, the douroucouli, and the potto, have each ten true ribs. Prof. Flower very kindly called my attention to a paper on the axial skeleton of the Primates by Mr. St. George Mivart,† in which these rib variations are described as follows: — "In the highest forms of the Primates, the number of true ribs is seven, but in Hylobates there are sometimes eight pairs. In Semnopithecus and Colobus there are generally seven, but sometimes eight pairs of true ribs. In the Cynopithecinæ the normal number is eight. In the Cebidæ there are generally seven or eight pairs, but in Ateles sometimes nine. In Hapale there are sometimes as few as six, sometimes as many as eight; seven or eight in Galago, Lemur, and Indris; nine in Cheiromys. The highest number, as might be expected, is found in the Nycticebinæ, there being as many as ten pairs of true ribs in Perodicticus and Loris."

Professor Flower remarks ‡ that "in the higher Simiina the ribs do not differ very notably from those of man, except in number; but in the lower forms, and especially in the Lemurina, they more resemble those of the Carnivora."

In the Carnivora the number of nine sternal ribs is fairly constant. There are some exceptions, however, *e.g.* the Esquimaux dog—the Arctic wolf and Proteles have only eight true ribs. The common badger (*Meles taxus*) has ten true ribs—the tenth rib being implanted on the apex of the xiphisternum. The ninth rib in all these animals is more or less intimately associated with the xiphisternum, but rarely forming so decided an articulation with it as in the badger.

In a dog's sternum lately in my possession, the xiphisternum had the ninth rib articulated directly with it.

See NATURE, vol. ii. p. 278.

* This does not obviate the rule laid down by Prof. Flower in his recent admirable book on the Osteology of the Mammalia, that the xiphisternum never carries any true ribs. This is the average rule. But variations are frequent, although they cannot be considered in a text-book on average, and not irregular, Osteology.

† Proceedings of the Zoological Society of London June 27, 1865.

‡ Osteology of the Mammalia, p. 89.

The former (xiphisternum) was bifid through its whole length.

The scientific value of this additional sternal rib—in a Darwinian sense—is simply great. It evinces in a clear and forcible manner a latent disposition in the human subject, either to revert to an original and lower condition, or to retain traces of that previous condition. We have already seen that some of the lowest forms of Primates have ten true ribs, others have nine, some eight, and others again seven, as in the human subject. But it is interesting, indeed, to find that the conflict between the major number ten and the minor seven takes place in the lower Primates. As we pass up to the higher Primates, there seems to be a decided tendency towards fixity at the number of seven true ribs. But yet a few solitary examples—besides the human subject—illustrate the lower type, as in the chimpanzee already mentioned. The number of ribs in the lower forms of monkeys seems to be a repetition of that in the Carnivora, and subject to the same fluctuations between seven and ten true ribs. Although the few specimens which I have examined of the higher Primates show a decided tendency towards fixity at the number of seven, yet I believe that in a very large number of skeletons of each of the higher species, various transitional grades would be met with closely according with those in the human subject. It is somewhat remarkable that each of the variations of the eighth rib in the human subject which I have described should all be on the right side.

From the preceding facts it may be decidedly inferred that the tenth, ninth, and eighth true ribs are gradually lost in the transition from the lower to the higher Primates, except in a few isolated examples. The recurrence of the eighth true rib in the human subject cannot be looked upon as an accident, any more than the presence of a distinct peroneus quartus, and a moderately large extensor primi internodii hallucis coming from the tibialis anticus, exactly as in the chimpanzee, in the same individual whose sternum, with an almost complete eighth rib, has been described.

J. BESWICK-PERRIN

NOTES

THE men of the North do not seem disposed to let grass grow under their feet in respect to their proposed College of Physical Science, at Newcastle-upon-Tyne. Of the 35,000*l.* required, in addition to to the Durham University endowment, to carry out their plans, upwards of 23,600*l.* has been already subscribed. Three of the professorial chairs have now been filled, viz. :—Experimental Physics: A. S. Herschel, M.A. Chemistry: A. Freire-Marreco, M.A. Geology: David Page, LL.D., F.R.S.E. No decision has yet been made public in respect to the professorship of Mathematics. This appointment, together with the chair of Experimental Physics, is in the hands of the Dean and Chapter of Durham. These selections will give general satisfaction, and are sufficient assurance of the desire of the Committee to obtain the services of the men within reach, without reference to local influence or predilections. Indeed it seems to us just possible that the claims of one eminent local geologist may have suffered somewhat through the fear of a charge of partiality. Few family names stand higher in the scientific world than that of Herschel, and its present representative is well known as a teacher of experimental philosophy. M. Freire-Marreco has long served the University of Durham as its reader in chemistry and the Newcastle College of Medicine as its lecturer. Apart from his acquirements as a chemist and his ability as a teacher, there is perhaps no one who is so thoroughly versed in the chemical technology of the industries of the North of England. Dr. Page's elementary works on geology are widely appreciated, and if one may judge of his capacity as a lecturer by his power of interesting a general audience, he is eminently fitted to instruct the rising generation of mining engineers. We learn that the opening of the College is fixed for October 7, and shall watch with pleasure the progress of the undertaking, bidding it heartily "God speed."

AT a meeting of the Council of University College, London, held on Saturday last, a scheme for the establishment of a Sharpey Physiological Scholarship in the College was adopted. It is expected that the annual value of the Scholarship will be about 100*l.*

SIR DOMINIC CORRIGAN, Bart., M.D., M.P., has been appointed Vice-Chancellor of the Queen's University in Ireland, in the room of the late Sir Maziere Brady, Bart.

ONLY one gentleman has this year obtained the degree of D.Sc. of the University of London, Mr. W. A. Tilden, in Chemistry.

M. H. SAINTE-CLAIR-DEVILLE, one of the most learned and popular members of the Institute, was a candidate at the recent French election on the moderate Republican ticket. M. Broca, the celebrated anthropologist, who will soon be a member of the Institute, was also a candidate on the same ticket, as was also M. Wolowsky, a member of the Académie des Sciences Morales et Politiques. We learn that M. Wolowski has been returned at the head of the poll, and that MM. Scheurer-Restner and Laboulaye have also been elected for Paris. The Institute is fast becoming, not actually a political body, but a body more closely connected with politics than it was formerly. For some time past a *résumé* of the sittings of the Academy has been inserted regularly in the *Journal Officiel*, which is becoming every day more scientific in its character. The National Society of Men of Letters recently held its ordinary meeting, when it was proposed to erase from ts list of members MM. Victor Hugo, Pyat, and Rochefort, who are being prosecuted for their deeds during the Commune. But the meeting rejected the motion.

THE *Revue des Cours Scientifiques* commences with July 1 a new series, with the new title *La Revue Scientifique*, under the old editorship of MM. Yung and Alglave. The first number of the new series contains a sketch of the labours of the late M. Claparède, translations of Profs. Huxley and Tyndall's addresses at the Liverpool meeting of the British Association, and some fresh notes by Prof. Van Beneden on Commensalism in the Animal Kingdom.

THE weekly journal, *L'Institut*, has just entered on the fortieth year of its existence.

HERR RÜMKER has communicated to the *Astronomische Nachrichten* the following ephemeris of a new comet discovered by Temple on the 14th ult. :

0h BERLIN MEAN TIME.

	R. A. h m	N. Decl. ° ′
July 6	9 37·0	58 35
,, 8	33·0	41
,, 10	29·0	46
,, 12	25·0	52
,, 14	21·1	58 56
,, 16	17·2	59 1
,, 18	9 13·3	59 5

AT the Anniversary Meeting of the Meteorological Society, held June 21, C. W. Walker, Esq., F.R.S., F.R.A.S., the president, in the chair, the following officers were elected :—President: Dr. John W. Tripe. Vice-Presidents: N. Beardmore, C. O. F. Cator, G. J. Symons, C. V. Walker, F.R.S. Treasurer: H. Perigal. Trustees: Sir Antonio Brady, S. W. Silver. Secretaries: Chas. Brooke, F.R.S., Jas. Glaisher, F.R.S. Foreign Secretary: Lieut.-Col. Alexander Strange, F.R.S.

Council: Arthur Brewin, Geo. Dines, F. W. Doggett, H. S. Eaton, Fred. Gaster, Rev. C. H. Griffith, Dr. R. J. Mann, W. W. Saunders, F.R.S., R. H. Scott, F.R.S., Thos. Sopwith, F.R.S., S. C. Whitbread, F.R.S., E. O. W. Whitehouse.

THE annual distribution of prizes at Owens College, Manchester, was held on June 23, when the chairman, Mr. A. Neild, stated that the report of the Principal exhibits a very satisfactory amount of work done during the session, and a considerable increase in the number of students. The quality of the work has also not in any degree fallen off. The session was opened by a lecture from Dr. Balfour Stewart, on his appointment to the chair of Natural Philosophy; but his work was interrupted soon afterwards by a terrible accident which occurred to him at Harrow. He was glad, however, to be enabled to say that Prof. Stewart had so far recovered that he would be able to resume work at the commencement of the next session. A great deal had been done of late in the North of England in the way of increasing the teaching of Natural Science. He thought that so far as the means at their disposal enabled them, the managers of Owens College had made the institution a great school of Natural Science. At the same time, he hoped they should never fall into the opposite error of neglecting classical study and all that belonged to it. There is every reason to anticipate that Owens College will enter on its new premises in the course of session 1872-73. In addition to the prizes in the various classes, the following scholarships, &c., were then awarded:—Shuttleworth Scholarship (Political Economy), value 50*l.* per annum, tenable for two years: James Parkinson; Dalton Chemical Scholarship, value 50*l.* per annum, tenable for two years: William Robert Jekyll; Dalton Senior Mathematical Scholarship, value 25*l.* per annum, tenable for one year: John Henry Poynting; Dalton Junior Mathematical Scholarship, value 25*l.* per annum, tenable for one year: Arthur Walton Fuller; Ashbury Scholarship (Engineering), value 25*l.* per annum, tenable for two years: Edgar S. Cobbold; Dalton Natural History Prize, value 15*l.*: Charles Henry Wade; Engineering Essay Prize, Books of the value of 5*l.*: John Alfred Griffiths.

THE *Glasgow Star* says that the trustees of Anderson's University have been informed by their president—Mr. Young, of Kelly—that a gentleman had of his own accord made an offer of 2,000*l.* towards founding a chair of Applied Physics. Among other things, the trustees agreed to record their hearty approval of the scheme for establishing a College of Technology in Glasgow.

THE conditions necessary to the completion of the Brown Trust by the University of London have now been fulfilled. The University has been placed in possession of an excellent site, and abundant funds are forthcoming to carry out the objects of the Trust by founding an institution for the reception and treatment of sick and diseased domestic animals, which will afford invaluable opportunities for the advance of our knowledge of their diseases and their relation to those of man—a subject, says the *British Medical Journal*, of scientific and national importance.

DR T. BUCHANAN WHITE, President of the Perthshire Society of Natural Science, and editor of the *Scottish Naturalist*, publishes a first contribution towards a knowledge of the animals inhabiting Perthshire, in the form of a list of the Lepidoptera of the county.

THE last number of Petermann's "Mittheilungen" contains an admirable map of the Diamond Fields of Natal and the Orange River.

THE York School Natural History Society has issued its thirty-seventh Annual Report, from which we are glad to learn that the members show no lack of interest in the various branches of Natural Science. The collections exhibited at the close of last year were as follows: in Botany, three, varying from 257 to 96 species; of Lepidoptera, five, ranging from 105 to 72 species; of Coleoptera, six, containing from 212 to 64 species, and one illustrative of Insects generally. Three Natural History diaries were exhibited, and three recording astronomical observations, the latter especially being the result of much care and labour, and the observatory has been very diligently used. We trust that the society will long continue to exercise its useful influence, and that the members will profit in after life by the opportunities which have been afforded them.

THE Eastbourne Natural History Society, although only established in 1867, has already done a useful work in compiling for a new "Guide" to the neighbourhood a provisional list of the Fauna and Flora of the district. The space at their disposal being necessarily limited, it was impossible to give more than an enumeration of the animals and plants of the neighbourhood: but the attempt is worthy of note as a step in the right direction. The mammalia and reptilia are arranged according to Bell, the birds and fishes after Yarrell; for marine mollusca "Forbes' Handbook," and for land and freshwater species "Jeffreys' British Conchology," are followed; while the butterflies and moths follow respectively Morris and Newman. The flowering plants and ferns are arranged according to the "London Catalogue;" the mosses and algæ after Wilson and Gray; there is also a list of fungi. The secretary of the society, the Rev. A. K. Cherrill, will be glad to receive any additional information. A valuable museum, chiefly geological, has been bequeathed to the town, and is to be placed under the care of the society, so soon as a suitable building can be provided for its accommodation.

AT a meeting of the Royal Bavarian Academy of Sciences, on the 28th of March, Baron Liebig spoke thus of the future relations between Germany and France:—"The Academy seizes this moment to declare openly that there exists no national hatred between the German and Latin races. The peculiar character of the Germans, their knowledge of languages, their acquaintance with foreign people, the past and present state of their civilisation, all tend to make them just toward other peoples, even at the risk of often becoming unjust toward their own; and thus it is that we recognise how much we owe to the great philosophers, mathematicians, and naturalists of France, who have been in so many departments our masters and our models. I went forty-eight years ago to Paris to study chemistry; a fortuitous circumstance drew upon me the attention of Alexander Von Humboldt, and a single word of recommendation from him caused M. Gay-Lussac, one of the greatest chemists and physicists of his time, to make to me, a young man of twenty, the proposal to continue and finish with his co-operation an analysis which I had commenced; he introduced me as a pupil into his laboratory; my career was fixed after that. Never shall I forget the kindness with which Arago and Thenard received the German student; and how many compatriots, physicians and others, could I not name who, like myself, gratefully remember the efficacious assistance afforded to them by French men of science in finishing their studies. An ardent sympathy for all that is noble and grand, as well as a disinterested hospitality, form some of the most noble traits of the French character."

THE *British Medical Journal* states that a person named G. M. Raufer puffs and sells for three shillings, under the name of "lemonade for strengthening the memory," a fluid mixture of about 30 grammes, containing 15 parts of phosphoric acid, 15 of glycerine, and 70 of water. This is sold in Vienna.

IT is stated in the *British Medical Journal* that the Emperor of All the Russias has intimated to the University of Helsingfors, through the Senate of Finland, his willingness to permit women

to attend the medical lectures at that University, in furtherance of the expressed wishes of His Majesty's Finnish subjects.

AT the last Calcutta University Convocation the novelty was the presence of eight native Brahme ladies.

GOLD is reported in New Caledonia, near the Scot River.

SUCH is the ease with which scientific intelligence is now propagated that the experiments of Dr. Fayrer, in India, on snake-bites, have attracted attention in the *Panama Herald*. It is there stated that an efficacious native Indian remedy for snake-bites has long been employed in many parts of the interior, and more successfully than ammonia, codron, cuaco, and other substances. The composition referred to is made by adding to a bottle of alcohol, as strong as can be got, and of at least 35°, the contents of the gall-bladders of every poisonous snake that can be got at. The dose is a thimble-full internally and the like externally.

THE *Mechanics' Magazine* for June 9 and 16 contains a full and interesting report of the recent *conversazione* of the Institution of Civil Engineers.

FIRST REPORT OF THE SCHEME OF EDUCATION COMMITTEE OF THE LONDON SCHOOL BOARD

THE questions referred to us appear to fall under two chief divisions :—(1) The nature of the schools which it is desirable that the School Board should provide ; and (2) the methods of instruction which should be adopted in such schools ; and we shall therefore group our recommendations under these two heads.

Before proceeding to state these recommendations, it is important to observe that they need not be considered to apply, unreservedly, to those already existing schools which may now, or hereafter, be taken over by the Board.

The nature of the schools to be provided by the School Board will, as a general rule, be determined by the conditions under which grants of public money are made to schools by the Education Department.

Under the new code grants are made to public elementary schools of two kinds—those in which the instruction is given in the daytime, and those in which it is given in the evening. Under the regulations of the Science and Art Department, payments are made to teachers of science and art classes upon the results of examinations passed by the scholars. It will be desirable, in the first place, to deal with the two kinds of schools, viz., public elementary day schools, and public elementary evening schools, which it is the immediate duty of the Board to provide ; and, subsequently, to consider the classes of the Science and Art Department, in relation to these schools.

I. PUBLIC ELEMENTARY DAY SCHOOLS

Public elementary day schools are conveniently classified into infant schools, for children below seven years of age ; junior schools, for children seven and ten years of age ; and senior schools, for older children.

Some of the recommendations we have to make are general, or hold good for all three classes of schools, while others apply only to one or two of them.

General Recommendations

a. MIXED OR SEPARATE SCHOOLS.—By mixed schools, we understand schools in which male and female children are taught in the same classes ; by separate schools, those in which boys and girls are taught in separate rooms.

It is universally agreed that infant schools may be mixed, not only without detriment, but with positive advantage to the children.

We therefore recommend that infant schools be mixed.

With respect to junior schools, so much depends upon the previous training of the children, and upon local circumstances, that we do not think it advisable to lay down any general rule regarding them.

On the other hand, while evidence has been brought before us tending to show that, under certain conditions, senior schools may be mixed, we are decidedly of opinion, and we recommend, that the senior schools provided by the School Board of London should be separate.

b. LARGE OR SMALL SCHOOLS.—A Board school should contain, under one management, an infant school or schools, a junior school, a senior boys' school, and a senior girls' school.

Large junior and senior schools of 500 children and upwards, can be worked with much greater economy and efficiency than small schools ; and we have no hesitation in recommending that large schools be established wherever it is practicable to do so. But we are of opinion that the number of children in average attendance in any infant school, or infant department of a school, under one principal teacher, should not exceed 250 to 300.

c. THE PROPORTION OF TEACHERS TO SCHOLARS.—Efficient and economical teaching, other things being alike, depends upon two conditions : the first, the regularity of the attendance of the scholars ; the second, the due proportion of the teaching power to the number of the scholars.

We are of opinion that the minimum number of teachers for a junior or senior school of 500 children should be 16—namely, 1 principal teacher, 4 assistant certificated teachers, and 11 pupil teachers ; and that the teaching staff should be increased by 1 assistant certificated teacher and 3 pupil teachers for every additional 120 children.

d. THE EMPLOYMENT OF FEMALE TEACHERS.—In infant and girls' schools, as a general rule, we recommend the employment of female teachers only ; and we are of opinion that, in many cases, women may advantageously take charge of mixed junior schools. We do not think it advisable that female teachers should be employed in senior boys' schools.

e. HOURS OF INSTRUCTION.—We recommend that the period during which the children are under actual instruction in school should be five hours daily for five days in the week.

We recommend that arrangements should be made by which, during the time of religious teaching, any children withdrawn from such teaching shall receive separate instruction in secular subjects.

f. CORPORAL PUNISHMENT.—While we consider that the frequent use of corporal punishment is a mark of incompetency on the part of the teacher, we by no means deny the necessity of the occasional and exceptional employment of such punishment. But we recommend that every occurrence of corporal punishment be formally recorded in a book kept for the purpose ; that the pupil teachers be absolutely prohibited from inflicting such punishment ; and that the head teacher be held directly responsible for every punishment of the kind.

g. MUSIC AND DRILL.—On the 1st of February, 1871, the Board resolved—"That it is highly desirable that means should be provided for physical training, exercise, and drill, in public elementary schools established under the authority of this Board :" and on the 22nd of March the Board passed another resolution—"That the art and practice of singing be taught, as far as may be possible, in the Board schools, as a branch of elementary education."

The new code of the Education Department encourages drill, by providing that attendance at drill, under a competent instructor, "for not more than two hours a week and twenty weeks in the year," may be counted as school attendance ; and although it does not make the teaching of vocal music compulsory, it inflicts a fine at the rate of one shilling per scholar in average attendance upon all schools in which vocal music is not taught.

We recommend that music and drill be taught in every school during the period devoted to actual instruction.

h. MORAL AND RELIGIOUS INSTRUCTION.—On the 8th March, 1871, the Board resolved—That in the schools provided by the Board, the Bible shall be read, and there shall be given such explanations and such instruction therefrom in the principles of morality and religion, as are suited to the capacities of children ; provided always—

1. That in such explanations and instruction the provisions of the Act, in Sections VII. and XIV., be strictly observed, both in letter and spirit, and that no attempts be made in any such schools to attach children to any particular denomination.

2. That in regard of any particular school, the Board shall consider and determine upon any application by managers, parents, or ratepayers of the district, who may show special cause for exception of the school from the operation of this resolution, in whole or in part.

We recommend, therefore, that provision should be made for giving effect to this resolution.

2. *Particular Recommendations*

INFANT SCHOOLS.—We cannot too strongly insist upon the importance of schools for children under seven years of age. In a properly conducted infant school, children are not only with-

drawn from evil and corrupting influences, and disciplined in habits of order, attention and cleanliness, but they receive such an amount of positive instruction as greatly facilitates their progress in the more advanced schools. There appears to be no doubt that by regular attendance in an infant school, provided with efficient teachers, a large proportion of ordinary children of six or seven years of age may be enabled to pass in the first standard of the new code.

The inducements which lead parents to keep older children from school are almost wholly absent in the cases of those under seven years of age, who are able to earn little or nothing, and are of no use in the house. And the fact that the younger children are taken care of in an infant school will often remove one of the chief difficulties in the way of securing the regular attendance of the elder girls of a family at the junior and senior schools.

The subjects in which we recommend that instruction should be given in infant schools are :—

a. Morality and religion.

b Reading, writing, and arithmetic.

c. Object lessons of a simple character, with some such exercise of the hands and eyes as is given in the "Kinder-Garten" system.

In addition, the general recommendations respecting music and drill apply to infant schools, in which singing and physical exercises, adapted to the tender years of the children, are of paramount importance.

JUNIOR AND SENIOR SCHOOLS.—We recommend that certain kinds of instruction shall form an essential part of the teaching of every elementary school; while others may or may not be added to them, at the discretion of the managers of individual schools, or by the special direction of the Board.

A. ESSENTIAL SUBJECTS.

a. Morality and religion.

b. Reading, writing, and arithmetic: English grammar in senior schools; with mensuration in senior boys' schools.

c. Systematised object lessons, embracing in the six school years a course of elementary instruction in physical science, and serving as an introduction to the science examinations which are conducted by the Science and Art Department.

d. The History of Britain.

e. Elementary geography.

f. Elementary social economy.

g. Elementary drawing, leading up to the examinations in mechanical drawing, and to the art teaching of the Science and Art Department.

h. In girls' schools, plain needlework and cutting out.

B. DISCRETIONARY SUBJECTS, which may be taught to advanced scholars.

a. Algebra and geometry.

b. Latin or a modern language.

II.—PUBLIC ELEMENTARY EVENING SCHOOLS

Evening Schools are of great importance, partly as a means of providing elementary education for those who, for various reasons, fail to obtain sufficient instruction in elementary day schools; and, partly, because it is easy to connect with such schools special classes in which a higher kind of instruction than that contemplated by the Sixth Standard can be given to the more intelligent and older scholars. In this manner the advantages of further instruction may be secured by those scholars who are unable or unwilling to go into secondary schools, but who are both able and willing to pay for instruction of a more advanced kind than that given in primary schools.

We recommend that the course of instruction in these evening schools shall be of the same general character as that already recommended for the junior and senior elementary day schools. Elementary evening schools should, in all cases, be *separate*, and the General Recommendation (*n*) respecting moral and religious instruction applies to them. In all other respects we recommend that the managers should be left free to adapt the instruction given in the schools to local requirements.

According to the New Code, the scholars in evening schools must be not under 12, nor above 18, years of age, and no attendance is reckoned unless the scholar has been under instruction in secular subjects for one hour and a half.

III.—SCIENCE AND ART CLASSES

Numerous classes for instruction in Science and Art are already in existence; their current expenses, and the remuneration of teachers, being defrayed, in part, by the grants paid upon the result of the annual examinations, and, in part, by pupils' fees.

These classes are usually held in the evening, and are frequently connected with evening schools.

The Science and Art Department comes into relation with these classes, and with the examination of the scholars taught in them, through the agency of Committees who voluntarily charge themselves with the responsibility of seeing that the regulations of the Department are carried out. The establishment of Science and Art Classes in connection with Public Elementary Evening Schools, therefore, would not involve the Board either in trouble or expense.

We recommend that the formation of such classes be encouraged and facilitated.

The Elementary Education Act does not confer upon a School Board the power of providing secondary schools, and it is silent as to the mode by which a connection may be established between the elementary and the secondary schools of the country. But it is of such importance to the efficiency of popular education that means should be provided by which scholars of more than average merit shall be enabled to pass from elementary into secondary schools that we feel it our duty to offer some suggestions upon the subject

The practical difficulty in the way of the passage of boys and girls from an elementary into a secondary school, is the cost of their maintenance; and the best way of meeting that difficulty appears to be to establish exhibitions equivalent to the earnings of boys and girls of from 13 to 16 years of age, tenable for the period during which they remain under instruction in the secondary schools. The funds out of which such exhibitions may be created already exist, and the machinery for distributing them has been provided by the Legislature in the Endowed Schools Act.

The Endowed School's Commissioners have fully recognised the claims of scholars in public elementary schools to share the advantages of the endowed schools. We recommend, therefore, that the Board enter into official communication with the Endowed Schools Commissioners, and agree with them upon some scheme by which the children in public elementary schools shall be enabled to obtain their rightful share of the benefits of those endowments with which the Commissioners are empowered to deal.

T. H. HUXLEY (*Chairman*).
JOSEPH ANGUS
ALFRED BARRY
EDM. HAY CURRIE
EMILY DAVIES
LAWRENCE
BENJN. LUCRAFT
J. MACGREGOR
CHARLES REED
JAMES H. RIGG
WILLIAM ROGERS
EDW. J. TABRUM

JOHN G. CROMWELL—

Except that, looking to the three concluding clauses of the Report and to the sixth recommendation founded thereon, I feel unable to join in recommending that "Latin or a modern language may be taught to advanced scholars" in schools provided by the Board.

J. ALLANSON PICTON—

Except the application of General Recommendation (*h*) to public elementary evening schools.

SANDON—

Except that I object to the teaching of Latin or a modern language in primary public elementary schools; and that I also object to pronouncing any opinion in this Report upon the appropriation of existing endowments to the public elementary schools of London, as I do not consider that it is competent to a committee appointed by the School Board "to consider and report upon the scheme of education to be adopted in the public elementary schools" to consider, or make recommendations upon, this important subject.

MR. BENTHAM'S ANNIVERSARY ADDRESS TO THE LINNEAN SOCIETY

(*Concluded from page* 172)

FRANCE, without any special endemic character, unites within her limits portions of several biological regions, thus requiring from her naturalists the study of all the European Floras and

Faunas in order rightly to understand her own. The greater part of her surface constitutes the western extremity of that great Russo-European tract I have above commented upon, its flora, and probably also its fauna, here blending with the West European type, which spreads more or less over it from the Iberian peninsula. To the south-east she has an end of the Swiss Alps, connected to a certain degree with the Pyrenees to the south-west by the chain of the Cevennes, but at an elevation too low, and which has probably always been too low, for the interchange of the truly alpine forms of those two lofty ranges. South of the Cevennes she includes a portion of the great Mediterranean region; and the marine productions of her coasts are those of three different aquatic regions—the North Sea, the Atlantic, and the Mediterranean. The few endemic or local races she may possess appear to be on those southern declivities which bound the Mediterranean region; and if the volcanic elevations of Central France have a special interest, it is more from the absence of many species common at similar altitudes in the mountains to the east or to the south-west, than from the presence of peculiar races not of the lowest grades, with the exception, perhaps, of a very few species now rare, and which may prove to be the lingering remains of expiring races.

With so many natural advantages, French science, represented during the last two centuries by as great, if not a greater, number of eminent men than any other country, has long felt the necessity of a thorough investigation of the biological productions of her territory. The French Floras, both general and local, are now numerous, and some of them excellent. The geographical distribution of plants in France has also been the subject of various essays as well as separate works. It is only to be regretted that in the Floras themselves the instructive practice of indicating under each species its extra-Gallican distribution has not yet been adopted. In Zoology no general fauna has been attempted, since De Blainville's, which was never completed, and none is believed to be even in contemplation; but I have a long list of partial Faunas and Memoirs on the animals of various classes of several French departments; and Rey and Mulsant are publishing, in the Transactions of two Lyons Societies, detailed monographs of all French Coleoptera.

The progress of French naturalists in Biology in general up to 1867 has been fully detailed as to Zoology by Milne-Edwards, in his "Rapport sur les Progrès de la Zoologie en France;" and as to Systematic Botany by Ad. Brongniart in his "Rapport sur les Progrès de la Botanique Phytographique." The recent progress as to both branches, as well as in regard to other natural sciences, has also been reviewed by M. Emile Blanchard in his annual addresses to the meetings of the delegates of French scientific societies, held every April at the Sorbonne from 1865 to 1870. The Société Botanique de France had also up to that time been active, and the publication of its proceedings brought down nearly to the latest meetings. I am compelled, however, for want of time, to defer some details I had contemplated relating to the recent labours of French biologists; but I cannot refrain from inserting the following note on a work mentioned only, but not analysed, in the last volume of the "Zoological Record," obligingly communicated to me with other memoranda by Prof. Deshayes, whilst slowly recovering from a severe illness contracted during the German siege:—"In Mollusca we have also to regret that we have no complete work embracing the whole of this important branch of the animal kingdom. It is true that we make use of numerous works published in England, amongst which several are excellent, such as those of Forbes and Hanley, Gwyn Jeffreys, &c. Nevertheless I have to point out to you an excellent work published in 1869 by M. Petit de la Saussaye. The author, a very able and scientific conchologist, is unfortunately just dead. He has had the advantage of preparing a general catalogue of Testaceous Mollusca of the European Seas, possessing in his own collection nearly the whole of the species inserted, and of having received direct from the authors named specimens of the species foreign to the French coasts. This work is divided into two parts. The first is devoted to the methodical and synonymical catalogue of the species amounting to 1,150. In the second part, these species are distributed geographically into seven zones, starting from the most northern and ending with the hot regions of the Mediterranean. These zones are thus distinguished:—1, the Polar zone; 2, the Boreal zone; 3, the British zone; 4, the Celtic zone; 5, the Lusitanian zone; 6, the Mediterranean zone; and 7, the Algerian zone. Some years since it would have been impossible for M. Petit to have established the fifth zone, for that nothing, literally nothing, was known of the malacological fauna of Spain. Its seas were until 1867 less known than those of New Holland or California. It was only in that year that Hidalgo published a well drawn up synonymic catalogue in Crosse and Fischer's "Journal de Conchyliologie."

The British Isles have less even than France of an endemic character in respect of biology. They form, as it were, an outlying portion of regions already mentioned, the greater part, as in the case of France, belonging to the extreme end of the great Russo-European tract. Like France, also, they partake, although in a reduced degree, of that Western type which extends upwards from the Iberian Peninsula. They are, however, completely severed from the Mediterranean as from the Alpine regions; their mountain vegetation, and, as far as I can learn, their mountain zoology, is Scandinavian; and if it shows any connection with southern ranges, it is rather with the Pyrenees than with the Alps. The chief distinctive character of Britain is derived from her insular position, which acts as a check upon the passive immigration of races, and is one cause of the comparative poverty of her Fauna and Flora; the isolation, on the other hand, may not be ancient enough or complete enough for the production and preservation of endemic forms. As far as we know, there is not in phænogamic botany, nor in any of the orders of animals in which the question has been sufficiently considered, a single endemic British race of a grade high enough to be qualified as a species in the Linnæan sense. How far that may be the case with the lower cryptogams cannot at present be determined; there is still much difficulty in establishing species upon natural affinities, and in some Lichens and Fungi, for instance, much confusion between phases of individual life and real genera and species remains to be cleared up. The study of our neighbours' Faunas and Floras is therefore necessary to make us fully acquainted with the animals and plants we have, and useful in showing us what we have not, but should have had, were it not for causes which require investigation; such, for instance, as plants like *Salvia pratensis*, a common European species to be met with in abundance the moment we cross the Channel, but either absent from or confined to single localities in England.

There is no country, however, in which the native Flora and Fauna has been so long and so steadily the subject of close investigation as our own, nor where it continues to be worked out in detail by so numerous a staff of observers. To the Floras we possess, a valuable addition has been made within the last twelvemonth in J. D Hooker's "Student's Flora of the British Isles;" the best we have for the purposes of the teacher, and in which the careful notation of the general distribution of each species is a great improvement on our older standard class-books. H. C. Watson's recently completed "Compendium of the Cybele Britannica" treats of the geographical relations of our plants with that accuracy of detail which characterises all his works. In Zoology, although we may not have compact synoptical Faunas corresponding with our Floras in all branches of the animal kingdom, the series of works on British Vertebrata published by Van Voorst are a better and more complete account of our indigenous races than any Continental State can boast of; and I observe with much pleasure that in the new edition announced of the "British Birds," Mr. Newton proposes specially to follow out the determination of their geographical range, upon which Mr. Yarrell had bestowed so much pains. With regard to our Mollusca, we have been very fortunate. Forbes and Hanley's costly work, published by the Ray Society, has been followed by Gwyn Jeffreys's "British Conchology," the great merits of which as a Malacological Fauna of Britain have been fully acknowledged abroad as well as at home. The present geographical as well as the fossil range of the species is specially attended to, and the only thing missed is perhaps a general synoptical view of the characters of the classes, families, and genera into which the species are distributed. The Ray Society series comprises also several most valuable works on the lower orders of British animals; but the entomological fauna of our country, especially in relation to the insects of the adjoining Continent, notwithstanding the numerous able naturalists who devote themselves to its study, appears to be somewhat in arrear. In answer to my query as to works where our Insects are compared with those of other countries, I received from our Secretary, Mr. Stainton, the following reply:—"The questions you have put to me with reference to our entomological literature are very important; they, however, painfully call my attention to the necessarily unsatisfactory nature of my replies. Wollaston's 'Coleoptera Hesperidum'* is the only separate

* Referred to in my Address of 1869.

work to which I can direct your attention as giving the fauna of a particular district, with the geographical range of such of the species as are likewise found elsewhere. R. M'Lachlan, who in 1865 had published (Trans. Ent. Soc. ser. 3, v.) a Monograph of the British Caddis-flies, gave in 1868 (Trans. Ent. Soc. for 1868) a Monograph of the British Neuroptera Planipenna, but little is there said of the European range of our species. In 1867 (Entom. Monthly Mag. iii.) Mr. M'Lachlan, who is one of our most philosophical writers, gave a Monograph of the British Psocidæ, and he there says with reference even to their distribution in our own country, 'As a rule, I have not mentioned special localities; these insects have been so little collected that an enumeration here of known or recorded localities would probably appear ridiculous in a few years.' The Rev. T. A. Marshall has given (Entom. Monthly Mag. i. to iii.) an essay towards a knowledge of the British Homoptera, in which occasionally allusion is made to the European distribution of our British species.

"The position of the Insect-fauna of Britain may be thus stated: the late J. F. Stephens commenced in 1827 a systematic descriptive work of all the orders of British Insects as 'Illustrations of British Entomology;' it ceased to appear after 1835, until a supplementary volume came out in 1846. The Lepidoptera, Coleoptera, Orthoptera, Neuroptera were wholly, the Hymenoptera partly, done, the Hemiptera and Diptera altogether left out. In 1839 Mr. Stephens published, in a more compendious form, a 'Manual of British Beetles.' In 1849 an attempt was made to supply the gaps in the British Entomology left by Stephens, and a scheme of a series of volumes called 'Insecta Britannica' was elaborated, in which Mr. F. Walker was to undertake the Diptera, Mr. W. S. Dallas the Hemiptera, and great progress having been made in our knowledge of the smaller moths since 1835, I undertook to write a volume on the Tineina. This scheme was so far carried out, that three volumes on the British Diptera by Mr. F. Walker (assisted by the late A. H. Haliday) appeared in 1851, 1852, and 1856, and my volume on the British Tineina in 1854. In 1859 another great group of the smaller moths was described by S. J. Wilkinson in a volume entitled 'The British Tortrices.' The British Hemiptera, not having been done by Mr. Dallas, were undertaken by Messrs. Douglas and Scott for the Ray Society; and in 1865 a 4to volume was issued, containing the Hemiptera, Heteroptera, leaving the Homoptera for a second volume, still in progress. Even in this elaborate work little or nothing is said of the geographical distribution out of Britain of our British species. The same will apply to the late J. F. Dawson's 'Geodephaga Britannica," published in 1854; to Westwood's "Butterflies of Great Britain,' published in 1855; and to E. Newman's 'Illustrated Natural History of British Moths,' published in 1869.

"I believe I do not at all exaggerate if I say that for many years Entomology was pursued in this country with an insularity and a narrow-mindedness of which a botanist can scarcely form a conception. The system of only collecting British Insects was pursued to such an extent, that it was almost a crime to have a non-British insect in one's possession; if accidentally placed in one's cabinet it might depreciate the value of the entire collection, for Mr. Samuel Stevens can assure you that the value of the specimens depends very much upon their being indubitably and unmistakeably British. A specimen caught in Kent which would fetch 2*l.* would not be worth 2*s.* if caught in Normandy. I satirised this practice several years since in the 'Entomologists' Weekly Intelligence' (vol. v. and 1858, articles 'Jeddo' and 'Insularity'), but it is yet far from extinct"

Perfectly concurring in Mr. Stainton's observations in the last paragraph, I would however add that there are purposes for which a local or geological collection distinct from the general one may be of great use, and such a collection would be much impaired by the introduction of stray foreign specimens. In a local museum, a separate room devoted exclusively to the productions of the locality is very instructive with reference to the history of that locality, and I have seen several such spoiled by the admission of exotic specimens, giving the visitor false impressions, which it takes time to remove. But it is never from such an exclusive collection that the fauna or flora of the district can be satisfactorily worked out, or that any branch of Zoology or Botany can be successfully taught.

Mr. Stainton adds, "It has been suggested to me that those who have critically studied the distinctions between closely allied species have rarely the time to work out in addition their geographical range, and that those who might work up the latter subject might fail in their good intentions for want of a proper knowledge of species." Upon this I would observe that, in the due appreciation of a species of its limits and connections, its geographical range and the various forms it assumes in different parts of its area are an essential element; and it appears to me that the neglect of this and other general characters is one reason why many able naturalists, who have devoted their lives to the critical distinction of races of the lowest grades unduly raised to the rank of species, have really contributed so little to any science but that of sorting and naming collections. On the other hand, the study of geographical range without a proper knowledge of species is little more than pure speculation. Division of labour carried too far tends to narrow the mind, and rather to delay than advance the healthy progress of science.

Mr. Stainton informs me that "there has just appeared a monograph of the Ephemeridæ, by the Rev. A. E Eaton (Trans. Entom. Soc. 1871), treating of those insects throughout the globe; and when any species are noticed which occur in this country, their entire geographical range is noticed. It is altogether a valuable paper, on account of the thoroughness with which it seems to be done."

Since I last noticed our biological publications two valuable and beautifully illustrated but costly Ornithological works, Sclater and Salvin's "Exotic Ornithology," and Sharpe's "Monograph of the Alcedinidæ." have been completed, and various Memoirs by Flower, Mivart, Parker, and others, have considerably advanced our knowledge of the comparative anatomy of various groups of Mammalia. In our own country also, as well as on the Continent, the biology of various distant lands has continued to be worked out in Memoirs or independent publications, which I had contemplated noticing in succession; but time obliges me now to stop, and defer to a future occasion the compilation of the notes I had collected on North American, Australian, and other Monographs, Faunas, and Floras.

SCIENTIFIC SERIALS

THE *Geological Magazine* for June (No. 84) commences with some notes on Crinoids by Mr. John Rofe, relating rather to the zoological than to the geological aspects of that class of animals. Mr. Rofe describes some experiments made on recent Crinoids by treating them with solution of potash or muriatic acid, from which he arrives at the conclusion that their hard parts are invested by a membrane giving them a certain degree of flexibility, a general position which few naturalists will be inclined to dispute. But the details of structure described by Mr. Rofe will be found of much interest. In his concluding remarks he endeavours to show an approximation between the Crinoids and the Tunicata, which, to say the least of it, is very doubtful.—Mr. S. Allport publishes a note on the microscopic structure and composition of a rock from the "Wolf Rock" off the Land's End, which he identifies with phonolite, and justly protests against the system which gives different names to rocks identical in mineral composition because they happen to be of different geological ages.—Mr. D. Mackintosh describes the drifts of the west and south borders of the Lake district, with especial reference to their great granitic dispersions which he believes have taken place; and Messrs. C. and A. Bell discuss the divisions of the English Crags as indicated by their invertebrate fauna. They propose as the result of their investigations, to divide the Crag into Upper, Middle, and Lower; the Upper including the Norwich, and the upper part of the so-called Red Crag; the Middle, the remainder of the Red Crag; and the Lower, the Coralline Crag. The last paper consists of a comparison of the metamorphic rocks of Scotland and Galway, by Mr. G. H. Kinahan. The first and last of these papers are illustrated with plates.

The second part of Tome xliii. of the *Bulletin de la Société Impériales des Naturalistes de Moscou*, completing the first half volume for 1870, is the last portion of this publication that has yet reached this country. It contains the continuation of M. Ferd. von Herder's notice of the monopetalous plants collected by G. Radde and others (*Plantæ Raddeanæ Monopetalæ*) in Eastern Siberia, the Amurland, Kamtschatka, and Russian America, and includes references to numerous species of Compositæ.—M. N. Erschoff communicates a note upon the Lepidoptera of Western Siberia, containing a list of species from the town of Omsk.—A Russian paper on the Oligochætal Annelid,

Pilorytes inquilina, by M. H. Zingera, will probably attract few English readers.—M. E. Regel publishes a portion of a second supplement to the enumeration of the plants collected by Sewerzow in 1857 in Central Asia. It includes the Ranunculaceæ, Berberideæ, Nymphæaceæ, Papaveraceæ, Fumariaceæ, and Cruciferæ. Several new species are described.—Another botanical paper is an abridged French translation of part of the Introduction to a Flora of Moscow, by M. N. Kauffmann, the translation being made by Mr. G. O. Clerc. The Flora, which is a Catalogue of the vascular plants of the Government of Moscow, will appear in future numbers.—We find in this number two entomological papers, both on Coleoptera, and one of them of great importance, namely, a Monograph of the Graphipteridæ by the Baron Chaudoir. The other paper is a continuation, by M. Victor Motschoulsky, of his apparently interminable enumeration of the new species of Coleoptera collected by him in his journeys. It includes descriptions of species of Melasomata, and is illustrated with two plates.—M. G. Schweizer describes an easy method of approximately finding the meridian line; and M. A. Trautschold gives a short notice of some cretaceous fossils from Ssaratof and Ssimbirsk.

Palæontographica.—Beiträge zur Naturgeschichte der Vorwelt. Herausgegeben von Dr. W. Dunker und Dr. K. A. Zittel. Band xx. Lief 1., 1871. In this part of the well-known and most valuable "Palæontographica," Prof. Geinitz commences a monograph of the fossils of the Lower Quader and Lower Pläner beds in the Saxon Elbe valley, which he regards as forming the lowest part of a great Quader-formation, including the Senonian, Turonian, and Cenomanian stages of the French geologists. His Lower Quader is equivalent to the Upper Greensand of English geologists. It is well known that sponges are among the most abundant and striking fossils of our Upper Greensand, and the corresponding beds in the valley of the Elbe seem to be equally rich in remains of this lowest class of animals. With the exception of a summary of the geology of the district, the whole of the present part of Prof. Geinitz's work is occupied by descriptions of sponges, the species of which are beautifully figured in the accompanying plates. Laying the reproaches of Oscar Schmidt to heart, Prof. Geinitz endeavours to arrange his fossil forms in accordance with the system of that author, although, as he justly remarks, it is impossible in the study of fossil sponges to have recourse to those minute characters derived from the spiculæ, which form the basis of recent attempts to classify the recent forms. He notices in all twenty-eight species, of which six appear to be new.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, June 15, "On a Law in Chemical Dynamics." By John Hall Gladstone, F.R.S., and Alfred Tribe.

It is well known that one metal has the power of decomposing the salts of certain other metals, and that the chemical change will proceed until the more powerful metal has entirely taken the place of the other. The authors have investigated what takes place during the process.

The experiments were generally performed as follows:—72 cubic centimetres of an aqueous solution of the salt of known strength, and at 12° Centigrade, were placed in a tall glass; a perfectly clean plate of metal of 3,230 square millimetres was weighed and placed vertically in this solution without reaching either to the top or bottom; the action was allowed to proceed quietly for ten minutes, when the plate was removed, and the deposited metal was washed off. The loss of weight gave the amount of metal dissolved, and represented the chemical action.

The most complete series of results was with copper and nitrate of silver.

In the earlier terms of this series, *twice the percentage of silver-salt gives three times the chemical action*. The close agreement of the observed numbers with those calculated on this supposition continues as far as the 9th term. The law then breaks down, and after about 7 per cent. the increased action is almost in direct ratio with the increased strength.

The position of the plate in the solution was found to make no difference to this 2–3 law.

Similar series of experiments were made with zinc and chloride of copper, zinc and sulphate of copper, zinc and nitrate of lead, iron and sulphate of copper, and other combinations; and in every instance where the solution was weak and the action simple, the law of three times the chemical change for twice the strength was found to hold good.

It was proved that the breaking down of the law at about 3·5 per cent. of salt in solution was irrespective of the quantity of the liquid, or of the time for which the plate was exposed. With 72 cub. centims. of a 1·41 per cent. solution of nitrate of silver, the rate of action remained sensibly the same for as long as twenty-five minutes, notwithstanding the constant deposition of silver. This apparently paradoxical result is due to fresh relays of the original solution being brought up to the plate by the currents produced, and that period of time elapsing before any of the products of decomposition are brought back again in their circuit.

When it was perceived that within easily ascertainable limits the chemical action is the same for similar consecutive periods of time, experiments were made in far weaker solutions. It was only necessary to lengthen the time of exposure. It was thus found that the law of three times the chemical action for twice the strength of solution holds good through at least eleven terms of the powers of 2; in fact, from a solution that could dissolve one gramme of copper during the hour, to a solution that dissolved only 0·000001 gramme, a million times less.

The manner in which the silver is deposited on a copper plate was examined, and the currents produced were studied. At first a light blue current is perceived flowing upwards from the surface of the plate, presently a deep blue current pours downwards, and these two currents in opposite directions continue to form simultaneously. A similar phenomenon was observed in every case where a metallic salt attacked a plate of another metal. The downward current was found to be a solution of almost pure nitrate of copper, containing about three times as much NO_3 as the original silver solution, while the upward current was a diluted solution of the mixed nitrates. Moreover, the heavy current took its rise in the entangled mass of crystals right against the plate, while the light current flowed from the tops of the crystalline branches. It was evident that when the fresh silver was deposited on these branches, and the fresh copper taken up from the plate, there was not merely a transference of the nitric element from one combination to another, but an actual molecular movement of it towards the copper plate, producing an accumulation of nitrate of copper there, and a corresponding loss of salt in the liquid that is drawn within the influence of the branching crystals. Hence the opposite currents.

The amount of action in a circuit of two metals and a saline solution must have as one of its regulating conditions the conducting-power of that solution. It appeared by experiment that a strong solution of nitrate of silver offers less resistance than a weak one; and it was also found, on adding nitrate of potassium to the nitrate of silver, that its power of attacking the copper plate was increased; that the augmentation of the foreign salt increased the action still further; and that the 2-3 law holds good between two solutions in which both the silver and potassium salt are doubled, though it does not hold good if the quantity of foreign salt be kept constant. Similar results were obtained with mixed nitrates of silver and copper.

While these later experiments offer an explanation of the fact that a solution of double the strength produces more than double the chemical action, they do not explain why it should produce exactly three times the effect, or why the ratio should be the same in all substitutions of this nature hitherto applied. The simplicity and wide range of the 2-3 law seems to indicate that it is a very primary one in chemical dynamics.

"On Cyclides and Sphero-Quartics." By John Casey, LL.D.

Royal Institution of Great Britain, July 3.—Sir Henry Holland, Bart., M.D., F.R.S., president, in the chair. William Amhurst Tyssen Amhurst and Lawrence Trent Cave were elected members.

Royal Geographical Society, June 26.—Major-General Sir Henry C. Rawlinson, K.C.B., president, in the chair. The following new fellows were elected: Thomas Brassey, M.P.; T. B. Baker, C.B.; D. Chinery (Consul-General for Liberia); Commander C. D. Inglis, R.N.; William Charles Jackson; G. W. Kennion; Alfred Morrison, William G. Margetts, Colonel R. Maclagen, R.E.; Captain G. S. Nares, R.N.; and James Rickards. A letter was read from Sir Roderick Murchison, giving Dr. Kirk's views of Dr. Livingstone's position, as communicated in a recent letter from Zanzibar, dated the 30th April last. It appeared that

no one at Zanzibar had been to Manime, the place where Livingstone was last heard of; but Dr. Kirk had ascertained that it was about a month's journey (200 or 300 miles) west of Lake Tanganyika, and was a thriving ivory-mart. Dr. Kirk expressed his hopes that, if Livingstone should have settled the problem of the outflow of Tanganyika, he would be satisfied, and leave all the rest of the work to future travellers, seeing that he has been out upwards of five years, and must sorely want rest. Abundant supplies were awaiting the great traveller's orders at Ujiji, on the shores of the lake.—Letters were read from Dr. J. D. Hooker to Sir Roderick Murchison, giving a description of his recent ascent of the Atlas Mountains, at two points south-west of the city of Marocco. On the first attempt, Dr. Hooker's party ascended to 12,000 feet; and on the second to the summit of a peak, further westward, 11,500 feet high. Storms of snow and hail were encountered near the crests; but the snow seemed to lie more compactly, and to a lower level (7,000 feet) further east. Constant humid and cold winds from the north are the cause of the low temperature, in consequence of which northern species of plants are found on the Atlas, to the exclusion of southern types.—A paper was read by Captain A. F. P. Harcourt on the districts of Kooloo, Lahoul, and Spiti, in Northern India; and a second one, by Major Sladen, on an exploration between the Irrawady and south-western China. Sir Donald MacLeod (late governor of the Punjaub), Sir Arthur Phayre, General Fytche (Commissioner of British Burmah), Colonel H. Yule, Mr. T. T. Cooper, Sir John Bowring, and others took part in the discussion, which followed the reading of the two papers.—The President announced that the Council had renewed, for the year 1872, the offer of geological prize medals to the chief public schools; and that the special subject for the year, both in the physical and the political divisions, would be South America. A proposition from the president for a vote of thanks to the Chancellor and Senate of the London University, for the use of their great hall, met with unanimous approval. The president stated that, although the ordinary meetings of the session had terminated, it was likely that a special sitting would be held to receive the Emperor of Brazil, an honorary member of the Society, should his Majesty accept, on his arrival, the invitation the Council had forwarded.

Anthropological Institute, June 19.—Sir John Lubbock, Bart., president, in the chair. Mr. G. Latimer was elected a local secretary for Puerto Rico and Logan; Dr. D. H. Russell was elected a local secretary for Bonny, west coast of Africa.—Prof. Busk exhibited two human jaws of remarkable thickness found in the superficial deposit of a cave near Sarawak, Borneo.—Mr. Josiah Harris exhibited from Macabi Island, off the coast of Peru, wood carvings, pottery, and cotton rags. The rags extended many hundred yards at an average thickness of five feet, and below a deposit of several feet of guano. The wood and pottery were discovered at a depth in the guano of from fifteen to forty-five feet.—Mr. G. M. Atkinson communicated some interesting facts connected with the discovery of a kitchen-midden in Cork harbour.—Mr. H. W. Flower exhibited a large jade implement from New Zealand.—A paper by Mr. A McDonald was then read, "On the Mode of Preserving the Dead among the Natives of Queensland."—Dr. Sinclair Holden contributed a paper "On Forms of Ancient Interments in Antrim;" and Mr. Hodden M. Westropp read a paper "On Analogies and Coincidences among Unconnected Nations."

DUBLIN

Royal Irish Academy, April 24.—The Rev. J. H. Jellett, president, in the chair. Mr. R. C. Tichbourne read a report on the molecular dissociation by heat of compounds in solution. The Rev. Dr. W. Reeves read a paper on the Irish tract by Onegus the Culdee, on the mothers of the saints of Ireland.

PARIS

Académie Française.—This is the most ancient of the French Academies, its special object being the publication of a Dictionary of the French language, which is thus officially protected against innovations. No word is considered classical without being duly registered in the Dictionary of the French Academy. Several editions have appeared successively, each of them containing many alterations. The next edition will soon be published, and is just now in active preparation. On June 29 the French Academy elected its Perpetual Secretary. All the votes were taken by M. Patin, a member of the Institute for the last twenty-eight years, and Professor of Greek Literature at the Sorbonne. The principal work of M. Patin is a study of the Greek tragedians, which is highly esteemed in France and abroad. The late Perpetual Secretary was the celebrated M. Villemain, a great friend of M. Guizot, and a former Minister of State in Louis Philippe's time. The election of M. Patin, although undisputed, was an event in the academical world, and many members left their residences, and even foreign lands, to vote for him. Amongst these learned travellers we must notice Father Gratry, of London, and the Marquis de Noailles, French Ambassador in London. MM. Guizot, Octave Feuillet, Nisard, &c., were present.

Académie des Inscriptions et Belles Lettres.—This Academy has also been engaged in filling the vacancies death had created in its ranks. M. Villemain was an ordinary member of this Academy. A scrutiny took place on the 30th ult., for the election of his successor. M. Charles Thurot was nominated by twenty-three votes against very few given to four other candidates. The Academy had also to vote for a successor to M. Alexandre, an inspector of the Academy, who was known merely by the publication of a Greek dictionary, which is the most useful in grammar schools. The succession to this office was more vigorously contested. M. de Rozière was elected only after a scrutiny, since a candidate must receive the actual majority of votes. A correspondent was also appointed. The successful candidate was M. Amari, an Italian learned antiquary of universal celebrity. All these nominations will be submitted to M. Thiers for approval, but it is a mere formality, and the assent of the Executive has never been refused for more than thirty years. M. Thiers himself is a member of the Institute, belonging to the Académie Française.

Academie des Sciences Morales.—The last sitting was occupied by a discussion raised by M. Egger on the degree of perception and intelligence in children. The question is to ascertain if infants are inferior or superior to ordinary animals in their mental condition. The reasoning of the learned member was grounded more on theoretical grounds than on actual observation of facts. None of the arguments offered were supposed to be conclusive, and the problem is left open for future investigations.

BOOKS RECEIVED

ENGLISH.—Travels in Central America: Mrs. M. F. Squier (Trübner and Co.).—A Practical Treatise on the Manufacture of Soap: Dr. C. Morfit (Trübner and Co.).—Overland through Asia: T. W. Knox (Trübner and Co.).—Notes on the Food of Plants: C. C. Grundy (Simpkin and Marshall).—Transactions of the Woolhope Naturalists' Field Club for 1870.

FOREIGN.—(Through Williams and Norgate)—Bericht über die wissenschaftliche Leistungen im Gebiete der Entomologie während der Jahre 1867-68: Brauer u. Gerstaecker.—Lehrbuch der allgemeinen Zoologie: G. Jaeger.—Die Molecular-gesetze dergestellt: Dr. C. Wittwer.

CONTENTS

PAGE

SENSATION AND SCIENCE 177
BASTIAN ON THE ORIGIN OF LIFE. By A. R. WALLACE, F.Z.S. . . 178
THE WORKSHOP. By W. MATTIEU WILLIAMS, F.C.S. 179
LETTERS TO THE EDITOR:—
A New View of Darwinism.—CHARLES DARWIN, F.R.S.; ALFRED R. WALLACE, F.Z.S. 180
Our Natural History Museum 181
Steam Lifeboats.—Lieut. JOHN FELLOWES, R.N. 181
The Internal Structure of the Earth.—H. HENNESSY, F.R.S. . . 182
Oceanic Circulation.—W. B. CARPENTER, F.R.S.; RICHARD A. PROCTOR, F.R.A.S. 183
Day Auroas.—JOHN LUCAS. 183
The Solar Parallax.—RICHARD A. PROCTOR, F.R.A.S. 183
Lee Shelter.—Dr. C. M. INGLEBY 183
AFFINITIES OF THE SPONGES. By W. SAVILLE KENT, F.Z.S. . . . 184
ON RECENT MOA REMAINS IN NEW ZEALAND. By Dr. J. HECTOR, F.R.S. 184
ON THE GASEOUS AND LIQUID STATES OF MATTER. (*With Illustrations.*) 186
ON AN ADDITIONAL TRUE RIB IN THE HUMAN SUBJECT. By J. BESWICK-PERRIN 188
NOTES 189
FIRST REPORT OF THE SCHEME OF EDUCATION COMMITTEE OF THE LONDON SCHOOL BOARD 191
MR. BENTHAM'S ANNIVERSARY ADDRESS TO THE LINNEAN SOCIETY (*Concluded*) 192
SCIENTIFIC SERIALS 194
SOCIETIES AND ACADEMIES 195
BOOKS RECEIVED 196

ERRATA.—Vol. IV., p. 168, 2nd column, line 28 from bottom, for "the Rev. T. C. Maggs" read "Mr. T. C. Maggs"; p. 174, 2nd column, line 31 from bottom, for "Nicturation" read "Micturition."