THURSDAY, DECEMBER 6, 1877

TECHNICAL EDUCATION

PROF. HUXLEY has seized the occasion afforded him by his promise to aid the Working Man's Club and Institute Union by contributing to their present series of fortnightly lectures, to state his opinion on a question which, as we have already informed our readers, has lately been exercising the minds of some of the most influential members of various city companies.

For some time past a joint committee, representing the most important among these bodies, has been endeavouring to obtain information as to the best means of applying certain of their surplus funds to the assistance of what is called technical education, and there is little doubt that a proposal for a huge technical university, made some time ago, and the discussion which took place in connection with that proposal, has had somewhat to do in leading to the present condition of affairs.

Prof. Huxley and some four or five other gentlemen have been appealed to by this joint committee to send in reports on what they consider the best way to set about the work, and it is from this point of view that Prof. Huxley's lecture is so important. It was not merely fresh and brilliant and full of good things, as all his lectures are, but is doubtless an embodiment of his report to the joint committee.

We are rejoiced, therefore, to see that Prof. Huxley is at one with the views which we have all along expressed in NATURE, namely, that, after all, the mind is the most important instrument which the handicraftsman, whether he be a tinker or a physicist, will ever be called upon to use, and that therefore a technical education which teaches him to use a lathe, or a tool, or a loom, before he has learned how to use his mind, is no education at all.

Prof. Huxley not only defined technical education as the best training to qualify the pupil for learning technicalities for himself, but he stated what he considered such an education might be, and how the city funds can be best spent in helping it on.

Besides being able to read, write, and cipher, the student should have had such training as should have awakened his understanding and given him a real interest in his pursuit. The next requirement referred to was some acquaintance with the elements of physical science—a knowledge rudimentary, it might be, but good and sound, so far as it went, of the properties and character of natural objects. The professor is also of opinion that it is eminently desirable that he should be able, more or less, to draw. The faculty of drawing, in the highest artistic sense, was, it was conceded, like the gift of poetry, inborn and not acquired; but as everybody almost could write in some fashion or other, so, for the present purpose, as writing was but a kind of drawing, everybody could more or less be supposed to draw. A further *desideratum* was some ability to read one or two languages besides the student's own, that he might know what neighbouring nations, and those with which we were most mixed up, were doing, and have access to valuable sources of information which would otherwise be sealed to him. But above all—and this the speaker thought was the most essential condition—the pupil should have kept in all its bloom the freshness and youthfulness of his mind, all the vigour and elasticity proper to that age. Prof. Huxley then went on to explain that this freshness and vigour should not have been washed out of the student by the incessant labour and intellectual debauchery often involved in grinding for examinations.

We gather from this part of the address—we shall refer to the others by and by—that so far as Prof. Huxley's advice goes we are not likely to see any great expenditure of the money of the ancient city corporations either in the erection of a huge "practical" university or in the creation of still another "Examining Board." How then does he propose to spend it?

Here we come to a substantial proposal, which Prof. Huxley may consider to be the most important part of his address. What is wanted, he considers, is some machinery for utilising in the public interest special talent and genius brought to light in our schools. "If any Government could find a Watt, a Davy, or a Faraday in the market, the bargain would be dirt cheap at 100,000*l.*" Referring to his saying when he was a member of the London School Board that he should like to see a ladder by which a child could climb from the gutter to the highest position in the State, he dwelt upon the importance of some system by which any boy of special aptitude should be encouraged to prolong his studies, to join art and science classes, and be apprenticed, with a premium if necessary. In the case of those who showed great fitness for intellectual pursuits they might be trained as pupil-teachers, brought to London, and placed in some collegiate institution or training school. In this way the money of the guilds would be spent in aiding existing teaching systems, in which, on the whole, an enormous progress was acknowledged.

It is true the architects of London would not have the opportunity of immortalising themselves by erecting an imposing edifice, but, on the other hand, the influence of the Guilds might be felt whenever there was a handicraft to foster, or a potential Watt to be sought out.

We do not imagine that it is Prof. Huxley's idea that there shall be no local representation of the city's new activity and influence; the reference to the training of teachers, we fancy, and other remarks here and there, seem to point to some such institution as the École Normale of Paris, where the best and most practica scientific teaching could be carried on. Every one knows how much room there is for such an institution as this, but on this little money need be spent, so far as bricks and mortar are concerned, as little money is needed to equip such laboratories as are really meant for work.

There is an advantage in such lectures as these by no means limited to the expression of opinion on the part of the speaker. The slow and sure way in which science is taking a hold upon our national progress is well evidenced by the fact that the daily press can now no longer ignore such outcomes as these, and hence it is that they do good beyond the mere boundary of the question under discussion. They show the importance of, and foster interest in, the general question of intellectual and scientific progress.

The *Times* agrees in the main with the kind of education to be given, and holds that "What is needed is to give a man the intelligence, the knowledge of general principles, combined with the habits of correct observation and quick perception, which will enable him afterwards to master the technicalities of his art, instead of becoming a slave to them. No objection can be taken to the advice that, for this purpose, a lad, after learning to read, write, and cipher, should acquire some facility in drawing, and should be familiarised with the elements of physical science. The importance of the latter study for this particular purpose is, indeed, unquestionable, and even paramount, for a handicraftsman is dealing exclusively with physical objects in his work, and his skill in applying the processes of his craft will vary in great measure with his knowledge of the scientific principles on which they depend."

But we fancy that the *Times* writer does not look upon this scientific part of education quite as the lecturer does, for he proceeds to add: "There can be little doubt, for instance, that many of the perils of mining might be averted if the miners were alive to the scientific reasons of the precautions they are urged to adopt. Many an improvement, probably, which now escapes the eye of a man who adheres slavishly to the rules of his craft would occur to him if he were applying them with conscious intelligence."

The *Times*, however, considers that the school-time is too short for the languages, and curiously enough drives its point home by saying a harder thing about the Greek and Latin of our public schools than Prof. Huxley has ever done; while, on the other hand, the *Daily News* points out that Prof. Huxley this time may have raised a hornet's nest about his ears by the unduly reasonable tone of his demands.

The *Daily News* then adds:—"A man of science who does not demand that from the earliest age an hour a day shall be devoted to each of the ologies may be regarded as a traitor to his cause." For our part we know of no man of science who has ever made such a demand; and a careful examination of what men of science have said on this point for the last ten years will show that these extreme views to which reference is here made are not those of men of science at all.

It will be well also if the strong language used in connection with the multiple examinations of the present day brings that question well before the bar of public opinion. The *Times* is "sorry to see another flout thus inflicted, in passing, on that system of examinations which, like most good institutions, may do harm to the few, but is indispensable as a motive for work to the great majority." Prof. Huxley has expressed the views of most of the leading teachers in this country with regard to the effect of these examinations upon the students, and he might have referred to their reflex action on the examiner. Go into a company of scientific men, and observe the most dogmatic, the most unfruitful, and the least modest among them, you will find that this man is, as we may say, an examiner by profession. Speak to him of research or other kindred topics, he will smile at you—his time is far too precious to be wasted in discussing such trivialities; like his examinees, he finds they do not pay. The example set by Germany in this respect, both as regards students and professors, cannot be too often referred to, and there is little doubt that the love of science for its own sake which has made Germany what she now is intellectually, has sprung to a large extent from the fact that each young student sees those around him spurred from within and not from without. *Noblesse oblige.*

In point of fact so far as our future scientific progress is concerned the examination question is as important as that connected with the kind of education to be subsidised by the city guilds, and it is important, seeing that our legislators will, in the coming time, have to give their opinion on these subjects as well as on beer, vivisection, and contagious diseases, that in Prof. Huxley's language "by the process called *distillatio per ascensum*—distillation upwards—there should in time be no member of Parliament who does not know as much of science as a scholar in one of our elementary schools."

NORTH AMERICAN STARFISHES

Memoirs of the Museum of Comparative Zoology at Harvard College. Vol. v. No. 1. North American Starfishes. By Alexander Agassiz. With Twenty Plates. (Cambridge, U.S., 1877.)

THIS memoir consists of two parts. The first contains a history of the Embryology of the Starfish, which is substantially the same as that published in 1864 as Part I., Vol. v., of Prof. Agassiz's "Natural History of the United States." The author has, however, added notes on the points where additions have been made by subsequent investigations. The second part treats of the solid parts of some North American starfishes.

The plates accompanying the second part were intended to form part of one of Prof. L. Agassiz's volumes of "Contributions to the Natural History of the United States," and have been drawn for more than twelve years. The late Prof. Agassiz intended to add them as illustrating the anatomy of several of the more common American species.

Under these circumstances the memoir is wanting in the completeness that distinguishes some of the other Memoirs of this series, such as that "On the Ophiuridæ," by Lyman, and that "On the Echini," by Alexander Agassiz; but though the subject of the Starfishes as thus presented is incomplete, it is beyond a doubt that we have here a work of great value that will serve not only as illustrating a number of American species, and showing the systematic value of characters often almost completely overlooked, but as determining the homology of several genera not previously figured, and of which the details of the solid parts are fully given.

The arrangement of the star-fishes into families adopted does not materially differ from that given by Perrier in his revision of the group. No general list, much less a synonymic catalogue, as in the case of Echini, is given; and this because the number of species in the hands of Prof. Perrier, from the *Florida* dredgings, as well as those found by the *Challenger* expedition, have added a number of remarkable forms not yet wholly determined to the American starfish fauna.

The author reminds us that the transformations peculiar to the Echinoderms constitute neither a metamorphosis nor a case of alternate generation. The egg becomes the embryo larva. Nothing essential is lost during the process. No intermediate form comes into the cycle; the yolk becomes the larva, and this latter becomes the young Echinoderm; and this larva is, according to A. Agassiz, an Acalephian larva, reminding one somewhat of the twin individuals of free Hydroids as Diphyes, though adapted to the mode of development of the Echinoderms. The Echinoderm plutean form, with its mouth-stomach intestine, and with its water system originally forming a part of the digestive cavity, bearing as it would seem, about the same relation to the Ctenophoræ, which the Hydroid Polyps hold to the true Polyps. Therefore Agassiz cannot admit that the views so frequently urged and so generally admitted as to the separation of the Acalephs and Polyps as a distinct type (Cœlenterata) from the Echinoderms have any foundation in nature. He would therefore still retain the Radiate sub-kingdom with its three equivalent classes—Echinoderms, Acalephs, and Polyps.

Agassiz thinks G. O. Sars' idea that Brisinga is the living representative of the palæozoic starfishes rather too far-fetched, and he sees no very radical difference between Brisinga and such ordinary starfishes as Solaster and Crossaster, and he considers that if there has been a single ancestral Echinoderm, his primordial descendants early assumed different lines of development diverging to a great degree, and retaining their characteristics from the earliest-known geological period. E. P. W.

VOGEL'S "SPECTRUM ANALYSIS"

Practische Spectralanalyse irdischer Stoffe. Von Dr. Hermann W. Vogel (Nördlingen: C. H. Beck.)

THE aim of the author in writing this book may best be described in his own words. He says in the introduction:—

"The many excellent popular books on spectrum analysis confine themselves chiefly to descriptions of the great discoveries made by means of it; the chemical books only give short descriptions of flame reactions of alkalies and alkaline earths; they contain seldom a detailed account of the methods of observation, and still less a description of absorption spectra. The present work is intended to fill up this want, and to be a text-book to the student, and a reference book to the initiated."

Prof. Vogel is an authority on the absorption spectra of liquids and solids. Nearly half the book is given up to them; and we must add the better half. Here we find for the first time a connected account of all that has been done on the subject. Such an account is exceedingly valuable, and it brings prominently forward the gaps which have yet to be filled up. Prof. Vogel treats the subject chiefly from the chemical point of view, but those who take greater interest in the theoretical part will also find excellent information. So, for instance, the effect of the solvent on the absorption spectra of solutions is discussed. The spectra of colouring matters are given in detail, and the account of the effect of chemical reagents on them will be found exceedingly interesting. There is no doubt that this part of the book will be of great use to every worker on the subject.

We wish we could say as much of the chapter on emission spectra. As long as the author treats of the spectra of alkalies and alkaline earths, he is on safe ground, but when he comes to discuss the question of double spectra and the spectra of gases, he is confused and unintelligible. Led away apparently by a desire to do justice to every writer, he quotes approvingly the most divergent opinions, as if they could be consistently held at the same time. He is very fond of saying that a body has been proved to have two spectra but that one of them belongs to the oxide or to an impurity, which is the same as saying that he possesses two watches but that one of them belongs to his brother.

The author is throughout the book careless in his expressions, and this comes prominently forward in this chapter. What, for instance, can the student make of the following paragraph (p. 170)?—

"*A strong electric spark passing through air gives the spectrum of oxygen together with that of nitrogen.* Both together form the so-called spectrum of air. Only one spectrum of oxygen is known. *In dry pure air the spark only generates the spectrum of nitrogen.*"

The two statements in italics contradict each other as they stand. One of them is true for higher pressures, the other for lower pressures, but this the author has forgotten to add.

It must be said that the subject is a complicated one, and even those who are practically acquainted with all the experimental details would find it difficult to give a connected and clear account of it.

The first part of the book which treats of the optical principles involved in the spectroscope is apparently well written, and the student will find in it elementary proofs of some important theorems.[1] ARTHUR SCHUSTER

OUR BOOK SHELF

Nyassa; a Journal of Adventures whilst Exploring Lake Nyassa, Central Africa, and Establishing the Settlement of "Livingstonia." By E. D. Young, R.N. Revised by Rev. Horace Waller. With Maps. (London: John Murray, 1877.)

THIS is a thoroughly interesting narrative, brisk, fresh, and instructive. Mr. Young tells the story of the planting of a missionary station under the united auspices of the Presbyterian churches of Scotland, at Cape Maclear, on the south-west corner of Lake Nyassa. Mr. Young for the most part takes us over classic ground, by the Zambesi and Shiré, over ground familiar to readers of Livingstone's earlier and his latest travels. Mr. Young in his hardy little steamer the *Ilala*, surveyed the north end of Lake Nyassa for the first time, discovering on its north-east shore a magnificent range of mountains, rising to from 8,000 to 12,000 feet above the level of the lake, and which he named after his old friend Livingstone. On the opposite shore is a range of less elevation. The lake is marshy at the north end, subject to quite oceanic storms, its shores being marked by varied and most attractive scenery. The steamer caused tremendous consternation among the slave-trading Arabs, who seemed to feel that with the advent of a British steamer on the lake their occupation was gone. The settlement was successfully planted and is likely to be of service both as a centre of civilisation and of more minute exploration.

Britannia: A Collection of the Principal Passages in Latin Authors that Refer to this Island. With Vocabulary and Notes. By Thos. S. Cayzer, Head-Master of Queen Elizabeth's Hospital, Bristol. Illustrated with a Map and twenty-nine Woodcuts. (London: Griffith and Farran, 1878.)

THE title-page sufficiently describes the contents of this

[1] As a personal question I may add that the remark attributed to me on page 198 was made by Mr. Stoney and only quoted by me.—A. S.

little volume. We think the idea of making such a collection a happy one, not only for scholastic purposes, but also for the use of those who wish to be able at any time easily to refer to any of the passages in Latin authors in which our island is referred to. Mr. Cayzer gives also translations of some of the chief references in Greek writers. We should think, if teachers and examiners could be persuaded to break through custom, the introduction of such a book into schools would add interest to the reading of Latin, and furnish, besides, the little fellows with a stock of valuable information. Most of the cuts are appropriate, several being old friends.

LETTERS TO THE EDITOR

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

The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

The Colour-Sense of the Greeks

MR. GLADSTONE has shown that the language of Homer is an inadequate vehicle for conveying precise and nicely distinguished ideas of colour. Whether the nation that was content to describe colours so imperfectly was also incapable of subtle perception of tones of colour is clearly another question. Language does not keep pace with perception unless a practical or æsthetic necessity arises for expressing what is perceived in words to other people.

Practical necessity gives names to pigments and bright objects, such as flowers and precious stones, rather than to tones of colour; the æsthetic necessity that lies upon the artist to utter what he has felt will naturally lead to imitative expression sooner than to an expression that is merely symbolical. In other words an early race will learn to use colour with nicety for decorative and pictorial purposes before it develops the distinctions of language requisite for accurate word-painting.

That this was actually the case among the Greeks appears, I think, very clearly in a passage of Ion which is preserved to us in Athenæus Deipnos., Lib. xiii. cap. 81 (p. 603 *seq.*). Ion, who was a contemporary of Sophocles, describes an evening which he spent with the great tragedian in Chios. Sophocles, admiring the blushing face of a little boy who served the wine, quoted, with high approval, a line of Phrynicus:—

"The light of love gleams on the purple cheek."

On this a certain pedantic grammarian breaks in—"In sooth, Sophocles, thou art skilled in poetry; but yet Phrynicus spoke not well when he called the cheeks of a beautiful person purple. For if a portrait-painter were to colour the cheeks of this boy with purple pigment he would no longer appear beautiful. It is not fitting to compare what is beautiful with what is not so." Sophocles laughs at the objection, and replies—"Neither, then, my friend, wilt thou be pleased with that line of Simonides which, to the Greeks, has appeared very well said:—

'The maiden sending forth her voice from her purple mouth;'

nor with the poet, when he says, 'golden-haired Apollo;' for if the painter made the hair of the god golden and not black, his picture would be less excellent. Nor wilt thou be pleased with him [Homer] who said 'rosy-fingered,' for if one were to dip the fingers in rose-colour, one would produce the hands, not of a fair woman, but of a dyer of purple." This retort produced a general laugh, and confounded the pedant not a little.

The Greeks, then, were perfectly aware of the insufficiency of the poetic vocabulary of colour; and accordingly they did not expect descriptive rendering of colour from the poet. This, it is plain, is a circumstance that must constantly be kept in view in any attempt to find in the poetry of the Greeks a measure of the development of their colour-sense.

Aberdeen, December 3 W. ROBERTSON SMITH

The Comparative Richness of Faunas and Floras Tested Numerically

IN his letter in NATURE, vol. xvii. p. 9, Prof. Newton has strongly brought out the absurdity of comparing districts of *very different areas* by the proportionate number of species to area in each. On this principle he shows that to be equally rich with the small island of Rodriguez, Madagascar ought to possess four times as many species of birds as exist throughout the whole world! It does not, however, by any means follow that the method thus exposed may not be of value in comparing regions of approximately equal area, as is the case with several of the primary regions, to determine the comparative richness of which Mr. Sclater first applied it. I have not Mr. Sclater's paper at hand, but it is my impression that he made no attempt to show—"that the proper mode of comparing the wealth or poverty of one fauna with another was to state the proportion which the number of species composing it bears to the area over which they range"—as Prof. Newton implies that he did, but that he merely adopted this method as the only one readily available for the comparison of his regions. Although I took the opportunity of making some corrections in the figures, I never committed myself to the principle; and I very soon afterwards found that it was not to be trusted. As, however, several later writers have made use of it without remark, it will be interesting to consider where the exact point of the fallacy lies, and with what modifications the method can be trusted to give useful and consistent results.

If we compare two islands of almost exactly equal areas, such as Ceylon and Tasmania, and find that the one has twice or three times as many species of mammals or birds as the other, it will be generally admitted that we express the fact correctly when we say that, as regards such a group of animals, the one is twice or thrice as rich as the other; and the same may be said of two countries or two continents of identical areas. For on the supposition that there is a general correspondence between the numbers of rare and common, of local and of wide-spread species in the two areas compared (and this seems probable), then the average number of distinct species to be met with on one spot, or to be seen during a journey of equal length, will be proportionate to the total number of species in the two areas. But now let us divide one of the two continents or islands which we are comparing into two or more parts. We know, as a matter of fact, that one-half the area will always contain much more than half the total number of species, while one-tenth of the area will contain immensely more than one-tenth of the species. To take an example: the county of Sussex is about one-eightieth part the area of the British Isles, yet it actually contains full two-thirds of the total number of flowering plants, both being estimated by the same flora (Babington's "Manual," fifth edition, British Isles 1,536 species, Sussex 1,059 species). If we now compare either Britain or Sussex with an *equal area* on the continent of Europe or North America, we may obtain an instructive estimate of the comparative richness of their respective floras; but if we compare *unequal areas*, and then endeavour to equalise them by getting the proportions of species to area, we shall obtain erroneous results, which will become literally absurd when the areas compared are very unequal.

The problem remains, how to compare unequal areas of which we possess the zoological or botanical statistics. We can only do so by equalising them, and this may not be so difficult as at first sight appears. For example, let us take the Palæarctic and North American regions, in which the species of birds are nearly equal in number, but the areas are as about seven to three. The number of the Palæarctic species have, however, been proportionately increased of late years, and if we take the western half of the Palæarctic region so as to include North Africa and Persia we shall have an area about equal to the Nearctic region, and a number of species perhaps one-sixth or one-eighth less, which will thus represent the comparative richness of these two areas. The eastern half of the region, including Japan and North China, is probably as rich as the western; while the intermediate portion is poorer in species. Combining these three portions, and taking the average, we should perhaps find the Palæarctic region about four-fifths or five-sixths as rich as the Nearctic, instead of less than one-half, as shown by the method of proportionate areas.

Whenever we know how many *peculiar* species any district contains, we can deduct its area from the total area of the region to be compared, and this number of peculiar species, from the fauna of the region; and by this means we may reduce two unequal regions to comparative equality. Again, all detached portions or islands should be omitted in estimating the comparative richness of regions, because they affect these regions very unequally. By adding Britain to Europe you increase the area without adding to the fauna, and thus make the region seem poorer; while by adding Madagascar to Africa, or New Zealand to Australia, you add to the fauna in a greater proportion than you increase the area, and thus make the region seem richer. For a fair comparison continents should be compared with continents, and islands with islands, and these should in every case be brought to an approximate equality of area by lopping off outlying portions with their peculiar species. We shall then get results which will be instructive, and which will afford us a true estimate of the comparative richness of different countries in the several classes of animals and plants.

ALFRED R. WALLACE

Mr. Crookes and Eva Fay

IN Dr. Carpenter's eagerness to show that his statements about Mr. Crookes and Eva Fay had some basis of fact, he seems entirely to have forgotten the real issue which he has himself raised, and which is of great importance to all engaged in the study of these tabooed subjects. The question simply is, whether *any* investigation of the alleged abnormal powers of individuals, however painstaking and complete it may be, and however decisive its results, is to be branded with opprobrious epithets, without any proof of error or fallacy, but merely on the dicta of newspaper writers and alleged "exposers."

In the case before us Mr. Crookes made certain experiments in his own laboratory, in which the greatest refinements of modern electrical science were employed; and of these he published a detailed account. That is the sum total of his acts and deeds in regard to Eva Fay. Yet because these experiments have been referred to in America as indorsing Eva Fay's remarkable powers, and because some persons charge her with being an impostor, and go through an alleged imitation of her performances, Dr. Carpenter accuses Mr. Crookes of encouraging "disgraceful frauds" and indorsing a "notorious impostor." Now it is clear that, to support this accusation, Dr. Carpenter must *prove* that Eva Fay was an impostor in respect to what happened *in Mr. Crookes's house*, and that, to use Dr. Carpenter's own words, she evaded his "scientific tests" by a "simple dodge." He must prove that Mr. Crookes exhibited culpable carelessness or incapacity in accepting, as conclusive, tests which were really fallacious; for, otherwise, how can Mr. Crookes be held responsible for anything which happened afterwards in America? Dr. Carpenter has promised to do this in the forthcoming new edition of his lectures; but as the accusation against Mr. Crookes has been made in the pages of NATURE, and the question is a purely scientific one—that of the absolute completeness of the test of "electrical resistance"—I call upon Dr. Carpenter to explain fully to the readers of NATURE the exact particulars of that "simple dodge" which is to destroy Mr. Crookes's reputation as a physical experimenter, and to sustain the reputation of his accuser. Unless the explanation is so clear and conclusive as to satisfy *all* the witnesses of the experiments that Eva Fay *did* evade the scientific tests, and that what they saw was simple conjuring, then Dr. Carpenter is bound to find a conjuror who will submit to the same tests as Eva Fay did, and produce the same phenomena before the eyes of the witnesses, so as to show "how it is done." Mr. Maskelyne, who professes to have exposed Eva Fay, will of course be ready to do this for an adequate remuneration, which I feel sure will be forthcoming if Dr. Carpenter is proved to be right and Eva Fay's "simple dodge" is clearly explained.

I have already shown (in this month's *Fraser*) that the supposed *exposure* of Eva Fay in America was no exposure at all, but a clumsy imitation, as will be manifest when it is stated that the exposer, Mr. Bishop, performed all his tricks by *stretching the cord* with which his hands were secured to the iron ring behind his back! There is hardly a greater exhibition of credulity on record than Dr. Carpenter's believing that *such a performer* proved Eva Fay to be an impostor and Mr. Crookes's experiments valueless. But what can we expect when we find a *Daily Telegraph* report quoted as an authority in a matter of scientific inquiry?

I venture to think that, whatever may be their opinions as to the amount of *fact* in the phenomena called "spiritualistic" (by Dr. Carpenter, but never by Mr. Crookes), all men of science will agree with me that Dr. Carpenter is bound to *prove by direct experiment* that Mr. Crookes and his coadjutors were the victims of imposture on the particular occasion referred to; or if he fails to do this, that he should in common fairness publicly withdraw the injurious accusations he has made against Mr. Crookes and all who are engaged in similar investigations. If this is not done it is equivalent to deciding that no *possible* proof of such phenomena is admissible—a position which is not that of Dr. Carpenter, or, as far as I am aware, of the scientific world generally.

I beg to take this opportunity of apologising for my involuntary appearance under false colours in this month's *Fraser*. The letters "F.R.S." were added to my name after the corrected proofs left my hands and wholly without my knowledge. I have desired the editor to make a statement to this effect in his next issue, but in the meantime wish to set myself right with the readers of NATURE.

ALFRED R. WALLACE

Nocturnal Increase of Temperature with Elevation

WITH reference to the article in NATURE, vol. xvi. p. 450, on the above subject, allow me to place on record the following facts. On the night of January 7, 1874, in Lucknow, the temperature fell considerably below the usual. The minimum thermometer on the grass at the observatory registered 5° below freezing point. The destruction of plants in the Horticultural Gardens was great. Plantains, pine apples, sugar-cane, mango trees, casuarinas, pomsettias, colvilleas, bugainvilleas, &c., &c., were all injured; some killed outright. The remarkable fact which I observed on that occasion was, that the destruction of vegetation was only up to a certain height, viz., up to between seven and eight feet from the ground. Above that, not a leaf was touched by the frost. On the mango trees especially, which were planted close to each other, it was very remarkable to see a distinct line of destruction along the trees, of seven or eight feet from the ground. This, I think, distinctly showed that the temperature on that night, above eight feet from the ground, was decidedly warmer, and thus protected all vegetation, while all below it was more or less injured, or killed by frost. Other observations, I made lately, corroborate the result of the direct observations made by Mr. Glaisher. During the commencement of October there were several rainy days, with an easterly wind; the total rainfall was under 2½ inches. When it ceased, and the clouds cleared away, I observed the following:—Before seven o'clock in the morning there were only a few low-lying clouds to be seen. As the sun rose, the wind still in the east and almost a calm, clouds began to form in all directions; about noon, and till about 3 P.M., the sky was thickly studded with cumuli of various sizes. After that hour, wider and wider gaps began to form between the clouds, and the dissolving of the cloud-masses continued as the sun approached setting. About two hours after sunset there was scarcely a cloud to be seen, and the twinkling stars came out in their full brilliancy. This melting of the clouds after a certain hour, and completely so after sunset, would, I think, indicate that the cloud region after sunset became decidedly warmer than it had been during the day.

E. BONAVIA

Lucknow, October 22

Expected High Tides

MR. EDWARD ROBERTS in his letter has, I think, missed the chief object I had in addressing you. I did not complain that the authorities had not taken pains to calculate the heights of the tides, but that while one could take up almost any paper on the coast and find the heights of the tides of the place for the coming week, not one of the London papers, so far as I could find, supplied this information for its readers. What I felt to be a desirable thing was that the Meteorological Office, or some other constituted authority, should send to the daily papers warnings, when necessary, that on such a day a dangerous tide might be expected with a wind from such a quarter and with such a barometer, as the tide would be unusually high under even favourable weather—in fact, give a forecast of the tide.

It is almost useless to ask the public or vestries to put two or three facts together and think out the matter for themselves; they require some authoritative announcement to prepare for danger. And this is the more necessary as an overflow of the Thames at above-average spring tides is, as Mr. Roberts says, now a matter of meteorological circumstances only, and on account of the increased range of the tide in the river.

I was not aware that Captain Saxby had predicted high tides so far back as 1869. If, as Mr. Roberts says, the Astronomer-Royal wrote re-assuring the public that there was nothing extraordinary in the November 3 tide, and as, on the contrary, that tide rose 3 feet 3 inches above Trinity high-water mark, this incident may possibly have had something to do with the establishing of Captain Saxby's reputation with the public as a predictor of tides, especially if he had previously predicted the great tide of March 1 of the same year, which rose to 3 feet 7 inches above the mark.

With respect to the actions of the planets, I did not refer to the ordinary tide-producing power, for on working that out some years ago for one of the planets I was somewhat surprised to find that the height was, I believe, a fraction of an inch. I referred rather to the action of that storm-producing power which apparently gives rise to the great atmospheric disturbances at certain times (and, indeed, more or less at all times) in the sun, and by sympathy, or even directly, in our atmosphere.

B. G. JENKINS

Diffusion Figures in Liquids

PROF. MARTINI describes his diffusion figures as being "both new and singular." In the *Phil. Mag.* for June and November, 1864, I have described and figured various examples of what I call "the submersion figures of liquids" in continuation of a series of papers commenced in 1861 on "The Cohesion Figures of Liquids," or those assumed by liquid drops when delivered to various surfaces. Some of these figures are identical with those given by Mr. Worthington in the *Proceedings* of the Royal Society for 1876, and recently in your pages. C. TOMLINSON

Highgate, N., December 3

Bees and Flowers

IN last Thursday's impression (p. 62) is a letter from Mr. H. O. Forbes, referring to bees confining their visits to plants of one kind during each excursion, and thus in a measure preventing hybridisation of plants, &c.

This may be the general habit of bees, but it is not invariable; some bees, more especially their females, are to be found at certain plants only, as *Andrena hattorfiana*, at the scabious *Colletes succincta*, at the heath, and many others in like manner.

I have collected bees for several years, and have often taken them with the pollen-grains varying from orange-red to almost white, and this mixture on the same leg. I have inclosed a slide of pollen-grains which I washed from the leg of an *Andrena nigro-ænea*, and mounted in balsam; this shows several very distinct kinds of pollen; this was mounted in 1875, and at the time I gathered such of the wild flowers as were then in bloom, and compared the pollen. I was able to identify several of them, but as I made no notes I cannot say which. I would advise such observers as intend investigating this very interesting subject, to capture the insects and examine the pollen which may be found on them; this will be difficult in the case of the Bombi and Apis, as they knead it into pellets, but with those which collect on the belly or whole leg it will be easy enough.

Norwich JOHN B. BRIDGMAN

Hearing in Insects

MY daughter bred this summer a number of the larvæ of *Sphinx ligustri* and *Metopsilus elepenor*, and I was much struck with the extreme sensitiveness to the sound of the voice—especially of the former. The child's treble I observed did not affect them so sharply; but at the first word I uttered they invariably started, and remained some time motionless, with head drawn back, after their manner. I was disposed to attribute it to the vibration set up in objects around by sounds toward the deeper end of the scale, as I have felt a form tremble under me at the deep bass notes of a strong singer; but it had all the appearance and effects of hearing. HENRY CECIL

Bregner, Bournemouth, December 1

A ZOOLOGICAL STATION FOR THE CHANNEL ISLANDS

SOME definite prospect at length presents itself of the establishment within British waters of an institution long recognised as a leading desideratum among our Biologists, Museum-Conservators, and Natural History Students, namely, a building with the necessary appurtenances suitably situated, and founded on a somewhat similar basis to that of Dr. Anton Dohrn's noted Zoological Station at Naples, or the Anderson School of Natural History at Penikese Island, Buzzard's Bay, U.S. This long-felt need will be met by the proposed "Channel Islands' Zoological Station and Museum, and Institute of Pisciculture" described at some length in the advertising columns of this journal, and the establishment of which, or a similar institution, has been the guiding star and main object of the writer's ambition during the several years' "apprenticeship" spent by him as Naturalist and Curator to the various leading public aquaria of England.

Successfully carried out, the more prominent features of this undertaking will comprise, as at Naples, in addition to an attractive public exhibition of the living inhabitants of the surrounding waters, laboratories fitted with tanks, tables, and all the necessary instruments and apparatus requisite for the satisfactory prosecution of marine biological research, supplemented by a library replete with the standard scientific works and serials mostly in demand by those occupied in such investigation. Under the same roof it is likewise intended to establish a natural history museum accessible to the public, and more essentially illustrative of the notably rich marine fauna and flora of the Channel Islands. In connection with the library and museum departments popular lectures upon natural history subjects will from time to time be given. Following the system productive of such gratifying results at the Penikese Island Station, it is further proposed for the full development of the scientific advantages of this institution to institute summer classes for the attendance of students, and to hold out sufficient inducements for the most eminent authorities on various biological subjects to deliver lectures and a course of instruction to these classes upon that branch of natural history with which their reputation is more especially associated.

An entirely novel feature to be incorporated with the Channel Islands' Zoological Station will be a department relegated to the conduct of experiments associated with the—in this country—little developed science of economic pisciculture, and in which department it is proposed to award a prominent place to the artificial rearing of lobsters. Experiments made in this direction by the writer some years since at the Manchester Aquarium have decisively shown that the artificial culture of these crustacea on an extended and systematic scale might be developed into a highly important and remunerative industry. In the experiments here referred to it was found that the little lobsters occupied from six to eight weeks in passing through those singular free swimming larval conditions, known respectively as the "Zoea" and "Megalops" stages, antecedent to their assumption of the adult and ambulatory form, and during which short interval they exuviated or cast their shells many times. These initial metamorphoses safely past, their further development to a marketable size, is a comparatively easy task. The scientific culture of the oyster and other edible species will likewise receive attention in association with this undertaking.

The appropriateness of Jersey as a site for this intended Museum of Pisciculture and Zoological Station is at once apparent, the variety and exuberance of the marine fauna of the Channel Islands being such as to assimilate it more closely to that of the Mediterranean than any other one within British waters. The occurrence on the Channel Islands' coast of the Sea Horse (*Hippocampus*), Urchin-fish (*Diodon*), Remora (*Echeneis*), Electric Ray (*Torpedo*), and Lancelet (*Amphioxus*), among the vertebrate group; and of the *Haliotis*, *Scyllarus*, *Comatula*, *Physalia*, *Velella*, *Lucernaria*, and many others among the invertebrate section, are a few from among many that might be named in demonstration of this fact. The sponge-tribe and the division of the tunicate might be likewise specially singled out as attaining upon the shores of these islands a development in both numbers and variety rarely if anywhere else excelled. Unprecedented facilities for the collection of all such marine productions are also afforded by the extraordinary low limit to which the water recedes during the monthly spring-tides. In no case less than thirty, and not unfrequently mo e than forty feet represents the vertical height of the rise and fall of the tide on these occasions, the waves on their retreat exposing to view and rendering accessible an extent of rocks and life-teeming pools that constitute a veritable elysium to the marine zoologist or botanist. The situation of Jersey, again, is such as to render it not only readily accessible to English naturalists and students, accompanied with just that amount of sea-passage requisite to satisfy the marine predilections of our countrymen, but it is also most conveniently reached from France, Belgium, Holland, and other Northern European countries, and which will thus invest the institution with international utility. Paris, indeed, already supplies a considerable number of the numerous summer visitors to the island, and from these no doubt might be enticed a strong contingent of students for the laboratories.

As will be found in the advertisement already referred to, a special appeal is addressed to the scientific section of the community rather than to the general public for the funds required for the successful establishment of this institution, and it is certainly most desirable that an enterprise calculated hereafter to confer so great advantages upon this more limited class should receive a fair quota of support through its ranks. The sum total required, in fact—5,000*l*.—for the founding of this zoological station, and all accessory departments, is so comparatively small as to place it not quite beyond the pale of hope that sufficient enthusiasm to effect the purpose may be yet forthcoming from among the more wealthy devotees to the shrine of science, and in emulation of the praiseworthy example set on the other side of the Atlantic by Mr. John Anderson, the munificent founder and endower of the Penikese Island Station. At all events, it is scarcely to be anticipated that so desirable an undertaking, replete with such promise of future advantage to the scientific world, will long lack the essential "sinews of war," considering that a contribution by each member of one only of our leading metropolitan scientific societies of less than one-half of his annual subscription to that society, would more than suffice to defray the whole expenditure contemplated. Through the kind liberality of a few, moreover, and the financial confidence of others, a small but substantial nucleus has been already formed, and it is confidently hoped that the full sum needed may yet be raised in time for naturalists and the public generally to participate in the advantages the Channel Islands' Zoological Station and Museum of Pisciculture will place at their disposal, so early as the summer of the year 1878.

In conclusion it is perhaps desirable to note that in drawing up the legal foundation of this Channel Islands' institution the strictest care has been taken to permanently exclude all possible chance of the society's premises being used for any of those attractions of an entirely irrelevant and unscientific nature more usually associated with exhibitions of the living inhabitants of the ocean, and the existence of which must ever constitute an insuperable barrier to that good service to science which these last-named establishments might otherwise contribute. It is only under such restrictions as are above set forth that patronage and support are solicited. In recognition of the purely scientific status of this enterprise, the members of the Executive Committee, or Directors of the Society, have also unanimously resolved to accord their services as such members gratuitously; and it is further pro posed, so as to divest the undertaking of any merely speculative aspect, that all profits arising from the business of the Society, beyond what would yield to the shareholders a return of five per cent., shall be devoted to the further development of the institution, or otherwise towards the aid and promotion of scientific research.

St. Helier's, Jersey W. SAVILLE KENT

GERMAN UNIVERSITIES

THERE have been comparisons made recently both in this and in other journals between the Universities of Germany and those of this country, and as the university question is at present giving rise to much discussion, it may be useful to give some statistics with reference to the former. Such statistics are much more easily attainable for Germany than for England, as there are two German publications in which all the important information concerning the various universities of the empire is systematically arranged, viz., the *Deutsche Universitäts Kalendar* and the *Deutsche akademisches Jahrbuch*. To obtain similar information concerning the universities of the United Kingdom it would be necessary to obtain a copy of the calendar of each university. Our statistics are obtained from the *Jahrbuch*, which contains information not only relating to the universities, but also to the technical and high schools, learned societies, and libraries of the country. Some such publication is wanted here, and might be made to include not only our various universities and colleges, but also our principal public schools. The *Jahrbuch* includes, moreover, the Russo-German University of Dorpat, the Universities of Vienna, Graz, Innsbruck, Prague, Czernowitz, Basel, but these we shall not take into account.

Germany has in all twenty-one universities, each complete in all departments. The number of students matriculated and non-matriculated attending each, mostly in the 1876-77 semester was as follows :—

	Matriculated Students.				Non-matriculated.	Total.
	Theology.	Law.	Medicine.	Philosophy.[1]		
Berlin	139	1003	281	1067	2107	4597
Bonn	163	200	118	312	36	829
Breslau	107	377	165	458	15	1122
Erlangen	136	37	102	147	—	422
Freiburg	41	64	128	60	36	329
Giessen[2]	—	—	—	—	10	331
Göttingen	71	324	122	474	—	991
Greifswald	32	89	235	142	9	507
Halle	190	150	103	439	16	898
Heidelberg	9	410	101	215	60	795
Jena	66	101	71	201	20	459
Kiel	47	14	73	78	11	223
Königsberg	44	186	127	264	10	631
Leipzig	328	1102	364	1182	113	3089
Marburg	49	65	104	164	4	386
Munich	75	357	440[3]	408[4]	—	1280
Münster	208	—	—	223	—	431
Rostock	24	35	31	54	—	144
Strassburg	49	211	178	236[5]	26	700
Tübingen	295	251	138	335[6]	6	1025
Würzburg	150	93	547	328	22	1040
	2223	5069	3428	6787	2501	20229

Thus, then, there are about 18,000 matriculated students attending the twenty-one universities of Germany, under a teaching staff of about 1,300 paid professors, besides about 450 privat-docenten. Of the students, about one-third belong to the philosophical faculty, the faculty in which the sciences are included. Unfortu-

[1] In "Philosophy" are included the physical and natural sciences.
[2] The Giessen students are divided into Hessian and non-Hessian, not according to faculties.
[3] Including 100 students of pharmacy.
[4] Including 9 students of forestry.
[5] Including 97 mathematical and natural science students, these being a separate faculty at Strassburg. The figures are for 1875-6.
[6] Including 53 students in political economy and 141 in natural science these subjects forming separate faculties at Tübingen

nately, in very few cases is the number of students attending the scientific as distinct from the literary classes given, and only in one or two universities has science as yet been erected into a separate faculty. If we may take the two universities, Strassburg and Tübingen, in which natural science forms a separate faculty as a criterion from which to judge of the number of students of science in the other universities, the proportion must be very large. In Strassburg, of the 236 students whom we have placed in the philosophical faculty, ninety-seven are students of science, and in Tübingen 100, or something like one-third of the whole philosophical faculty. Or again, if the number of science students is at all in proportion to the number of science-teachers, the position held by science in German universities is in striking contrast to its position in our universities and colleges. Of the professors, among whom we do not count the privat-docenten, about one-half belong to the philosophical faculty, and of these again, nearly one-half are teachers of science, that is, in the philosophical faculty of the German universities there is one teacher on an average to every ten students, and in science the proportion is considerably greater. In these estimates we do not take account of the medical faculty, in which, in most of the universities, there are several chairs which might well be classed as belonging to science generally.

For example, the well-known anthropologist, Dr. Virchow, the conclusion of whose address at the German Association we give this week, is Professor of Pathology at Berlin, and has been able to bring the results of his special medical line of investigation to bear, in an important way, upon his anthropological researches. Both in Berlin and elsewhere, other names of eminent medical professors might be mentioned who have not only themselves made important contributions to science, but under whom students are encouraged to do so likewise.

Of the nature and extent of the scientific teaching in German universities some idea may be formed from the subjects represented by the teaching staff at Berlin, which may fairly be taken as a type of the whole. In Berlin then we find that there are (excluding the privat-docenten) five professors of mathematics, two of astronomy, seven of chemistry, five of physics, three of geology, four of botany, two of zoology, one of meteorology, two of geography, one of anthropology, and one of agriculture—physiology and comparative anatomy being well represented in the medical faculty, and we might well have included among teachers of science those who devote themselves to the scientific investigation of languages. But a mere statement of the number of teachers gives no adequate idea of the means at the command of a German University for training its students in science. The number of teachers in each subject secures that its various departments will be thoroughly worked out, and gives a student a chance of following out any specialty he may take up; this is made still further possible by the number and variety of institutions, museums, laboratories, collections, &c., attached to each university, not to speak of its large and comprehensive library. In connection with Berlin alone there are twenty-three scientific "Anstalten," as they are called, for practical investigation in connection with the various faculties. Had we taken the numerous Realschule and the high and polytechnic schools into account, where an education can be obtained quite equal to that obtainable at most of our universities and colleges, it would have been seen that higher education in Germany leaves little to be desired.

And in reference to the subject of our leader this week, we would point to these Realschulen as embodying the German idea of what *practical* training should be. The carefully drawn-up time-tables of these schools are an instructive study, showing, as they do, that general mental culture is regarded as of the first importance in training a youth for the work of the world.

The *Jahrbuch* gives a statement of income and expenditure in connection with only one or two of the universities. Some interesting details, however, on the contributions of the State to the universities, as well as on other points, were given in a recent number of the *Academy* by Prof. Ray Lankester:—

"The sum expended by the North German States on the twenty universities belonging to them is annually more than 500,000*l.* The Imperial Government has expended upon the new University of Strassburg alone 70,000*l.* in one year. The University of Leipzig alone receives annually from the Saxon Government over 50,000*l.* There are eight universities in North Germany which are little, if at all, less costly, and there are eleven of smaller size which receive each from 8,000*l.* to 20,000*l.* annually.

"In North Germany there is one university to every two million inhabitants; in Austria there is one to every five millions; in Switzerland one for each million; in England one to every seven millions. In the twenty North German universities there are 1,250 professors.[1] In the British Islands we ought to have sixteen universities and 1,000 professorships in order to come up to the same level in this respect as North Germany. The stipend (apart from fees) of a professor in a German university ranges from 100*l.* to 600*l.* a year. As a rule, at the age of five-and-thirty, a man in this career may (in Germany) count on an assured income of 400*l.* a year (with retiring pension). The expenditure on attendants, libraries, laboratories, and officials may be calculated as being (in a well-conducted university) more than equal in amount to the total of the professors' stipends. Taking the *average* German professorial stipend at only 200*l.* a year, we find that 250,000*l.* must be spent annually on this item alone in the North German States.

"In order to equip and carry on sixteen universities in this country which should bear comparison with the German universities, we require not less than an immediate expenditure of 1,000,000*l.* sterling in building and apparatus, and an annual expenditure of from 500,000*l.* to 800,000*l.*"

When we add to the Government subsidy the income of the universities from other sources, the sum is enormously increased. The half-million, moreover, does not include the occasional grants of the Government for special purposes. Some idea of the magnificence of these was shown in our recent "University Intelligence," where it was stated that in the budget submitted to the present Prussian House of Deputies are the following items:—Erection of the German Industrial Museum, 998,000 mk.; erection of a Polytechnic in Berlin, 8,393,370 mk.; erection of an Ethnological Museum in Berlin, 1,800,000 mk.; and for the Berlin University, erection of an Herbarium, 422,000 mk.; of a Clinic, 1,955,000 mk.; of a new building for a second Chemical Laboratory, as well as of a Technical and Pharmaceutical Institute, 967,000 mk.

OUR ASTRONOMICAL COLUMN

THE METEORITE OF JULY 20, 1860.—The occurrence of the splendid meteor of November 23, which has probably been observed with sufficient completeness to allow of the determination of its path, while it remained visible, recalls a similar object which passed over the northern parts of the United States and adjacent parts of Canada, on the evening of July 20, 1860, which was made the subject of investigation by the late Prof. J. H. Coffin, of Lafayette College, N.Y. Probably no one of these remarkable bodies has been more extensively observed, and we do not remember any case where the calculations have been more laboriously conducted, and with greater hope of reliable results.

[1] *i.e.* we presume professors strictly so-called, exclusive of "privat docenten."

The "meteoric fire-ball," as Prof. Coffin calls it, was first seen moving in an easterly direction from a point nearly over the western shore of Lake Michigan, though it may have become luminous somewhat further to the west as the sky was clouded over that region. From thence it was watched until it disappeared out at sea in a south-easterly direction from the island of Nantucket. Its course was therefore about 1,300 miles, and it was seen for several hundred miles on either side of this track. Upwards of 230 descriptions of the meteor were collected, and upon the best of these Prof. Coffin undertook the determination of the orbit, by an elaborate process detailed in his memoir, which formed No. 221 of the "Smithsonian Contributions to Knowledge," entitled "On the Orbit and Phenomena of a Meteoric Fire-ball, seen July 20, 1860." The various accounts of the meteor are printed in the memoir, and reveal some peculiar points of interest in its path. There were two "remarkable ruptures of the main body of the meteor," particularly near the meridian of 77° west of Greenwich, when it separated into two parts nearly equal in size which disappeared below the horizon, as one observer describes it, like a chain-shot.

Considering that whatever might have been the orbit of the meteor before it became visible, its course while it was under observation, from being so near the earth, must have been controlled almost wholly by her attraction. Prof. Coffin mentions that the orbit he has investigated is not the path of the meteor in space, but the orbit relative to the earth, having the centre of our globe in one of its foci. Approximate elements having been obtained, azimuths and altitudes deduced from them were compared with those given by the various observations to ascertain what modifications of the elements were required in order to satisfy them. It was found that with certain corrections thus indicated the first orbit represented tolerably well most of the reliable observations to the west of 76° or 77°, near which the most easterly of the two points from which it was determined, was situated ; but further to the east the discrepancies between calculation and observation were "so great that they could be reconciled only by introducing changes in the elements of the orbit, one on the meridian of 77° and another near the meridian of 74°, and as Prof. Coffin remarks, it is worthy of note that it was in the vicinity of these points that observers report the violent ruptures of the body of the meteor, which seems to afford a rational explanation of the changes of elements found to be required. It was apparent that while the meteor descended rapidly towards the earth till it reached the meridian of about 74°, it afterwards rose, and the change was too great to be accounted for on the supposition that the meteor at that point attained the perigee of its hyperbolic orbit. After the introduction of other considerations, it resulted that the path divided itself into three sections, "the first and third of indefinite length, over only a small portion of which the meteor was visible, and the second an intermediate one, 160 miles long, where it was most brilliant." The elements for the three sections, as finally adopted, are :—

	Sec. I.	Sec. II.	Sec. III.
Long. of perigee	294 57 ...	275 37 ...	261 2
,, descending node...	332 56 ...	325 11 ...	329 24
Inclination to ecliptic	66 12 ...	67 10 ...	66 26
Eccentricity	2·9984 ...	2·9817 ...	2·9921
Major semi-axis	2005·3 ...	2005·3 ...	2005·3
Perigeal distance	4007 ...	3974 ...	3995

The major semi-axis and the perigeal distances are expressed in miles. According to these elements, Prof. Coffin concludes that the meteor entered the sphere of the earth's attraction from the direction of the constellation Sextans, in about R.A. 148°, N.P.D. 87°, and left it toward a point in R.A. 355°, N.P.D. 121°.

THE PLANET MARS AND B.A.C. 8129.—The near approach of Mars to the seventh-magnitude-star, B.A.C. 8129, appears to have been observed pretty generally. Taking the mean place of the star from the Washington Catalogue of 1860, its apparent position on the evening of November 12 is found to be R.A. 23h. 14m. 24·37s., N.P.D. 96° 34′ 22″·5. By Leverrier's tables the place of Mars at 6h. Greenwich time and the hourly motions were :—

R.A.	23h. 14m. 24s·91	+ 3s·473t.
N.P.D.... ...	96° 34′ 25″·1	− 30″·49t.

Taking account of parallax, the star at 6h. would be on an angle of 319°·4, distant from planet's centre, 17″·8, by calculation, as seen at Greenwich. Probably the actual approach was not quite so close.

THE BINARY-STAR CASTOR.—Dr. Doberck, of Col. Cooper's Observatory, Markree, whose investigations relating to the orbits of the revolving double-stars have been on several occasions referred to in this column, has corrected the elements of the fine binary α Geminorum, given by Thiele in 1859, by measures to 1877 inclusive. Thiele's period of revolution was 997 years, Dr. Doberck's calculation gives 1,001 years, and the comparison with observations, from those of Bradley and Pound in 1719 to the present year, exhibits no larger differences than are to be attributed to unavoidable errors, or in one or two cases, bias on the part of the observer. The new elements are as follow :—

Passage of the peri-astre	1749·75
Node	27 46 (meridian of 1850).
Node to peri-astre on orbit ...	297 13
Inclination...	44 33
Eccentricity	0·3292
Semi-axis major...	7″·43
Revolution	1001·21 years.

This orbit gives, for 1878·0, position 234°·9, distance 5″·76.

TRANSITS OF THE SHADOW OF TITAN ACROSS THE DISC OF SATURN.—Mr. Marth has drawn attention to the following dates of transit of the great satellite's shadow, as the only opportunities for observation until the year 1891 :—December 9, about 6½h. Greenwich time, December 25, about 5¾h., and January 10, about 5h.

THE "NAUTICAL ALMANAC," 1881.—As usual the *Nautical Almanac* was published in November, the last volume being for the year 1881, which does not appear to be one distinguished by any particular astronomical phenomena. The two solar eclipses on May 27 and November 21, the first partial, the second annular, are both invisible in this country, and the line of annularity in the November eclipse runs at great south latitude. The total eclipse of the moon on June 11 will also be invisible here, while in the partial eclipse on December 3 (magnitude 0·97) the moon will rise at Greenwich about twenty minutes after first contact with the shadow. A transit of Mercury on November 7, will be wholly invisible in this country, the first external contact (geocentric) taking place at 10h. 16m. 13s., and the last at 15h. 37m. 41s. mean times at Greenwich. The list of visible occultations does not contain any planet, nor any star over the third magnitude. The list of standard stars is on the same scale as for the year 1880, and numbers close upon 200. The *Nautical Almanac* circulates to the extent of more than 20,000 copies, inclusive of the number appropriated for the use of the Royal Navy.

OLE RÖMER

WHEN Newton's "Principia" raised the theory of astronomy to a height not previously dreamt of, practical astronomy was still where Tycho Brahe left it almost a century before. Such was the respect paid to the memory of that great man that Hevel in Danzig carried out Tycho's ideas about his observatory, and rejected all the improvements that had since originated, amongst which was the application of the telescope to astronomical observations. The obstinacy with which Hevel refused to adopt this invention appears strange to us now, but we must remember the great accuracy which was then obtained by pinnules alone. Tycho had reduced the probable error of astronomical observations from ten minutes to one, and some of Hevel's observations have been found to be affected by errors of less than half a minute of arc, results which show that the old astronomers were in possession of a skill in handling their apparatus which has since been lost. It should also be taken into account that the telescopes of Hevel's day were generally of Dutch construction, and Kepler's tube, with wires in the field to mark the centre, was first brought into general use by Auzout and Picard about the end of the century. Of hardly less importance was the application of the pendulum to clocks, which from that time have been used as astronomical instruments. They had in Tycho's observatories been used merely to show what o'clock it was when observations were made, but never to determine differences of right ascension.

With sufficiently good clocks it was possible to determine the positions of the stars by observations in the meridian alone, and it was no doubt Picard who first became aware of the immense advantage of this. Consequently he solicited Government for a large mural quadrant, but Cassini was then called in from Italy, and no notice was taken of the request made by Picard, who, unfortunately for the practical astronomy of France, was not thought much of by the court of Louis XIV., his important, but modestly-conducted researches being eclipsed by Cassini's brilliant discoveries. Had Picard got the direction of the Royal Observatory in Paris he would have been able to make further improvements in the construction of instruments; but with no sufficient means at hand, he ascribed the partial failure of his attempts to the small size of his instruments. A mural quadrant like Tycho Brahe's, but furnished with a telescope, was first fixed at the observatory when Picard died.[1] Flamsteed and Sharp adopted the methods just as Picard left them and with all their drawbacks. They used the quadrant both for right ascensions and declinations. Their observations may perhaps be said to be twice as accurate as Hevel's naked-eye observations.

This was the state of practical astronomy when Römer raised it to a height which was not surpassed before Bessel. Ole Römer was born in Aarhus on September 25, 1644. Thence he came, 1662, to Copenhagen, where he studied mathematics and astronomy under Erasmus Bartholin, whom he subsequently assisted. As has already been pointed out, Tycho's observations continued to be consulted by astronomers, and in 1671 Picard went to Denmark to determine the difference between the longitude of Uraniburg and Paris.[1] There he found Römer occupied in revising Tycho's manuscripts, and he secured his assistance in the observations on Hveen, and when Picard returned to France he procured Römer a place as assistant at the observatory of Paris. There his talents did not fail to be appreciated, and he was soon elected a member of the Academy. It was in Paris that Römer discovered the gradual propagation of light from

QVADRANS MVRALIS

SIVE TICHONICUS.

FIG. 1.

observations of the eclipses of the first satellite of Jupiter. His results, which were not very exact, were, however, contested by Cassini and most other authorities for a long time after. Indeed, the theory of the motion of the satellites was at that time so little elaborated, that similar conclusions might be questioned all the more as they had been deduced from observations of the first satellite alone. Römer shortly afterwards discovered the epicycloid, and published a paper on the proper form of toothed wheels, and descriptions of a Jovilabium and Saturnilabium; he afterwards invented different kinds of

[1] This interesting instrument is represented in Fig. 1. It was cast wholly in brass and fixed with strong iron screws as exactly as possible in the meridian in the south-western room of the ground-floor of Uraniburg. Its radius was about six feet, and it could by means of transversals be read off to ten seconds of arc. It had in a hole in the south-western wall in the centre a gilt cylinder and two pinnules movable along the edge, which were so constructed that the slit could be opened or closed more or less according to the faintness or brightness of the objects to be observed. Tycho Brahe, who, in contradistinction to Ole Römer, was not only anxious about the quality but also about the appearance of his instruments, had ornamented the large empty space of the quadrant with the splendid picture shown in the plate. He is here depicted in his usual attire. At his feet is lying one of his favourite hunting-dogs, more as a symbol of ingenuity than as a symbol of nobility. Behind him are small portraits of King Frederick and Queen Sofie. This was painted by John of Antwerp and is more like him than any other image, but the space contained also an architectonic picture by Steenvinkel, somewhat reduced as if at a distance. In the upper story are represented some of his most celebrated instruments, in the middle story the library inside with the large celestial globe and his pupils occupied with their studies, and in the cellar the chemical laboratory. On the plate is seen a young man observing through one of the pinnules, another is watching the clocks, while a third is noting down their remarks at a table. Tycho Brahe's image seems as if admonishing and instructing them in their work.

[1] On this occasion fire-signals were for the first time made use of for the determination of longitude. A fire was lit on the top of the astronomical tower in Copenhagen. There Picard eclipsed it at regular intervals, and the moment the light disappeared was noted by the observers on Hveen.

planispheres. He was, in 1679, sent by the Academy to London, to examine the English determination of the length of the second pendulum. He took part in the levellings necessary for conducting water to Versailles,

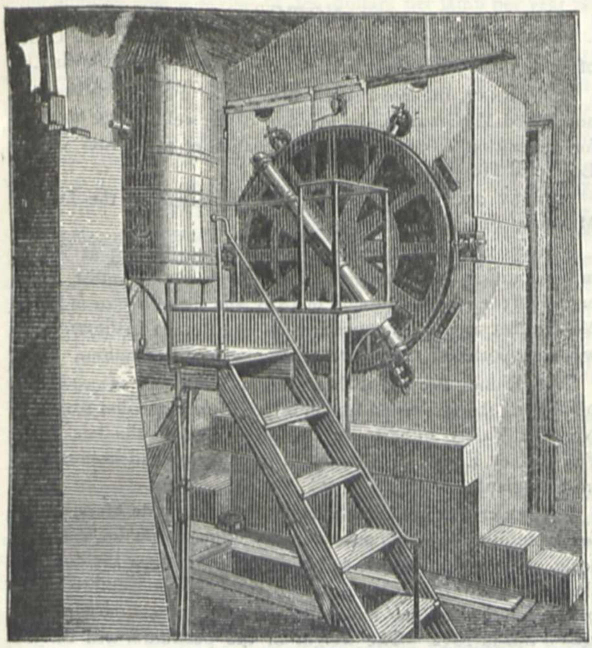

FIG. 2.—Mural Circle, U.S. Naval Observatory.

which gave him occasion to write several interesting papers. He made many observations in Paris. Already in 1671 he had taken part in the observations of the altitude of Mars, which was simultaneously observed by Richer in Cayenne, for the determination of the parallax of the sun. His fame increased so much that he was made tutor to the Dauphin, and in 1681 Christian V. called him to Denmark as Astronomer-Royal. His great technical knowledge made him useful to that country in many ways, and we see him in succession as Professor of Mathematics, Mayor of Copenhagen, Master of the Mint, Prefect of the Police, Privy-Councillor, and one of the Judges of the Supreme Court, in all of which capacities he left behind a lasting fame. He was one of the first who recommended Protestants to adopt the calendar as reformed by Gregory XIII. He had also to make a journey in 1687 to acquaint himself with the latest progress in naval architecture and pyrotechnics. We cannot fail to respect his perseverance when we hear that, notwithstanding so many different occupations, he left behind about as many observations as Tycho Brahe himself. But these were mostly all lost by the great fire which devastated the town in 1728.

Römer found in Copenhagen the old observatory of Longomontanus on "the round tower" almost devoid of instruments, and it was first in 1690 that two were placed there. One of these was not unlike a modern equatorial, and intended for extra-meridian observations; but it was generally clamped in the meridian, and used as a transit circle. The other was a vertical circle for taking corresponding altitudes, a method much used by Picard. The position of these instruments on the top of the tower (over 100 feet high), where the observations had to be made under the open air, rendered their use, however, so inconvenient to the observer, that Römer about the same time arranged an observatory in one of the windows of his dwelling house. Here was placed the transit instrument which Römer invented, but it was greatly inferior to the instrument he afterwards constructed. The telescope was not fixed in the middle of the horizontal axis as in modern instruments, but near one end. The axis, which rested on iron supports in the wall, was a long and thin iron bar, furnished with a counterpoise acting in the middle, to prevent flexure. The tube itself was cone-shaped for the same reason. In the focus were drawn a horizontal and a number of vertical wires. The interval between the three he generally used was thirty-four seconds in the equator, and the time was noted to half seconds. The field was illuminated by means of a polished ring placed outside of the object-glass. The circle was not movable with the telescope but fixed to the wall, and the telescope carried with it a microscope fixed upon an arm for reading the declinations. The arc was divided to ten minutes and in the microscope were eleven wires, each one minute distant from its neighbour. The minutes were read thus and could be subdivided by estimates to about four seconds. The instrument being placed in a window Römer could only observe the stars of between twenty-eight south and forty degrees north declination, and the arc was therefore not a whole circle but merely about seventy degrees. The error of collimation was corrected by reversion. The azimuth was ascertained by comparing the observed error of the clock with that determined by corresponding altitudes. It was at this observatory that Römer tried from observations of the right ascensions of two bright stars on opposite sides of the sky, to determine the sum of their parallaxes.

But these arrangements did not long satisfy Römer, and in 1704 he built, at his own cost, the "Observatorium Tusculaneum," seventeen feet long and broad, near the village Vridlösemagle, between Copenhagen and Roeskilde. The principal instrument of this observatory was a meridian circle, and the stars were observed through a very narrow opening in the ceiling and the walls running

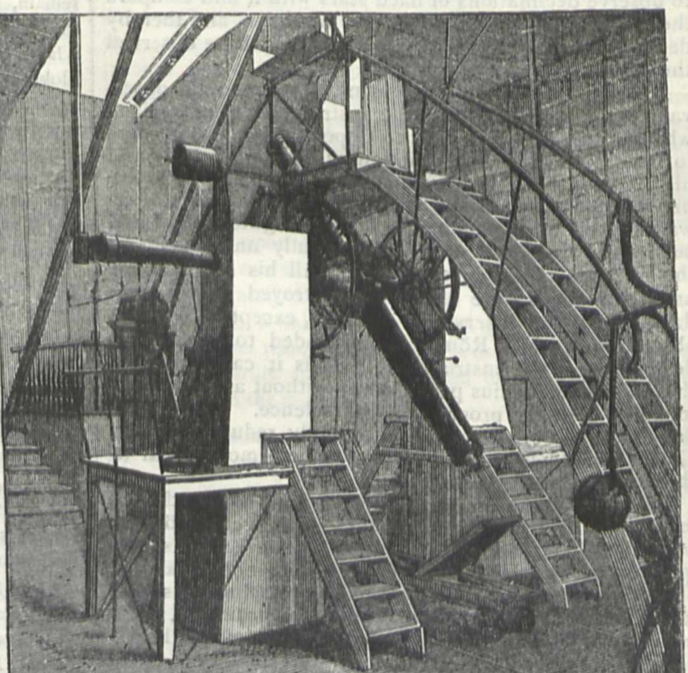

FIG. 3.—Meridian Circle, U.S Naval Observatory.

from north to south, which was closed with shutters when not in use. The axis was made of conical iron plates lighter and more inflexible than in the old transit. The pivots were conical and fitted into brass holes on the sides of the pillars, into which the axis was tightly pressed with screws. The axis could be shifted a little both in altitude and azimuth. Römer had afterwards occasion to regret that the instrument was supported on wooden pillars and not on stone. The tube was not fixed immediately to the axis but to the circle. It was five feet long, and allowed stars of the second magnitude to be observed during the day. It had three horizontal wires in the focus and seven vertical; the intervals between these were twenty-four seconds in the equator, and the time was noted to a fraction of a second. There were three good clocks in the observatory. The circle which was fastened to one end of the axis was about five feet in diameter. It is not unlikely that Römer afterwards considered a smaller size preferable. He disapproved altogether of the use of the quadrant and sextant, and said that a circle of four feet was superior to a quadrant of ten. This circle had been divided to ten minutes with Römer's own hands, and in the microscopes three seconds were easily discerned. It was read by two microscopes fixed side by side to one of the supports of the axis. Before the observations were made the circle was ascertained, by means of a plumb-line, to be vertical. The errors of collimation and azimuth were determined in the same way as with the old instrument, and Römer had fixed two meridian-marks, which were besides used to discover whether the microscopes had changed their position. Römer was the first who determined the azimuth from culminations of circumpolar stars above and below the pole.

Besides this instrument Römer had also a transit instrument placed in the first vertical, but that was not used much because it had been so badly made by the workmen that it disturbed the meridian circle with which it had one of the supports in common. Römer intended to observe declinations of fixed stars with it and compare them with those observed in the meridian, and thereby determine the refraction. He would also have observed the sun with it.

After Römer's death, on September 19, 1710, his observatory was neglected and the instruments were spoiled, when at last they were sent to Copenhagen. Römer was to have published a description of the observatory and his methods, but was prevented by the illness which terminated his active career, and the descriptions were afterwards given from memory by his little gifted pupil and successor, Horrebow, who did not fully understand all the precepts of his great master. All his observations and instruments were ultimately destroyed by the conflagration of the observatory in 1728, except three days' observations, which Römer had intended to use for his description of the instruments. Thus it came to pass that this great genius passed away without any adequate influence upon the progress of the science. These three days' observations have been carefully reduced by Dr. Galle; their accuracy is shown to be almost equal to that attained at the present day.

In England the methods adopted by Flamsteed were followed until Bradley permanently introduced Römer's transit at Greenwich. He continued, however, to use the quadrant for declinations, and in most other observatories of this country the right ascensions and declinations continued to be observed with different instruments. We may also trace to this circumstance the immovable heavy mural instruments so common in this country.[1] The French astronomers adhered to Picard's methods until lately, and used quadrants even for the right ascensions; the transit in the first vertical was not used before it was rediscovered by Bessel. On the whole we may say that no observatory fully expressed Römer's ideas before Bessel's and Struve's practical talents had altogether changed the face of the science. W. DOBERCK

[1] On the accompanying plates are represented one of the formerly more common mural circles (Fig. 2), and also a meridian circle (Fig. 3); both instruments of the U.S. Naval Observatory, Washington.

NOTES

PROF. KIRCHHOF has been created a Knight of the Order of Maximilian for Science and Art, by King Louis of Bavaria.

M. BRUNET, the late French Minister of Public Instruction, nominated M. Gramme, the inventor of the well-known machine for generating electric light, a Chevalier of the Order of the Legion of Honour.

NEARLY 200*l*. have already been promised for the Darwin Memorial Fund at Cambridge.

A MONUMENT was inaugurated on November 23 at Rouen in honour of M. Pouchet, the celebrated naturalist, who organised the Rouen Museum in 1828, and died director in 1872. M. Pouchet was a correspondent of the French Institute. He was a supporter of the theory of spontaneous generation.

THE Rhine Provincial Museum in Bonn has succeeded in purchasing the famous collection of prehistoric remains from the Neander Valley, hitherto in the possession of the late Prof. Fuhlrott, of Elberfeld, although a high price had been offered from England.

PREPARATIONS are being made at the Champ de Mars, Paris, for executing Foucault's pendulum experiments on an enlarged scale. His apparatus was suspended in 1851 under the dome of the Pantheon. It was in operation for a long while and removed only when the building was transformed into a church after the *coup d'état* in 1852. The weight of the pendulum will be 300 kilogrammes, and it will oscillate at the end of an iron wire from 65 to 70 metres long. Thus a special construction will be required for its suspension. The pendulum will be suspended above a grooved pipe which will move freely on an axis in its centre. The pendulum in oscillating will displace this pipe, which will remain, like the pendulum itself, fixed in space, in reference to the constellations. Underneath the pendulum will be arranged a large terrestrial globe, from 25 to 30 metres in diameter. This globe, resting on the ground, will necessarily follow with the spectators the movement of the earth. The pipe, on the contrary, supported by a pivot at the extremity of the axis, will carry large indexes, which will appear to be displaced with it. The globe, which will represent the earth, having a considerable volume, the movement of these indexes will be visible; it will render tangible in some degree to the least attentive, the rotation of the planet on its axis.

IN the *Times* of Monday is a pleasant leader on the Royal Society *à propos* of the anniversary last Friday. The article contains nothing striking, the drift of it being that the Royal Society has done much to foster science, but that science never was altogether, and is now not at all, dependent on the Royal Society for its progress—which is probably true. The article concludes with a strongly-expressed desire to see literature, "the old learning," recognised by the Royal Society, that, in fact, it should be turned into a sort of academy, after the pattern of that of Paris. But practically the French Academy is a collection of societies, one of which, like the Royal Society, devotes itself wholly to science.

AN article in Tuesday's *Times* describes some experiments which are being made at the Fulham gas-works in the lighting of lamps by electricity. The patent is that of Mr. St. George Lane Fox, the distinctive feature being an electromagnetic apparatus attached to each lamp, and connected with a central station, at which an electric current is generated. If the experiments prove successful and the apparatus is adopted, a great saving is likely to be effected. All practical difficulties seem, however, to have been solved in America Electricity has been tried for the purpose of lighting and extinguishing 220 street lamps in Providence, R. I., scattered over a district nine miles long. One man attends to the whole business and does it in fifteen seconds. The method has now been on trial for some months, and a saving of ten dollars per lamp per year is reported.

As might have been expected, Mr. Stanley has been received with unbounded enthusiasm at the Cape, and his followers petted and loaded with presents to such an extent that they must feel amply rewarded for all their labours. Mr. Stanley in his lecture at Cape Town, reported in the *Times* and *Telegraph*, went over all his journey again, and defended himself stoutly against the criticisms which have been made on his conduct. He is expected in England about Christmas. The United States House of Representatives are to pass a vote of thanks to Mr. Stanley, and the King of Italy is to present him with a gold medal. Would it not be just to recognise, in some public manner, the great service rendered to geography by the organisers of the expedition, the proprietors of the *Telegraph* and *Herald ?*

COL. W. H. REYNOLDS has concluded a contract with the English Government by which the Post Office Department has adopted the Bell telephone as a part of its telegraphic system. In a recent telephonic experiment in connection with the cable 21¾ miles long, between Dover and Calais, there was not the slightest failure during a period of two hours. Though three other wires were busy at the same time, every word was heard through the telephone, and individual voices were distinguished. This important experiment was conducted by Mr. J. Bourdeaux, of the Submarine Telegraph Company. Some very successful experiments were made with the telephone on Saturday night between Aberdeen and Inverness, a distance of 108 miles. Songs and choruses were distinctly transmitted, and conversation was carried on at times with marvellous distinctness, notwithstanding the weather was unfavourable. The experiments were made with Prof. Bell's instruments. The Berlin correspondent of the *Daily News* states that a Berlin house is making a number of telephones for experimental use in the Russian army. The result is awaited with great curiosity in military circles. The *Cologne Gazette* denies that any telephone is in existence between Varzin and Bismarck's office at Berlin. Our contemporary says that the distance, 363 kilometres, is too large for using a telephone with any advantage.

ON Dec. 1 the council of the Paris Observatory held its second meeting for deliberating upon the improvements to be suggested to the Government. The existing regulations had been printed and distributed among members, who discussed them article by article, in order to better understand their bearing. M. Faye, the present Minister of Public Instruction and one of the councillors, did not resign his office. He merely intimated to his colleagues that he should not take part in the discussions so long as he should be obliged to remain a minister for the welfare of the commonwealth. Consequently it may be considered as certain that the Assembly will come to no conclusion so long as the political crisis does not permit the learned astronomer to resume his usual labours. M. Faye, whose voice will have great weight, is a strong supporter of the existing connection between astronomy and meteorology.

THE Society of Apothecaries have decided to offer two prizes for competition by young women under twenty years of age, in the science of botany. The prizes will consist of a gold and a silver medal and books, to be awarded to the first and second candidates respectively in order of merit. The Rev. M. J. Berkeley (the examiner for the prizes given by the Society to medical students) will conduct the examinations. The date of the examination and the conditions of competition will be published shortly.

A PRIZE of 1,000 Italian lire has been offered by the Committee of the Italian Alpine Club for the best description of any Italian mountain group.

THE Horseshoe at Niagara, the *New York Tribune* states, is now a right-angle rather than a curve. The rocks in the centre have been eaten away from year to year, and now the side walls are crumbling. On November 17 a large section of rock toward the Canada shore fell with a tremendous crash, and during the night a still larger area went down. The falls now wear a new face, and visitors will undoubtedly be charged twenty-five cents extra next season.

THE Russian Government has issued an ukase according to which Novaya Zemlya is to be colonised. The Norwegian journal *Tromsoeposten* now reports that on August 28 last six Russian sailing vessels arrived at Tromsoe, carrying the necessary building materials such as timber, bricks, and lime for the construction of six houses upon Novaya Zemlya. These houses were to be constructed during the course of the present autumn and are to be inhabited by six Samojede families, who will form the first colonial residents upon the island. The Russian Government hopes by the colonisation of Novaya Zemlya to be able to establish successfully a permanent commercial communication with the mouths of the Yenisei and Obi Rivers, while at the same time the new colony may form a convenient place of exile for political criminals.

THE deepest artesian well in the world is being bored at Pesth, and has reached already a depth of 951 metres. The well at Paris, which measures 547 metres has hitherto been the first. The work is undertaken by the brothers Zsigmondy, partially at the expense of the city, which has granted 40,000*l.* for the purpose, with the intention of obtaining an unlimited supply of warm water for the municipal establishments and public baths. A temperature of 161° F. is shown by the water at present issuing from the well, and the work will be prosecuted until water of 178° is obtained. About 175,000 gallons of warm water stream out daily, rising to a height of 35 feet. This amount will not only supply all the wants of the city, but convert the surrounding region into a tropical garden. Since last June the boring has penetrated through 200 feet of dolomite. The preceding strata have supplied a number of interesting facts to the geologist, which have been recorded from time to time in the Hungarian Academy of Sciences. Among some of the ingenious engineering devices invented during the course of the boring are especially noteworthy the arrangements for driving in nails at the enormous depth mentioned above, for pulling them out (with magnets), for cutting off and pulling up broken tubes, and above all, a valuable mechanical apparatus by means of which the water rising from the well is used as a motive power, driving the drills at a rate of speed double that previously imparted from the mouth of the well.

THE preliminary works for boring the British Channel Tunnel are being prosecuted with very great activity at Sangate. A shaft has been sunk to a depth of 100 metres, and the experimental gallery has been commenced. It is to be continued for a kilometre under the sea. If no obstacle is met with the work will be continued without any further delay. Two powerful pumps have been established for elevating the water which, of course, filters in in large quantity.

IN the French estimates for 1878 a supplementary credit of 5,000*l.* is asked for the learned societies in connection with the exhibition of 1878.

AN international exhibition is to be held at Milan in 1879.

AN excellent measure was decided on by M. Brunet, the late French Minister of Public Instruction. Special maps on the scale of $\frac{1}{100000}$ are to be designed of the country around each college, so that pupils when out walking, may be enabled to practice topography. These maps will extend to a radius of thirty kilometres from the college, and will be placed in the hands of masters.

THE Geographical Society of Paris will hold its anniversary meeting on December 19; a banquet will take place at the Grand Hotel on the 22nd.

THE administration of the Eastern Railway of France has intimated to the Geographical Society of Paris that orders will be given for inscribing on the wall of each station the altitude above the sea, the distance from Paris, the name of the chief town of the district, the name of the department, &c., &c. Thus railway travellers will learn the geography of France *nolens volens*.

IN last week's NATURE Mr. G. J. Hinde gave some details concerning the earthquake of November 4 in Canada. The *New York Tribune* gives some interesting details concerning the same earthquake in the States as well as subsequent earthquake phenomena. The shocks were felt in the east, in the west, and in the south. Commenting upon them the *Chicago Evening Journal* makes an interesting statement about the recent active condition of a little-known volcano in Nebraska. The latest earthquake shocks, it states, which especially affected Western Iowa, and were still sharper in North-eastern Nebraska and South-western Dacota, bring to mind the fact that the "Ionia Volcano," known to a few scientific investigators of the west as existing in the high bluffs near the little village of Ionia, in North-eastern Nebraska, is directly in the centre of the area traversed by the earthquake vibrations. Being in a retired spot, miles away from any line of travel, on the west bank of the Missouri River, in a bluffy region, the little volcano has attracted the attention of only a few of those who make such subjects a study, and hence is not mentioned, as we believe, in any of the works on geography or geology. The occurrence of the earthquake, with its key or centre at the Ionia volcano, makes worthy of remark the fact that for a few months past this little American Vesuvius has been unusually active. Its vapours have arisen almost constantly, and, for the first time since white men have viewed its action, these vapours have been easily distinguishable for a dozen or more miles away. The first of these disturbances of the earth's surface was perceived on November 4 by the inhabitants of Northern New Hampshire, Vermont, Western Massachusetts, Northern and Central New York, and Canada. The course of the shocks was from west to east. They were especially violent in the Adirondack Mountains region. On November 15 an earthquake shock was felt in the States of Kansas, Nebraska, and Iowa, and in Dakota Territory. The shock was a very severe one, and its effects were perceptible in most of the cities of the States mentioned. In Sioux City, Iowa, there were two earthquake waves, the second being the most powerful and immediately following the first. There was a continuous vibration lasting forty-five seconds. In Kansas the shock was noticed at Topeka and Atchison. At Topeka, in the Santa Fé depot, the employés felt the building rocking gently from north to south. On November 16, the day following the earthquake in the west, a violent earthquake shock was felt at Knoxville, Tenn. The shock was apparently only perceived at this place in the south, as there are no reports from any other southern city of such an occurrence.

NOTHING is as yet known about the Marquis Antinori and his expedition. The news of his death, which did not emanate, we believe, from the Italian Geographical Society, may therefore be considered as premature. Matteucci, who takes a lively interest in the fate of the Antinori expedition, will probably be able to gather more precise and definite information at Khartoum.

PROF. STOPPANI, the eminent Italian geologist, has been called to occupy the chair of geology at the Instituto Superiore of Florence. He delivered his opening discourse on Saturday, November 17, and will give exclusively public lectures during the whole following scholastic year.

THE "Science Primers" by Hooker, Balfour Stewart, and Geikie, have been translated into Italian by Profs. Pedicino, Cantoni, and Stoppani, and published in nicely-bound small volumes by the editor, U. Hoepli, of Milan.

THE enormous whale captured in the Gulf of Taranto in February last, has now been studied by Prof. Capellini, who found it to be a new species, to which he gives the name of *Balæna tarentina*.

WE are informed that Dr. Forsyth Major, of Florence, intends to publish a periodical for the "Zoology and Palæontology of Vertebrata," which will contain original articles in four languages. We cannot but wish the best success to Mr. Major's interprise, which is the first of the kind in Italy or anywhere else, we believe.

A NEW and perfectly mounted meteorological observatory, under the direction of Prof. Nardi, was inaugurated on Sunday, November 25, in the Seminary of Fiesole, near Florence. The funds for the same were subscribed by the Bishop of Fiesole and the Italian Alpine Club. Another observatory will shortly be opened under the care of the latter society, at Castel Piano, on Mount Amiato, near Siena. The number of meteorological stations in Italy thus amounts to about eighty, the greater part of which have been founded on the initiative, and by the support, of the Club Alpino, who deserve every praise for their continual and strenuous efforts to further and foster the study of meteorology in Italy.

A MOST elaborate monograph has been published by a distinguished Italian geologist, Prof. Baretti, on the geology of the large Alpine group known under the name of Gran Paradiso in the Graiian Alps.

IN the *Annali di Storia naturale del Museo Civico di Genova*, the illustrious traveller and botanist, Prof. O. Beccari, describes the wonderful gallery or bower-constructions of the *Amblyornis inornata*, observed by himself in the Arfak Mountains. The huts and gardens, as built and laid out by this bird, which is called "the gardener," seem to surpass any production of intelligence and taste for the beautiful hitherto described and observed in birds of the Paradise family.

ON the very rich collections made in, and sent over from, New Guinea by those intrepid and persevering champions of science, Messrs. O. Beccari and D'Albertis, Prof. Mantegazza has completed a series of anthropological and ethnographical studies, the first part of which are now being published in the *Archivio per l'Antropologia e la Etnologia*. It may be mentioned that the museum, founded by Prof. Mantegazza in Florence contains the largest known collection of Papuan skulls, the number of which exceeds two hundred.

THE additions to the Zoological Society's Gardens during the past week include a Vervet Monkey (*Cercopithecus lalandii*) from South Africa, presented by Mr. F. H. Taylor; a Green Monkey (*Cercopithecus callitrichus*) from West Africa, presented by Mr. J. R. Phillpotts; a Spotted Ichneumon (*Herpestes auropunctatus*) from Persia, presented by Mrs. Fleuss; a Common Ocelot (*Felis pardalis*), a Scarlet Ibis (*Ibis rubra*), a Fulvus Tree Duck (*Dendrocygna fulva*) from South America, presented by Mr. George Ransom; a long-eared Owl (*Asso otus*), European, presented by Mr. W. H. Millington; three Weeper Capuchins (*Cebus capucinus*), a Squirrel Monkey (*Saimaris sciurea*) from South America, two Cheer Pheasants (*Phasianus reevesii*) from North India, purchased; a Black-footed Fox (*Canis jubata*) and an Azara's Fox (*Canis azaræ*) from South America, deposited.

THE LIBERTY OF SCIENCE IN THE MODERN STATE[1]

III.

If what I have said before is true—that half-knowledge is more or less the characteristic of all naturalists, that in many, perhaps in most, of the lateral branches of their own science, even the naturalists themselves are only half-knowers; if later on I said that the true naturalist was distinguished by his being perfectly aware of the limit between his knowledge and his ignorance, then you understand, gentlemen, that also with regard to the public at large we must confine our claims to demanding that merely what every single investigator in his own direction, in his sphere, can designate as reliable truth which is common to all—that only this shall be admitted into the general plan of education.

In thus marking the confines of our knowledge we must remember before all things that what is generally termed natural science is, like all other knowledge in this world, composed of three totally different parts. Generally a difference is only made between *objective* and *subjective* knowledge, but there is a certain intermediate part—I mean *belief*—which also exists in science, with this difference only, that here it is applied to other things than in the case of religious belief. It is somewhat unfortunate, in my opinion, that the expression belief has been so completely monopolised by the church, that one can hardly apply it to any secular object without being misunderstood. In reality there is a certain domain of belief even in science, upon which the single worker no longer undertakes to prove what is transmitted to him as true, but where he instructs himself merely by means of tradition, just what we have in the church. I would like to remark on the contrary—and my conception has not been contradicted by the church—that it is not belief alone which is taught in the church, but that even ecclesiastical dogmas have their objective and their subjective sides. No church can avoid developing in the three directions I have pointed out: in the middle the path of belief, which is certainly very broad, but on the one side of which there is a certain quantity of objective historical truth, and on the other a variable series of subjective and often very fantastic ideas. In this the ecclesiastical and the scientific doctrines are alike. The cause of this is that the human mind is a simple one, and that it carries the method which it follows in one domain finally into all the others as well. But we must be aware at all times how far each of the directions mentioned extends in the different domains. Thus, for instance, in the ecclesiastical domain—it is easier to show it in this one—we have the real dogma, the so-called positive belief; about this I need not speak. But each creed has its peculiar historical side. It says: this has happened, this has occurred, these events have taken place. This historical truth is not simply handed down, but in the garb of an objective truth it appears with certain proofs. This is the case with the Christian religion just as much as with the Mohammedan, with Judaism just as much as with Buddhism. On the other side we find the left wing as it were, where subjectivity reigns; there the single individual dreams, there visions come and hallucinations. One religion promotes them by special drugs, another by abstinence, &c. Thus subjective individual currents are developed, which occasionally assume the shape of perfectly independent phenomena existing by the side of and apart from the previous ecclesiastical domain, which at other times are rejected as heresies, but which often enough lead into the large current of the recognised church. All this we find again in natural science. There too we have the current of the dogma, there too we have the currents of the objective and subjective doctrines. Consequently our task is a compound one. First of all we always try to reduce the dogmatic current. The principal aim of science has for centuries been to strengthen more and more the right, the conservative side. This side, which collects the *ascertained facts* with the *full consciousness of proof*, this side, which adheres to *experiment as the highest means of proof*, this side, which is in possession of the real scientific treasury, has always grown larger and broader, and this principally at the expense of the dogmatic stream. Really, if we only consider the number of natural sciences which since the end of last century have grown and now flourish, we must admit that an almost incredible revolution has taken place.

There is no science in which this is so eminently evident as in medicine, because it is the only science, which has a continuous history of nearly 3,000 years. We are, so to speak, the patriarchs of science, inasmuch as we have the dogmatic current at its longest. This current was so strong, that in the early part of the middle ages even the catholic church embraced it, and the heathen Galen appeared like a father of the church in the ideas of men; indeed, if we read the poems of that period, he often presents himself exactly in the position of a church dignitary. The medical dogma went on until the time of the Reformation. As contemporaries of Luther, Vesal and Paracelsus came and made the first grand attempts at reduction, they drove piles into the dogmatic stream, constructed dykes by its sides, and left only a narrow fair-way to it. Beginning from the sixteenth century it has grown narrower and narrower every century, so that finally only a very small channel has remained for the therapeutists. Thus vanishes the lordliness of the world.

Only thirty years ago the Hippocratic method was spoken of as something so sublime and important that nothing more sacred could be imagined. Nowadays we must own that this method is annihilated nearly down to its root. At least, a good deal of imagination is necessary if we say that any physician of the present day acts as Hippocrates did. Indeed, if we compare the medicine of to-day with the medicine of the year 1800—accidentally the year 1800 marks a great turning-point in medicine—then we find that our science has undergone a complete reformation during the last seventy years. At that time the great Paris school was formed, immediately under the influence of the French Revolution, and we must admire the genius of our neighbours that enabled them to find all at once the fundamental basis of an entire new discipline. If now we see medicine continue its development in the greater breadth of objective knowledge, we will never forget that the French were the precursors, as in the middle ages the Germans were.

By our own example I only wished to show you shortly what changes both the methods and the storehouse of knowledge undergo. I am convinced that in medicine, at the end of the present century, only a sort of clay-pipe system will have remained, through which the last weak waters of the dogmatic stream may move—a sort of drainage. For the rest the objective current will probably have entirely consumed the dogmatic one.

Perhaps the subjective one will remain as well. Perhaps even then many an individual will dream his beautiful dreams. The field of objective facts in medicine, great as it has become, has yet left such a number of lateral fields, that for anybody who *wants* to speculate, plenty of opportunities offer daily. And these opportunities are honestly made use of. A multitude of books would remain unwritten if only objective things were to be communicated. But the subjective wants are still so great, that I believe I am justified in maintaining that of our present medical literature about one half might safely remain unpublished, without doing any damage worth mentioning to the objective side.

Now when we *teach*, in my opinion, we ought not to look upon this subjective side as an essential object in the doctrine. I believe I now belong to the oldest professors of medicine; I have taught my science now for over thirty years, and I may say that during these thirty years I have honestly striven by myself to free my mind more and more from all subjective tendency, and to get more and more into the objective current. Nevertheless I openly confess that I find it impossible to give up subjectivity altogether. Every year I see again and again that even in points, where I had believed myself to be entirely objective, I still retained a large number of subjective ideas. I do not go so far as to make the inhuman demand that everybody is to express himself entirely without any subjective vein, but I do say that we must set ourselves the task to transmit to the students the real knowledge of facts in the first place, and if we go further, we must tell them each time: "but this is not proved, but this is *my* opinion, *my* idea, *my* theory, *my* speculation."

This, however, we can only do with those who are already educated and developed. We cannot carry the same method into the elementary schools, we cannot say to each peasant boy, "This is a fact, this we know, and that we only suppose." On the contrary, that which is known, and that which is only supposed, as a rule get so thoroughly mixed up that that which is supposed becomes the main thing, and that which is really known appears only of secondary importance. Therefore we who support science, we who live in science, are all the more called upon to abstain from carrying into the heads of men, and most of all into the heads of teachers, that which we only suppose. Certainly, we cannot give facts only as raw material, that is impossible. They must be arranged in a certain systematic

[1] Address delivered at the Munich meeting of the German Association, by Prof. Rudolf Virchow, of Berlin. Continued from p. 94.

order. But we must not extend this arrangement beyond what is absolutely necessary.

This is a reproach which I cannot help making against Prof. Nägeli as well. Prof. Nägeli has discussed, certainly in the most measured way and—you will notice this if you read his address—in a thoroughly philosophical manner, the difficult questions which he has chosen as subjects for his address. Nevertheless he has taken a step which I consider extremely dangerous. He has indeed done in another direction what is in one way done by *generatio æquivoca.* He asks that the mental domain shall be extended not only from animals to plants, but that finally we shall actually pass from the organic world into the inorganic with our conceptions of the nature of mental phenomena. This method of thinking, which is represented by great philosophers, is natural in itself. If anyone wants by any means to connect mental phenomena with those of the rest of the universe, then he will necessarily come to transfer the mental processes, as they occur in man and the animals of highest organisation, to the lower and lowest animals; afterwards a soul is even ascribed to plants; further on the cell thinks and feels, and finally he finds a passage down to chemical atoms, which hate or love one another, seek one another, or flee from one another. All this is very fine and excellent, and may after all be quite true. It *may* be. But then, do we really want, is there some positive scientific necessity, to extend the domain of mental phenomena beyond the circle of those bodies, in which and by which we see them really happening? I have no objection if carbon atoms have a mind as well, or that they obtain a mind in their union with the plastidule association, but *I do not know in what I am to recognise this.* It is simply playing with words. If I declare attraction and repulsion to be mental occurrences, to be mental phenomena, then I simply throw the mind (*die Psyche*) out of the window; then the mind ceases to be mind. The phenomena of the human mind may eventually be explained in a chemical way, but for the present, I think, it is not our task to mix up these domains. On the contrary, it is our duty to keep them strictly where we understand them to be. And as I have always laid stress upon this, that we should not in the first line try to find the *transition* from the inorganic into the organic, but that we should first of all determine the *contrast* between the inorganic and the organic, and carry on our investigations among those contrasts in the same way, I now maintain that the only way to progress—and I hold the firmest conviction that we shall not advance at all otherwise—is to limit the domain of mental phenomena where we really perceive mental phenomena, and not to *suppose* mental phenomena, where perhaps they *may* be, but where we do not notice any visible, audible, sensible, in one word, *perceptible* phenomena, which we might call mental ones. There is no doubt that for us the whole sum of mental phenomena is attached to certain animals, not to the totality of all organic beings, not even to all animals generally, and I maintain this without hesitation. We have no reason yet to say that the lowest animals possess mental characteristics; we find them only with the higher animals, and with perfect certainty only with the highest.

Now I will admit with pleasure that certain gradations, certain gradual transitions, certain points can be found, where from mental phenomena one gets to phenomena of simply material or physical nature. I certainly do not declare that it will never be possible to bring psychical phenomena into immediate connection with physical ones. All I say is, that *at present* we are not justified in setting down this *possible* connection as a scientific *doctrine*, and I must distinctly oppose the attempts to enlarge our doctrines prematurely in this manner, and to bring again and again into the foreground as a positive statement what we so often proved a useless problem. We must distinguish strictly between what we want to teach and what we want to investigate. What we investigate are problems. We need not keep them to ourselves; we may communicate them to the whole world and say, There is the problem, this is what we are trying to find; like Columbus, who, when he started to discover India, made no absolute secret of it, but who eventually did not find India, but America. And the same happens to us not rarely. We start to prove certain problems which we suppose to be perfectly correct, and in the end we find something quite different, which we never expected. The investigation of such problems, in which the whole nation may be interested, must be open to everybody. That is the *liberty of research.* But the problem is not at once to be the object of instruction. When we teach we must confine ourselves to those smaller domains which are already so large, and which we have actually mastered.

Gentlemen, I am convinced that only with a resignation of this kind, which we impose on ourselves, which we exercise towards the rest of the world, shall we be enabled to conduct the fight against our enemies with a victorious result. All attempts to transform our problems into doctrines, to introduce our theories as the basis of a plan of education, particularly the attempt simply to depose the church, and to replace its dogma by a religion of descent without further trouble, these attempts, I say, must fail, and their failure would at the same time bring the greatest dangers upon the position of science generally.

Therefore let us be moderate, let us exercise resignation, so that we give even the most treasured problems which we put forth, always as problems only, and that we say it a hundred and again a hundred times: "Do not take this for confirmed truth, be prepared that this may perhaps be changed; only for the moment we are of opinion *that it may be true.*"

By way of illustration I will add another example. At this moment there are probably few naturalists who are not of opinion that man is allied to the rest of the animal world, and that a connection will possibly be found, if indeed not with apes, then perhaps in some other direction, as is now the opinion of Prof. Vogt.

I acknowledge openly that this is a desideratum of science. I am quite prepared for it, and I would not for a moment wonder nor be alarmed if the proof were found that the ancestors of man were vertebrate animals. You know that just at present I work by preference in the field of anthropology, but yet I must declare that every step of positive progress which we have made in the domain of prehistoric anthropology, has really moved us further away from the proof of this connection. At this moment anthropology studies the question of fossil man. From man in the present "period of creation" we have descended to the quaternary period, to that period when, as Cuvier maintained with the greatest confidence, man never existed at all. Nowadays quaternary man is a generally accepted fact. Quaternary man is no longer a problem, but a real doctrine. But tertiary man is a problem—of course a problem which is already in a stage of material discussion. There are objects already about which discussions are going on as to whether they may be admitted as proofs for the existence of man during the tertiary period. We do not merely speculate on the subject, but we discuss certain objects, whether they may be recognised as witnesses for the activity of man during the tertiary period. The question raised is answered differently according to whether these objective material elements of proof are considered sufficient or not. Even men who, like Abbé Bourgeois, are decided ecclesiastics, are convinced that man has lived during the tertiary period; for them tertiary man is already a doctrine. For us, who are of a more critical nature, tertiary man is still a problem, but, as we must acknowledge, a problem worthy of discussion. Let us therefore for the present remain at quaternary man, whom we really find. If we study this quaternary, fossil man, who ought after all to stand nearer to our ancestors in the series of descent, or rather of ascent, we find a man just the same as we are ourselves.

Only ten years ago, when a skull was found, perhaps in peat or in lake dwellings, or in some old cave, it was believed that wonderful marks of a wild and quite undeveloped state were seen in it. Indeed we were then scenting monkey air. But this has died out more and more. The old troglodytes, lake inhabitants, and peat people turn out to be quite a respectable society. They have heads of such a size that many a person living would feel happy to possess one like them. Our French neighbours have certainly warned us not to conclude too much from these big heads; it may be possible that they were not filled only with nerve-substance, but that the old brains had more intermediary tissues than is the case now-a-days, and that their nerve-substance in spite of the size of the brain, remained at a low state of development. However this is only a friendly conversation which to some extent is held as a support of weak minds. On the whole we must really acknowledge that all fossil type of a lower human development is absolutely wanting. Indeed if we take the total of all fossil men that have been found hitherto and compare them with what the present offers, then we can maintain with certainty that amongst the present generation there is a much larger number of relatively low-type individuals than amongst the fossils hitherto known. That only the highest geniuses of the quaternary period enjoyed the good fortune of being preserved for us I do not dare to suppose. As a rule we draw conclusions from the condition of a single fossil object with respect to the majority of others which have not been found. But I will not do this. I will not maintain that the whole race was as good as the few skulls which were found. But I must say that one fossil monkey-skull or man-ape skull which really belonged to a human proprietor has never been found. Every addition which we have obtained in the material inventory of objects for discussion has moved us further away from the problem to be solved. Now of course we cannot avoid the consideration that perhaps it was on some quite special spot of the earth that tertiary man lived. This is quite possible, since during the last few years the remarkable discovery has been made in North America that the fossil ancestors of our horses occur in countries from which the horse had entirely disappeared for a long time. When America was discovered there were no horses there at all; in the very place where the ancestors of our horses had lived no living horse had remained. Thus it may also be that tertiary man has existed in Greenland or Lemuria, and will again be brought to light from under the ground somewhere or other. But as a fact we must positively acknowledge that there is always a sharp limit between man and the ape. *We cannot teach, we cannot designate it as a revelation of science, that man descends from the ape or from any other animal.* We can but designate this as a problem, may it seem ever so probable and may it lie ever so near.

We ought to be sufficiently warned by the experiences of the past, at a time when we are not justified in drawing conclusions, not unnecessarily to burden ourselves with the obligation, or yield to the temptation of drawing them all the same. Look you, gentlemen, it is in this that the difficulty lies for every naturalist who speaks to the world at large. Whoever speaks or writes for the public, ought, in my opinion, doubly to examine just now, how much of that which he knows and says is objective truth. He ought to try as much as possible to have all inductive extensions which he makes, all progressing conclusions by the laws of analogy, however probable they may seem, printed in small type underneath the general text, and to put into the latter only that which really is objective truth. In that case we might perhaps succeed in gaining an always increasing circle of followers, in obtaining an always increasing number of fellow-workers, and in causing the educated public to continue to take part in that fertile manner in which it has already taken part in many domains. Otherwise, gentlemen, I fear that we overrate our power. Certainly old Bacon said with perfect justice, *scientia est potentia*, knowledge is power. But he has also defined knowledge, and the knowledge which he meant was not speculative knowledge, not the knowledge of problems, but it was the objective knowledge of facts. I think that we should abuse our power, we should endanger our power, if in our teaching we do not fall back upon this perfectly justified, perfectly safe, and impregnable domain. From this domain we may as investigators make our excursions in the direction of problems, and I am convinced that every attempt of this kind will then find the necessary safety and support.

AMERICAN SCIENCE

THE principal paper in the *American Journal of Science and Arts* for November, is Prof. Marsh's able address at the recent meeting of the American Association, on the Introduction and Succession of Vertebrate Life in America, which we have given at length. —Discussing the question, Is the existence of growth rings in the early exogenous plants proof of alternating seasons? Dr. Warring concludes from observations, that some exogens form rings at intervals much less than a year; others require intervals of several years, and some form no rings. The presence or absence of rings in exogens occurs in all climates. Large and well-defined rings are found where there is absolutely no appreciable variation of temperature or moisture throughout the year. An exogen naturally forming rings will continue to form them, although the climate become uniform throughout the year. Thus the existence of these markings in ancient flora gives no information as to the existence at that time of seasons, and so far as they are concerned we are left free to adopt any conclusion as to inclination of the earth's axis, which may appear most reasonable. —Some years ago Prof. Newcomb showed that the improvements introduced into the theory of the moon's mean motion by Hanssen's lunar tables did not extend to the inequalities of long period in that motion. While Hanssen, by an empirical term had secured a very good agreement with observations from 1750 to 1860, this agreement was found to have been obtained by sacrificing the agreement before 1750, and the moon had then begun to deviate from the tables at such a rate that they could not continue satisfactorily to represent the observations. Prof. Newcomb has since attempted a complete discussion of all recorded observations of any astronomical value before the year 1750, and his suspicion has been entirely confirmed. The results of this examination are communicated. Comparing a theory of the moon's mean motion founded on gravity alone, with the observations, he is led to suppose that the deviations may be due to the action of some of the bodies of the solar system. He corrects Hanssen's term by an empirical addition.—Prof. Dana contributes to the number a note on the Helderberg formation of Bernardston, Massachusetts, and Vernon, Vermont, and Mr. Mallet describes "Serpylite," a new niobate, from Amherst County, Virginia.

The *New York Tribune* states that the Johns Hopkins Scientific Association has recently been organised in Baltimore. Prof. Sylvester is president, Prof. Remsen, vice-president, Dr. Story, secretary. A great feature in the programme is that the essays presented are to be short and concise, and to contain the particulars of original research exclusively. There is also to be a discussion of new scientific publications, both foreign and domestic, at the meetings, of which the first has been held, with a score of members present.

Under date November 20, the *Tribune* has the following telegram from Washington:—Messrs. S. H. Scudder of Cambridge, and F. C. Bowditch, of Boston, have just returned from a two months' tour in Colorado, Wyoming, and Utah, where, under the direction of Dr. Hayden, they have been exploring for fossil insects and collecting specimens especially in the high regions. They report having secured many specimens of fossil insects at different points along the railways from Pueblo to Cheyenne, and from Cheyenne to Salt Lake, as well as at Lakin, Kansas, and Garland, and Georgetown, Col., and in various parts of the South Park and surrounding region. Their time was so limited that they were unable to visit White River and explore the beds of fossil insects) known to exist there. Ten days were spent at Green River, and in that vicinity, in exploring the tertiary strata for fossil insects, but with very unsatisfactory results. Near Florisante the tertiary basin was found to be exceedingly rich in insects and plants. Mr. Scudder spent several days in the careful survey of this basin, and estimates that the extent of the insect-bearing shales there is at least fifty times as great as that of those in Southern Bavaria. Six or seven thousand specimens of insects, and 2,000 or 3,000 of plants have already been received from Florisante, and as many more are expected before the close of the year. Arrangements were also made with persons who have found a new and rich deposit of fossils in the tertiary strata in Wyoming to forward all the specimens obtained there. Mr. Scudder believes that the tertiary strata of the Rocky Mountain region are richer in the remains of fossil insects than any others in the world, and that within the next few months the amount of material at hand for the study of the subject will be greater than was ever before possessed by any single naturalist. Prof. Joseph Leidy, the comparative anatomist and microscopist, has also recently returned from his second visit to the west, under the direction of Dr. Hayden. His field of operations during the past season was the country about Fort Bridger, Unitah Mountains and the Salt Lake Basin. The specimens he has collected comprise the lowest and simplest forms of animal life, the most minute requiring high microscopic power to distinguish their structure.

THE METEOR

WE have received some further communications concerning this remarkable phenomenon, and some interesting details concerning a similar body will be found in our "Astronomical Column." Mr. A. O. Walker writes from Chester:—

In reading the notice of the meteor of November 23 in NATURE, vol. xvii. p. 94, I am surprised to see no mention of any report from it. As I only heard it without seeing it I send you the notice of it from my diary, written immediately after the occurrence:—

"About 8.30 P.M. heard a loud report like that of a cannon (say 32 lbs.), fired about 200 yards off, which shook the house, and the servants saw a bright flash. The sky overhead was quite clear and only cloudy on the horizon south and east. Thought it was the explosion of an aerolite."

Next day I made inquiries and added the following:—

"Parry and Field said the flash was blue, and five minutes elapsed between the flash and bang. Parry's girl was outside, and came in crying; said she had seen 'a very funny kind of lightning.' Parry remarked it shook his door."

The two men named above are in my employ, and live about 300 yards from my house. Some friends of ours living about two miles from us also saw the flash and heard the report, but the latter not so loud as we did. They described it as sounding as if a bird had flown against the window."

I give the above extracts *verbatim*, as first impressions, uninfluenced by what one hears or reads subsequently, are much the most valuable.

Dr. S. Drew, of Chapeltown, Sheffield, writes as follows:—

I send you the following calculations as to the meteor of November 23. They may interest some of your readers. The estimates are only intended as approximate, as the observations at different points of view were too vague for much accuracy, and indeed, in two instances, obviously quite unreliable.

The visible course of the meteor appears to have been from a point about 150 miles above the town of Worksop to the Irish Channel, north-west of Liverpool, probably nearly half-way between Liverpool and the Isle of Man—a direction from east by south to west by north, the horizontal distance traversed being rather over 100 miles and the perpendicular 150 miles. The size of the fire-ball before breaking up was about 150 yards in diameter. By this is meant the size of the luminous sphere, not that of the actual bolide, which would be much less.

The rate of motion was near twenty miles per second in horizontal, and thirty miles in perpendicular; as this in horizontal is little more than would be caused in appearance by the orbital and diurnal motion of the earth, it is evident that the proper motion of the meteor was nearly perpendicular to the earth's surface; and, if belonging to the solar system, it must have moved in a very eccentric orbit, stretching far beyond that of the earth. The meteor broke at an elevation of about fifty miles, and then appeared much larger. The fragments must have dropped into the sea.

Was it seen from Ireland or the Isle of Man?

S. A. K. writing to the *Manchester Courier* from Blackpool states that about 8.30 P.M. on the 23rd he beheld a ball of a pale blue colour shoot across the sky from east to west, followed by a train of rainbow lines, brilliant beyond description. "It was over in a moment; but as I and several others stood discussing the phenomenon we had just witnessed, two muffled booms as of far-distant cannon were distinctly heard in the west, after an interval of two or three minutes." Capt. Tupman writes from the Royal Observatory, Greenwich, to the *Times*: "There is reason to suppose that the great meteor which appeared at 8.20 P.M. on Friday last (November 23) fell into the sea near the mouth of the river Dee. From its splendour it was probably seen by many persons near the shores of North Wales, Cheshire, and Lancashire, whose observations would be of the greatest value; and I venture to solicit the publicity of your columns in order that such observations may be forwarded here. On Tuesday night (Nov. 27), at 10.26, G.M.T., I observed another pass slowly from a point about 6° over Castor to 5° left of Sirius. It remained in sight fifteen or sixteen seconds, determined by counting. Towards the end it became faint, of a dull red colour, and moved with extreme slowness. I have no doubt it must have appeared very large to observers near Dover and in Normandy, and it is to be hoped its path has been recorded elsewhere."

A meteor was observed at Strassburg on November 23, the very day when the meteor was observed in England, but the time was a little after six o'clock (local time), and the direction from north to south. A violent detonation was heard, but without any resemblance to that of thunder. The light was as vivid as ordinary lightning at Strassburg. A witness states that he saw the meteor falling at a small distance from him (three or four metres) in a wood belonging to the Chevaudier de Valdrome on the new road leading from Lorquin to the French frontier. All the trees were illuminated as if by daylight. It is not reported by the *Strassburg Gazette* whether any stone was found on the spot.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The Brackenbury Scholarship in physical science has been awarded to Mr. Cunningham, Balliol College.

LONDON.—The Council of University College have awarded the Sharpey Physiological Scholarship to Mr. Patrick Geddes and the Joseph Hume Scholarship in Political Economy of 20*l.* per annum for three years to Mr. J. G. Schurman.

EDINBURGH.—A public meeting, under the presidency of the Right Hon. the Lord Provost, was held on the 29th ult. at Edinburgh to advocate the claims of the Edinburgh University Buildings Extension Scheme. The cost of the new medical school, &c., will be about 187,000*l.*, and of that sum 82,000*l.* has been subscribed by the public and 80,000*l.* has been promised by Government on condition that the remaining 25,500*l.* be subscribed before the end of next year. It was announced that about 10,000*l.* of this has been promised, leaving upwards of 14,000*l.* still to be raised. In support of the appeal it was mentioned that in some class-rooms there is not sitting room for the students. The number of students is increasing every year, there being at present enrolled 212 more than at the same time last year, so that before the summer session is over there will probably be close on 2,500 students matriculated.

The first meeting of the fourth session of the Chemical Society of the University was held in the University on November 28, the president, Prof. A. Crum Brown, in the chair. The president gave an introductory lecture on the "Life and Works of Dr. Joseph Black." The following office-bearers were elected for the ensuing season:—President—Prof. A. Crum Brown; Vice-Presidents—J. Gibson, Ph.D., F.R.S.E., W. Inglis Clark, B.Sc.; Secretary—J. Adams; Treasurer—C. Maxwell, R.N. The society numbers fifty-two members, and ten new members were proposed.

MANCHESTER.—A Chemical Society has been commenced at the Owens College. The society is intended to include all students of science at the College—Dalton Scholars, Associates, and a few others connected now, or in the past, with the Science Classes of Owens College. The society was opened on Wednesday evening by an address from Prof. Thorpe, F.R.S. on "Robert Boyle and the Sceptical Chemist." The Syllabus of the society for the session is as follows:—"Are the Elements Elementary?" by Mr. Pattison Muir; "Graham," by Mr. P. P. Bedson, B.Sc.; "Berzelius," by Mr. J. K. Crow, B.Sc.; "Alkali Manufacture," by Mr. Bevan: "Crystallisation," by Mr. Baker; "Liebig," by Mr. C. F. Cross; "Valensy," by Mr. O'Shea; "Chemical Industry of Japan," by Mr. Siguira; and a paper, subject not settled, by Prof. Gamgee. It is hoped and believed that the society will tend to increase the interest in scientific pursuits already manifested by members of the College.

FRANCE.—A number of important measures have been taken by the French Minister of Public Instruction for fostering the zeal of students and professors in the several French faculties. By a decree issued on November 5 a number of scholarships have been created in each academy at the expense of the public exchequer. In future years scholars are to be appointed after having passed special examinations similar to those for exhibitions in the English universities. Exceptions are created in favour of students who have been particularly successful in taking their preliminary degrees and have published approved papers in the Academical *Transactions*, or have rendered special services in tuition. For the present year the different scholarships are to be granted by a special commission. Three of these commissions have been established—one for letters, another for science, and the third for medicine. These scholarships are to be continued only for a limited time, varying from two to four years, but are to be stopped at once if the scholar does not give satisfaction to the professors or lecturers. A part of these scholarships is to be granted to candidates for the mastership of arts (Licencié-ès-Lettres and ès-Sciences), and another part to the masters in several faculties wishing to take the highest honours in their respective faculties. By another decree, published on the same day, M. Brunet has created a number of lectureships styled "conferences." A number of the lecturers are to act as public tutors, helping public professors in their duties. Other lectureships are to be granted to professors teaching supplementary sciences which, up to the present time, have not come within the limits of the official programme. The salary of all of them is 120*l.*, and they are to be appointed yearly from among doctors or members of the academies. In some peculiar cases Masters of Arts are eligible to these lectureships. The new organisation is expected to work during the present classical year.

SOCIETIES AND ACADEMIES

LONDON

Geological Society, November 7.—Prof. P. Martin Duncan, F.R.S., president, in the chair.—Stephenson Clarke, William Hunter, and the Rev. W. Roberts, were elected Fellows of the Society. The following communications were read: A letter dated September 14 was read, from Lord Derby, stating that his lordship had received a despatch from her Majesty's Minister at Tehran, reporting that a mining engineer had arrived there from Berlin, who, at the request of the Persian government, had been selected by Messrs. Siemens to ascertain what foundation there was for the reported existence of a rich vein of gold in the vicinity of Zengan; that he had visited the locality and reported that auriferous quartz does exist, but that he had not yet succeeded in finding any vein or deposit of the metal.—Notes on fossil plants discovered in Grinnell Land by Capt. H. W. Feilden, Naturalist to the English North Polar Expedition, by Prof. Oswald Heer, F.M.G.S. Near Discovery Harbour, where H.M.S. *Discovery* wintered in 1875-6, in about 81° 45′ N. lat., and 64° 45′ W. long., a bed of lignite, from twenty-five to thirty feet thick, was found, resting unconformably upon the azoic schists of which Grinnell Land chiefly consists. The lignite was overlain by black shales and sandstones, the former containing many remains of plants; and above these there were, here and there, beds of fine mud and glacial drift, containing shells of marine mollusca of species now living in the adjacent sea. This glacial marine deposit occurs up to levels of 1,000 feet, indicating a depression and subsequent elevation of the region to at least this extent. Remains of twenty-five species of plants were collected by Capt. Feilden, and eighteen of these are known from miocene deposits of the Arctic zone. The deposit is therefore no doubt miocene. It has seventeen species in common with Spitzbergen (78° 79′ N. lat.), and eight species in common with Greenland (70° 71′ N. lat.). With the miocene flora of Europe it has six species in common; with that of America (Alaska and Canada) four; with that of Asia (Sachalin) four also. The species found include two species of *Equisetum*, ten Coniferæ, *Phragmites œningensis*, *Carex noursoakensis*, and eight dicotyledons, namely, *Populus arctica*, *Betula prisca*, and *Brongniarti*, *Corylus macquarrii* and *insignis*, *Ulmus borealis*, *Viburnum nordenskiöldi*, and *Nymphæa arctica*. Of the Conifers, *Torellia rigida*, previously known only by a few fragments from Spitzbergen, is very abundant, and its remains show it to have been allied to the Jurassic genera *Phœnicopsis* and *Bæiera*, the former in its turn related to the carboniferous *Cordaites*, and among recent conifers, to *Podocarpus*. Other conifers are, *Thuites ehrenswärdi* (?), *Taxodium distichum miocenum* (with male flowers), *Pinus feildeniana* (a new species allied to *P. strolbus*), *Pinus polaris*, *P. abies* (twigs covered with leaves), a species of *Tsuga Pinus dicksoniana*, Heer.), and a white spruce of the group of *Pinus grandis* and *cariocarpa*. *Pinus abies*, which occurs here and in Spitzbergen, did not exist in Europe in miocene times, but had its original home in the extreme north, and thence extended southwards; it is met with in the Norfolk forest-bed, and in the interglacial lignites of Switzerland. Its present northern limit is 69½° N., and it spreads over 25° of latitude. *Taxodium distichum*, on the contrary, spread in miocene times from Central Italy to 82° N. latitude, whilst at present it is confined to a small area. *Betula brongniarti*, Ett., is the only European species from Grinnell Land not previously known from the arctic zone. The thick lignite bed of Grinnell Land indicates a large peat-moss, probably containing a lake in which the water-lilies grew; on its muddy shores stood the large reeds and sedges, the birches, poplars, *Taxodia*, and *Torelliæ*. The drier spots and neighbouring chains of hills were probably occupied by the pines and firs, associated with elms and hazel bushes. A single elytron of a beetle (*Carabites feildenianus*) is at present the sole evidence of the existence of animals in this forest region. The nature of the flora revealed by Capt. Feilden's discoveries seems to confirm and extend earlier results. It approaches much more closely to that of Spitzbergen than to that of Greenland, as might be expected from the relative positions of the localities; and the difference is the same in kind as that already indicated by Prof. Heer between Spitzbergen and Greenland, and would indicate the same kind of climatic difference. Nevertheless, the presence of *Taxodium distichum* excludes arctic conditions, and that of the water-lily indicates the existence of fresh-water, which must have remained open a great part of the year. Representatives of plants now living exclusively in the arctic zone are wanting in the Grinnell Land deposits; but, on the other hand, most of the genera still extend into that zone, although they range in Grinnell Land from 12° to 15° further north than at present.—On our present knowledge of the invertebrate fauna of the lower carboniferous or calciferous sandstone series of the Edinburgh neighbourhood, especially of that division known as the Wardie Shales, and on the first appearance of certain species in the beds, by Mr. R. Etheridge, jun., F.G.S.

Zoological Society, November 20.—Prof. Flower, F.R.S., vice-president, in the chair.—Mr. Howard Saunders exhibited a specimen of the rare Aleutian Tern (*Sterna aleutica*) from Alaska, and made remarks upon its intermediate position between typical *Sterna* and the group of the Sooty Terns (*Onychoprion*).—A communication was read from the Marquis of Tweeddale, F.R.S., containing an account of a collection of birds made by Mr. A. H. Everett in the Island of Zebu, Philippines. Six new species were found in this collection, and were named *Oriolus assimilis*, *Phyllornis flavipennis*, *Zosterops everetti*, *Prionochilus quadricolor*, *Turnix nigrescens*, and *Megapodius pusillus*.—Three communications were read from Dr. O. Finsch, C.M.Z.S. The first contained a report on a collection of birds made at Eua, Friendly Islands, by Mr. F. Hübner, which had increased our knowledge of the avifauna of Eua from four to twenty-four species. The second contained a description of a collection of birds made on the Island of Ponapé, Eastern Carolinas, by Mr. J. Kubary. The total number of species known at present from Ponapé was stated to be twenty-nine, of which seven were peculiar to the island. The third contained a list of the birds obtained at Ninafou Island in the Pacific, by Mr. F. Hübner. This collection raised the number of the known birds of this island from one to twenty.—Prof. Garrod, F.R.S., read notes on the *Taenia* of the rhinoceros of the Sunderbunds *Plagiotaenia gigantea*), on the anatomy of the Chinese water-deer (*Hydropates inermis*), on the possible cause of death in a young seal, and on the occurrence of a gall-bladder in certain species of parrots.—Mr. Howard Saunders, F.Z.S., read a paper on the *Laridæ* collected during the voyage of H.M.S. *Challenger*, which comprised nine species of *Sternæ*, five of *Larinæ*, and three of *Stercorarinæ*, altogether seventeen species represented by forty-given specimens; several of these were very rare in museums, although none of them were absolutely new to science.—A communication was read from Dr. A. B. Meyer, containing some additional proofs of the fact that the Red *Eclecti* are the females of the green species of that genus.—A paper was read by Mr. G. French Angas, C.M.Z.S., containing notes on *Helix sepulcharalis* of Ferrusac, and its allies, with descriptions of two new species.

Physical Society, November 17.—Dr. Stone, vice-president, in the chair.—The president, Prof. G. C. Foster, described and exhibited a very simple form of absolute electrometer, which acts on the same principle as Sir W. Thomson's trapdoor form of apparatus, but can be constructed at a very moderate cost. To one arm of a balance is suspended by silk fibres a zinc disc, which hangs horizontally in the plane of a sheet of the same metal forming a guard-plate; and at a distance of about one inch below is a flat sheet of zinc, also horizontal. An electrical connection is formed between the guard-plate and suspended disc by a bridge of very fine wire. The method of using the apparatus to determine the potential required for a spark to pass from a Holtz machine through varying thicknesses of air was explained. When the balance has been accurately counterpoised, an excess weight, say one gramme, is introduced into the scale pan, and the guard-plate and the lower attracting-plate, as well as the two knobs of a spark-measurer, are connected with the conductors of the machine. If this be now set in action, and the knobs of the spark-measurer be gradually separated, a point will be reached at which the attraction upon the suspended disc just overcomes the excess weight in the balance pan. The length of spark for which this occurs can now be read off. The difference of potential causing the spark is given by the formula $\frac{e}{a}\sqrt{8F}$, where a is the radius of the attracted disc, e its distance from the attracting-plate, and F the force of attraction in dynes. In the apparatus exhibited, a had the value 5·195 cm., and e the value 2·4 cm., whence, if w be the excess weight in grammes—so that $F = 981\,w$—the difference of potential becomes $39\sqrt{w}$. The proper action of the apparatus depends essentially upon the attracted disc being accurately in the same plane with the guard-plate. To facilitate this adjustment, each of the silk fibres by which the disc is suspended is attached to a screw, by which it can be separately raised or lowered; and by means of another screw the small brass plate holding the suspending screws can be raised or lowered as a whole. A few numerical results were given to illustrate the action of the apparatus. These were taken from a set of experiments in which the difference of potential needed to produce sparks in air between two equal brass spheres of 2·61 cm. radius was measured. The following are the results for a few of the shortest and longest sparks measured:—

Length of Spark.	Difference of Potential.	Mean Electrical Force.
cm.		
0·1325	17·4	131
0·1825	20·4	117
0·237	24·6	104
0·68	62·9	93
0·71	65·2	92
0·74	68·7	93

Vienna

Imperial Academy of Sciences, October 11.—Preliminary note on the position of the optical axes of elasticity in gypsum for various colours, by M. Lang. The angle of the optic axes shows a maximum for the Fraunhofer line D. The dispersion of the axes of elasticity in the plane of symmetry is abnormal. These observations agree on the one hand with Poggendorff's exact description of the axial forms of gypsum, and on the other side with Descloigeaux's observation that at the higher temperatures, where the plane of axis is at right-angles to the place of symmetry, no horizontal dispersion is observable.—Annual periods of the insect fauna of Austro-Hungary, by M. Fritsch.—On the relation between the second principal proposition of the mechanical theory of heat and the calculation of probability respecting the propositions on heat-equilibrium, by M. Boltzmann.—The cylindroid and its specialties, by M. Kozak.—Simple calculation of elliptic arches, by G. Seewald.—On eruptive sands, and on the Flysch and the *Argille scagliose*, by M. Fuchs.—On equal figures in curves, cones, and surfaces of the second order and of certain of higher orders, by M. Puchta.—Calculation of cylindrical vessels with complicated relations, by M. Streicher.—On development of the resinous passages in some coniferæ, by M. Weiss.—Continued studies on the mode of ending of nerves of smell, by M. Exnor.

Paris

Academy of Sciences, November 26.—M. Peligot in the chair:—The following papers were read:—Geographical positions of the principal points of the coast of Tunis and Tripoli, by M. Mouchez. This relates to observations during the hydrographic voyage of the *Castor* in 1876, of some fifty points equally distributed along about 300 leagues of coast.—On some applications of elliptic functions (continued), by M. Hermite.—The Echidna of New Guinea, by M. Gervais. He notes several points in which the head differs from that of the Australian animal.—On invariants, by Prof. Sylvester.—On the waves of various kinds which result from the working of the sluice of Aubois, by M. Caligny.—On the solution of the equation of the fifth degree, by M. Brioschi.—Nature of the hydrocarbons produced by action of acids on manganesiferous spiegeleisen, by M. Cloez. Several of these products seem identical with those which exist in the ground and are extracted on a large scale under the name of petroleum. This production of complex carbonised compounds, without any intervention of life, supports the views of certain geologists on the origin of petroleum. The reproduction of a large number of organic species might be realised by commencing with ethylenic or formenic hydrocarbons, furnished by cast iron.—Discovery and observation of the planet 175 by Mr. Watson.—On the distances of stars, by M. Flammarion. He cites several facts which seem not to allow of basing on differences of brightness an estimate of distances.—On the intermediary integral of the third order of the equation with partial derivatives of the fourth order expressing that the problem of geodesic lines supposes an algebraic integral of the fourth degree by M. Levy.—Graphic tables and anamorphic geometry; reclamation of priority, by M. Lalanne.—Second note on the magnetisation of steel tubes, by M. Gaugain. The variations of magnetism produced by heat in a solid bar of steel are not different from those in a system composed of a tube and a core. Both seem to depend on the *inverse* magnetism developed by the mutual reaction of concentric layers, whether of the bar or of the system.—Liquefaction of bioxide of nitrogen, by M. Cailletet. This he effected by compressing to 104 atmospheres at − 11°. At + 8° the bioxide is still gaseous under 270 atmospheres. He hopes, also, to be able to liquefy formene. M. Berthelot remarked on the importance of this achievement, and thought it probable that most of the gases not yet liquefied, such as oxygen, which already diverges from Mariotte's law under great pressures, and oxide of carbon, would yield to M. Cailletet's new processes.—On nitrification by organic ferments, by MM. Schloesing and Muntz. Whenever, in these experiments, a nitrifiable medium has remained in the presence of chloroform, or has been heated to 100°, then guarded from dust, the nitrification has been suspended, but it has been possible to renew it, by introducing into the heated medium a minimum quantity of a substance like mould in process of nitrification.—On the termination of the nerves in tactile corpuscles, by M. Ranvier. He studied these organs in the tongue and bill of the domestic duck (where they are found in great simplicity). The tactile disc, the true sensitive nervous organ, is protected against mechanical excitations from without by the special cells surrounding it. It can only be impressed in an indirect way.—An experiment in *stasimetry* or measurement of the consistence of organs, by M. Bitot. The instrument is a kind of balance having at the end of one arm a perforating or sounding needle, at the end of the other a small controlling plate, and at the centre a pendulum with successive weights and a long indicator needle connected to it above, moving over a graduated scale.—On a modification of Bell's telephone, with multiple membranes, by M. Trouvé. A cubical chamber is substituted for the single membrane; each face of it is a membrane which, in vibrating, influences a fixed magnet with electric circuit. Associating all the currents generated, an intensity is obtained proportional to the number of magnets affected.—On the telephone, by M. Pollard. This describes some experiments at Cherbourg. M. Du Moncel called attention to the ideas expressed by M. Ch. B—— more than twenty years ago, and which contains the telephone in germ.—On a new sounding apparatus for works of coast hydrography, by M. Pinheiro.

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