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THURSDAY, JULY 9, 1874

THE COMET

To those who are familiar with the triumphs which that most wonderful of modern instruments of research—the spectroscope—has achieved, the short time during which it has been at work will be most forcibly recalled by a reference to the circumstance that the comet which is now, astronomically speaking, a magnificent object in the northern sky, is the first one of any considerable brilliancy which has shown itself since the spectroscope has been adapted to the telescope.

The truly splendid comets which delighted us during the autumn of 1858, and for a brief space in the summer of 1861, made their appearance, in fact, during what we may term the pre-spectroscopic age; for, however little to the credit of modern science it might have been that the spectroscope was no employed in their investigation, the fact remains that they were allowed to pass away mere telescopic objects, and that two opportunities were thus lost such as, perhaps, may not offer themselves again to the present generation of men.

I propose, in the present paper, to state some points of inquiry regarding comets in which the spectroscope may help us, with a view of showing how much closer is our grip of celestial phenomena when physical astronomy, in its widest sense, is superadded to the older astronomy, and to indicate the numerous gains to knowledge which may be hoped for if adequate telescopes, properly armed with spectroscopes, are employed both here and in the southern hemisphere upon the present visitor.

Omitting all reference to the paths of comets round the sun, with which mechanical astronomy has to do, there are perhaps but few points in which the spectroscope cannot help us; somewhat unfortunately, however, there is one in which it appears powerless, and that precisely one of the greatest difficulty in cometary theory. I allude to the apparent sweep of the tail round the sun when the comet is at its perihelion point, which has suggested to Faye a theory of a repulsive force due to solar heat, and which perhaps is one of the most mysterious phenomena which we witness in the skies. Leaving this aside, however, there are many questions relating to what Sir John Herschel terms their "interior economy," in which, undoubtedly, the guesses of telescopic observers may be turned into hard, detailed fact.

Let us briefly refer to some of these points.

Generally speaking, as a comet approaches the sun it gets brighter and its tail lengthens, whether the nucleus is intensely stellar, as in the present case, or not; in some cases a violent action may be observed; *aigrettes*, or jets, make their appearance; and the nucleus, or head, is surrounded, or partly surrounded, by envelopes or shells, very obvious and with marked boundaries, and these are visible in some cases at the commencement of the tail.

Now, of course, if any or all of these luminous phenomena were due to the reflection of sunlight by masses of whatever kind not luminous in themselves, then the spectrum would be the same from all, differing only in intensity, and the spectrum would be the true solar spectrum if there were light enough, and a dim continuous spectrum if the part of the comet under examination were dim.

If, on the other hand, the masses were self-luminous and consisted of vapours not too dense, then we should get a characteristic spectrum proving first the existence of vapours driven into incandescence; and secondly, if the observations went far enough, the precise quality or nature of the vapour would be determined for us by the spectroscope. Thanks to the labours of Donati, Huggins, Secchi, Wolf, Rayet, Vogel, and others, the brightest portions of the comets which have appeared since 1864 have been examined with the undoubted result that they consist, in part at least, of not very dense incandescent vapour. I say in part, because in some cases the continuous spectrum, which may denote dense vapours, or perhaps vapours of relatively greater molecular complication, or again even glowing solid substances, has been so strong as almost entirely to mask the bright lines or bands by means of which the presence of the rarer or simpler vapours is determined.

Nor is this all. Not only have lines been seen, but their positions have been determined with some degree of accuracy, although it must be pointed out that the opinions of authorities do not coincide as to the actual materials indicated or as to the interpretation to be put upon the observations. This is not to be wondered at, considering the amazing delicacy of the research and the few opportunities there have yet been of making perfectly satisfactory determinations.

The most searching criticism of the results hitherto obtained appeared some little time ago in *Poggendorff's Annalen* from the pen of Dr. Vogel (NATURE, vol. ix. p. 193), and it will be well to briefly glance at some points which result from his inquiry. Donati, in the first observations of this nature made in 1864, determined the existence of three bright bands, but made no attempt to determine the substance from which the light proceeded. Huggins in 1866 made the first attempt in this direction, and came to the conclusion that, like the nebulæ, the comets might be composed of nitrogen, as in the spectrum of the comet visible in that year there was a single line which nearly, if not quite, coincided with one of the brightest lines of that element. In 1868, however, the idea of nitrogen comets was abolished, as the idea of nitrogen nebulæ has been since; and the three bands, which were again observed in the comets visible in that year, were found to coincide with those of olefiant gas. Hence it was suggested by Huggins that they consisted of carbon vapour. He writes:—"The great fixity of carbon seems indeed to raise some difficulty in the way of accepting the apparently obvious inference of these prismatic observations. Some comets have approached the sun sufficiently near to acquire a temperature high enough to convert carbon into vapour. Indeed, for these comets a body of great fixity seems to be necessary. . . . If the substance of the comet be taken to be pure carbon, it would appear that the nucleus had been condensed from the gaseous state in which it existed at some former period. . . . If we were to conceive the comet to consist of a compound of carbon and hydrogen . . . other difficulties would arise in connection with the decomposition we must then suppose to take place . . ."

It is clear that Mr. Huggins' opinion is that a comet consists of carbon; that the vapour is carbon vapour driven into incandescence by a temperature high enough to volatilise carbon, and not the vapour of a volatile hydrocarbon.

Such is not M. Vogel's view, and I confess it is not mine. After giving details of the observations of the nine comets examined between 1864 and 1871, M. Vogel thus analyses them:—

"Of these nine comets, there is only one (1870) for which we have no observations as to the position of the bright bands. Of the remaining eight, the spectra of five (1, 2, 4, 7, and 9) have shown *no* agreement with the hydrocarbon spectrum. As regards the Comet II. 1867 the supposition is offered that its spectrum was similar to the spectrum named; as to Encke's Comet III. 1871, it remains uncertain in which class it is to be reckoned (Huggins' observations being at variance with those of Young and myself). There remains only the Comet II. 1868, for which Huggins' and Secchi's observations assert a probability of coincidence of the lines in its spectrum with those in the spectra of volatile hydrocarbons.

"It thus appears a somewhat questionable view, that the comets consist of such matter; and we should, I think, content ourselves with the deduction that a portion of the light emitted by the comet is its own light, and very probably from glowing gas."

Hence, then, the whole question of the true material of which that part of the comet consists, the spectrum of which has been already observed, must be acknowledged as being still *sub judice*: and this is a matter of the first order of importance, on which the present comet may throw much light.

But one of the most hopeful points is this: the comets up to the present time have been either so small or so distant that the record of aigrettes or envelopes on the spectrum has not been determined; nay, the comets might have been deprived of those appendages, hence the statement concerning the spectrum is a very general one; there has been no sufficient opportunity of localising the spectrum-giving region or regions.

What a glorious harvest will be reaped should the jets appear as decided as in the comet of 1861, or in Halley's comet at its return in 1835; "jets, as it were, of flame, or rather of luminous smoke, like a gas fan-light," which, as described by Sir John Herschel, "varied from day to day as if waving backwards and forwards, as if they were thrown out of particular parts of the internal nucleus or kernel, which shifted round, or to and fro, by their recoil, like a squib not held fast."

Or again, suppose the system of concentric envelopes is developed to the same extent as in Donati's comet, in which the action at all points of the nucleus, to follow Sir John Herschel's reasoning, was probably more general, a result due to a more uniform chemical constitution.

Hence the comet may leave us a rich inheritance in the shape of "spectrum of jets," or "spectrum of envelopes;" and from what I have already seen dimly (for such observations are beyond my instrumental power), the former is the more probable, and in the nucleus we may have the equivalent of the sun, or the carbon pole of an electric lamp, with a continuous spectrum, and in the jets phenomena identical with those presented by solar storms, or the electric arc, that is, lines of various lengths indicating various vapours, shooting out or extending to various distances according to their volatilities, or vapour densities.

We seem, indeed, to have got a true physical approximation to this state of things in the comet of 1868, for Mr. Huggins observed that while some of the lines thinned out as one sees them do in the ordinary spark by using a lens, quite independently of the general visibility of the vapour, others did not so thin out, but retained their breadth till they disappeared altogether.

The extent to which this action will go on will obviously depend upon two things, first the temperature and secondly the materials of the comet; and this raises an important question, which perhaps is easier of solution than the determination of the materials ejected, should that phenomenon be spectroscopically recognisable.

I have already communicated to NATURE the fact that to me the continuous spectrum of the nucleus appears deficient in blue rays. The effect of this upon the colour of the nucleus would be to give it a yellowish tinge like that of a candle flame, and for the same reason.

Dr. Vogel, in the paper to which I have already referred, deals with this question of colour, stating that:—

"Dr. Zenker arrives at the conclusion that there must be water-vapour in the comets; since they have, according to Schmidt, a yellowish-red colour, and the sun's rays, when they pass through a considerable thickness of aqueous vapour, are coloured thus. But apart from the consideration that sunlight has a yellowish-red colour on passing through other vapours as well as aqueous, I would remark that we must take the proper light of the comet, which appears from spectral analytic observations to be generally more intense than the reflected light, as determining its colour. According to the observations made, we should expect that the comet is, on the whole, of greenish or greenish-blue colour, since all the spectra consist, as we have seen, of two or three bands of light, of which one is in the yellow, the second and brightest in the green, and the weakest in the beginning of the blue. Of the (generally very faint) continuous spectrum, only the brightest part—yellow, green, and commencement of blue —is visible. The entire image, therefore, even where the weak continuous spectrum appears, will seem of greenish colour. Colour-data have been furnished by other observers besides Schmidt; and the head of the Comet 1811, *e.g.* had, according to Herschel, a greenish or bluish colour; the nucleus was slightly red. The colour of Halley's comet, at its return in 1825, was a bluish-green (Struve). Winnecke says of the comet of 1862, 'The colour of the neck appears to me yellowish; the coma has bluish light.'"

It will be seen that these remarks are quite in accordance with the suggestion. Dr. Zenker attributes to absorption the effect which I ascribe to defective radiation, and if it should be determined that the spectrum of the nucleus is truly deficient in blue rays, then a great point will be gained, *for its temperature must be low*.

Angström, whose death the world of science is now deploring, lived to say that he conceded that different molecular arrangements of the same element might give us different spectra; and Roscoe and Schuster have recently placed beyond all doubt that, besides the well-known high temperature spectra of sodium and potassium, there are other spectra appertaining to the vapour of these elements at a lower temperature.

Now these spectra are *channelled-space spectra*, that is similar in character to the spectrum which has already been observed in the case of comets; and if such spectra be obtained for all elements (and I have already added to the list), if a comet be a body at a low temperature, it is such spectra as these that we shall see, and not line spectra. Further, in the case of compounds in which the molecules which give us these new spectra enter into combination, we may possibly dissociate them and observe their spectra at a much lower temperature than we can drive the higher molecular arrangement of the solid into vapour.

Such considerations as these derive additional interest and importance from the beautiful researches of Schiaparelli, which connect comets with meteorites.

Modern science acknowledges that comets are individual members of meteor swarms—not that meteors are comets' tails, as some think; this idea is, one may say, impossible to reconcile with facts—that one difference at any rate between a comet and a meteor is that one is self-luminous, the other is not till it arrives within the limits of our atmosphere. If this be acknowledged, then to what is this difference to be ascribed? A possible cause is certainly a difference of chemical constitution—a difference between materials incandescent at a high temperature and materials incandescent at a low one. It is not necessary to stop to inquire how this temperature has been arrived at, but it is important to show that the question of temperature is one of the very first points to be attended to by those who can bring sufficiently powerful instruments to bear upon the present comet, and that the question of its actual chemical constitution is bound up with it.

But whatever be the temperature of the head there is another point which must not be lost sight of. Sir John Herschel writes concerning Halley's comet: "The bright smoke of the jets, however, never seem to be able to get far out towards the sun, but always to be driven back and forced into the tail, as if by the action of a violent wind rolling against them—always from the sun—so as to make it clear that this tail is neither more nor less than the accumulation of this sort of luminous vapour, darted off in the first instance towards the sun, as if it were something raised up, and as it were exploded by the sun's heat, out of the kernel, and then immediately and forcibly turned back and repelled from the sun." Here we have the question raised not only whether the envelopes consist of different materials, but whether the tail is not entirely or in part self-luminous: the present comet may show that this point is not so satisfactorily settled as it is supposed to be in favour of reflected light.

Such then are briefly some of the questions at issue. It is to be hoped that our beautiful visitor will answer some of them for us, and that when it leaves our northern skies the work may be carried on in the southern hemisphere.

J. NORMAN LOCKYER

THE CHANNEL TUNNEL

WE fear there are still many who fail to see that any good can come of scientific research unless it has some well-defined "utilitarian" object in view. Even in this and in other countries that are in the van of civilisation and in which education is comparatively wide-spread, the majority of mankind can appreciate a benefit only when it takes a concrete and tangible form. That love of knowledge for its own sake, that noble inquisitiveness which has been so fruitful in results during the last two hundred years, even yet belongs to comparatively few, who are still regarded by the many with a kind of impatient pity as mere unpractical hobby-riders. Still the people who talk in this way are proud enough of the glory which their great men have shed upon their country, and would not willingly, we believe, part with it for money were this possible; and indeed how would this country appear among the nations were she deprived of the inestimable inheritance which her great sons have bequeathed to her in every department of intellectual activity? Happily, however, the race of those who decry single-eyed scientific research is getting sensibly smaller; and we firmly believe that as education improves and as higher education spreads, carrying with it the results of this same scientific research, it will disappear.

Still, a little consideration might show those who are ever ready to cry "what's the good?" that since all so-called "practical" schemes are concerned either with man's own body or with the surrounding universe, an essential part of the basis of any scheme is a thorough knowledge of the material on which it is proposed to work. Such a knowledge it has over and over again been shown is only to be attained by abstract scientific research, by investigation conducted as if the only end in view were a thorough knowledge of the subject in hand in all its scientific aspects and relations. Many instances could be given, and indeed are every day occurring, of the highest practical results unwittingly following from such investigations; and to the sceptic we could not recommend a better example of how indispensable is thorough scientific research as a basis for the useful arts than the results of the investigation into the geology of the Channel which Mr. Prestwich (the newly elected Oxford Professor of Geology) presented to the Institution of Civil Engineers last December, and which, with the subsequent discussion and maps, has just been published in a separate form. This study of the strata which underlie the Channel, and which seems to us an almost perfect example of close and careful reasoning on physical facts, is now brought forward to enlighten the projectors of a tunnel between England and France as to the nature of the material with which they will have to work; but Mr. Prestwich distinctly states that the various formations are considered "irrespective of their relative merits in any other than a geological point of view."

Mr. Prestwich's plan is to discuss carefully all the strata which underlie the Channel, from the London clay down to the Palæozoic series, exhibiting distinctly their lithological characters, dimensions, range, and probable depth, and from these data deducing his conclusions as to the suitability of each formation for being pierced by a tunnel. The investigations of himself and others on which Mr. Prestwich's paper is founded were mostly undertaken from no practical point of view, and before a Channel tunnel was thought of. Mr. Prestwich, many will be glad to think—grateful, we hope, at the same time for this very practical result of pure scientific research—concludes that from a geological point of view it is quite practicable to construct a tunnel underneath the Channel, although to do so with safety it will be necessary to go very deep down. But an excellent idea of the results of the investigation will be obtained from the following clear summary with which Mr. Prestwich's paper concludes:—

"In the London clay there exists a perfectly impermeable bed of sufficient thickness, but nowhere between the two countries, except probably at points where the distance presents apparently insuperable difficulties. The lower chalk or chalk marl affords a comparatively impermeable deposit, also of sufficient dimensions: but from its having a calcareous base, and from the possibility of fissures, with the absence of a protecting overlie, it has great uncertainty. In the gault there is another impermeable stratum, but of dimensions too small. The lower greensand contains no beds sufficiently continuous and impermeable. The Weald clay ranges about half-way across the channel; and if a belt of it should possibly pass round at the north end of the Varne and range to Wissant, it might prove to be worth further inquiries. In the Kimmeridge clay there is again a deposit of sufficient dimensions, but with a subordinate band which may be sufficiently permeable to present difficulties, whilst, though it comes to the surface on the French coast, its depth on the English coast must be very considerable. There is, however, just a chance that the Kimmeridge clay may in mid-channel be overlapped unconformably, and at a slight angle, by the Weald clay, and in that case they might for all purposes be considered as continuous strata. The Oxford clay presents similar difficulties, in addition to its greater depth and inaccessibility. In the secondary strata the irregular lie of the strata, and the presence of faults, are contingencies important to be considered.

"On the other hand, the great mass of the Palæozoic rocks so protected by impermeable overlying strata, is of such great dimensions, and so compact, and holds its range so independently of the more irregular range of the secondary strata, that it offers the conditions most favourable for the secure construction of a submarine tunnel; and that such strata can be worked in safety and for considerable distances under great bodies of water, has been proved at Whitehaven and Mons. But, on the other hand, the depths of these old rocks below the surface is very great, and they are much more dense and harder than the overlying formations.

"There is another important problem in connection with the Palæozoic rocks which such an undertaking might help to solve. The great question of the range of the coal measures under the south of England has lately come prominently into notice; and it was, in fact, in inquiries connected with that question that the foregoing considerations presented themselves to the author. The rich coal basin of Mons and the north of France has been traced to within thirty miles of Calais, where it thins out; but, like the coal basins of Liege, Aix, and Westphalia, which form separate sections of the same great trough, to the eastward, so there is reason to suppose that other sections of the trough set in on the westward, forming other coal basins, which possibly range to the west of England (Somersetshire), passing under the north-eastern part of Kent and the Thames. Any such work, therefore, as a submarine tunnel in these Palæozoic rocks could not fail to throw much light on the subject; while, in case it were to hit upon the line of strike of the coal measures, and could be carried on along that line, the work might prove otherwise remunerative, and tend to solve the great problem which interests so largely both geologists and the general public.

"Such, briefly, are the conditions which bear on the construction of a submarine tunnel between France and England. The author is satisfied that, considered on geological grounds alone, it is in one case perfectly practicable, and in one or two others it is possibly so; but there are other considerations besides those of a geological nature, and whether or not they admit of so favourable a solution is questionable. In any case the author would suggest that the one favourable solution admitted, it may be desirable, in a question involving so many and such great interests, not to accept an adverse verdict without giving all those other considerations the attention and deliberation which the importance of the subject deserves.

"Under any circumstances, the difficulties are formidable. Whether or not they are insuperable are questions which may safely be left to Civil Engineers. The many and great obstacles overcome by engineering science in late years lead the author to expect that, should the occasion arise, and the attempt be considered worth the cost, the ability to carry it out would not be wanting. Various preliminary trials are, however, indispensable, in order to clear up some of the geological questions before a balance of the comparative advantages presented by the different formations could be satisfactorily settled, and before the grounds for action could be accepted."

From this it will be seen that the possibility of a Channel Tunnel remains now only with the engineers to decide. Geology has told them all the natural conditions under which they will have to work, so far as these can be known without actually tunnelling; and since so cautious a reasoner as Mr. Prestwich thinks it possible to carry out the scheme from a geological point of view, we should think that if it could be proved that the undertaking would pay, our engineers would be eager to show that the resources of their art are quite equal to its successful accomplishment.

OWENS COLLEGE "ESSAYS AND ADDRESSES"

Essays and Addresses. By Professors and Lecturers of the Owens College, Manchester. (London: Macmillan and Co., 1874.)

THIS book is due to the natural desire of the teaching staff of the Owens College to have some memorial of an event of the first importance in their own history, and to give expression to the hopes that animate the institution. The Owens College was founded by a single legacy a quarter of a century ago—for the creation of a college in which Lancashire lads might study at home the "branches of learning commonly taught in the English Universities." It first became known in connection with its first Principal, Scott, a writer who has left nothing which explains the high rank he held among his contemporaries and especially the influence he unquestionably exercised over every young man with whom he was brought into contact. Under him, however, the College did not flourish—the number of the day students sank at one time as low as 25—and it was only after the appointment of the present Principal, Dr. Greenwood, that it began to take root in Manchester. It has now about 350 day students—not including the medical students, who have been added only this session—and nearly 800 evening students. Curiously enough, what happened in Glasgow to the disappointment of many of the well-wishers of the University, happened also in Manchester. When the new buildings, with all their increased convenience for study were opened, it seemed natural to anticipate a great increase of students. Nothing of the kind took place. Students seem to come and go to college because they want to be taught, not because they are to have beautiful buildings to be taught in. The effect will certainly be considerable, alike on teachers and on taught, of the more commodious buildings recently erected in Glasgow and in Manchester, and it will be felt more and more as time goes on. The fact that it is not felt at first shows, however, that the wants that are satisfied by university teaching lie so deep down that an external event like the inauguration of new buildings scarcely influences them.

The success which the Owens College has thus attained in a quarter of a century is due to much hard work—to careful and deliberate adaptation not merely to the wants of the time, but to the claims of real culture—and above all of course to the fact, which that success proves, that in Lancashire, or that portion of it of which Manchester is the capital, there is a real demand that the higher education may be brought home even to the doors. This book serves as a record of much of the work done—and an expression of the ideas of the teachers whose spirit has made and still makes the Owens College. No one who glances at the titles of the fourteen essays and addresses of which it consists can fail to be struck with the variety of the teaching. It accomplishes the task laid upon it by its founder, by teaching nearly everything commonly taught in the English Universities. We find two Professors of Classics, one of Oriental Languages and one of Modern Languages, two of Natural Philosophy, a Professor of Natural History, and a teacher of Geology, a Professor of Chemistry, a Professor of Engineering, a Professor of Jurisprudence and Law, a Professor of Physiology, and two gentlemen who seem to be three or four Professors rolled into one, the accomplished incumbents of the chairs of "English and History," and of "Logic, and Mental and Moral Philosophy, and Political Economy." Besides these, there are at least half a dozen more, the Professors of Mathematics, the Professors of three or four Medical subjects, the additional lecturers on Law, on Organic Chemistry, and so on, who put in no appearance in the volume. The College is in fact equipped with a staff of teachers which bears favourable comparison with that which is usually found in older Universities. The Medical department has been added only this session; the Law and Jurisprudence department has recently made a considerable step in advance. Except that several of its members are evidently overburdened with subjects too large for any single man, the staff of the College is reasonably complete, and most things can be learned in it which are taught elsewhere.

We turn with interest to the volume before us to discover, in the choice of their subjects and in the manner of treating them, the aims and tendencies of the professors and lecturers. What is most noticeable, and it cannot fail to strike even the casual reader, is the caution, the moderation, we had almost said the conservatism which is characteristic of most of them. People are still tempted to associate the name of Manchester with everything that is "advanced," and we look in such a book as this for a daring championship of educational and scientific novelties. From the first words of the President's opening address to the last words of the essay which closes it, the tone of responsible thoughtfulness, of the wish to be just and true more than to be vigorous or startling, is never to be mistaken. The Duke of Devonshire the President, and Dr. Greenwood the Principal, unite in urging that the older class studies—those connected with literature—should not be pushed aside and comparatively disregarded, and that the newer studies should be taken up in their full depth and breadth, not in a fragmentary or superficial manner or with any supposed reference to their immediate application. These cautions are supplemented, indeed, but they are not contradicted, by Prof. Roscoe and Balfour Stewart, who urge, the one that original research is a powerful means of education, and that original research should be organised, as it has already been to some extent, especially in his own department; the other that we should set about great national studies, establishing a watch, for instance, on the sun, "a creator of disturbances on the greatest possible scale, who is ever ready to afford us information about himself at the smallest possible cost." Mr. Reynolds follows them with a demand for a national commission to experiment on heat engines, and the conditions under which they could be practically worked, economically, or efficiently, or both, to higher pressures than we now attempt to use, so as to get more work out of our coal and our machinery, and perhaps some day to enable a light-weight jockey to fly at the rate of 200 miles an hour. After these speculations and demands, which are certainly significant of the modern age, follows Prof. W C. Williamson's cautious and copious discussion of the theories of natural selection and evolution, as tested by primeval vegetation. We call it a conservative paper because the conclusion of the writer is that among the innumerable facts known and co-ordinated about the primeval vegetation, there is little sign that the laws of natural selection and evolution have operated to a large extent in transforming the vegetable species of the pre-carboniferous strata to those with which we are now familiar. But Prof. Williamson is absolutely frank in his admission of the new laws, and singularly candid in accepting any explanations which they seem to offer. He admits "that by the help of natural selection man has brought into existence many new varieties of pre-existing plants and animals, most, if not all of which, were his protecting hand withdrawn, would soon revert to their primal forms. We have no evidence that unaided nature has produced a single new *type* during the Historic period. We can only conclude that the wonderful outburst of genetic activity which characterised the Tertiary age was due to some unknown factor, which then operated with an energy to which the earth was a stranger, both previously and subsequently." It is in a bolder spirit that Prof. Bryce speaks of the new Judicature Act, a measure which throws us back in principles and in practice many centuries, and which is, in his view, "a reform in English law greater in some points of view than we have had since English law itself began to exist." The note of conservative caution returns on our ears in the two last essays on the Relation of the Railways to the State, by Prof. Jevons, and on the Peace of Europe, by Prof. Ward. The conclusion of the former is emphatic, and altogether hostile to the movement party who advocate the State purchase of our railway system. There are few questions deserving to be more seriously studied by politicians or likely to need more serious study for in the changes and chances which affect our governments, some new men may some day drift with us into schemes which would be in themselves imprudent, and which would be foolish except by way of preface to a more comprehensive measure. We could not take the railways over, Prof. Jevons thinks, for less than a thousand million sterling, which is about double their commercial value. The attempt might be all but ruinous to the nation, and the results would be altogether disappointing. But among the middle and upper classes, who own the railways, there is certain to be a considerable feeling in favour of a scheme which would be fruitful of so much pecuniary benefit to themselves, and it is well to have it discussed beforehand as thoroughly and as thoughtfully as it is discussed here. It is in useful conservatisms such as these that Universities often do their greatest services. They are mints at which the coinage that is passing current in the commoner exchanges of the world may be thoroughly tested. Prof. Jevons offers statesmen and politicians an admirable discussion, luminous with the most practical good sense. Like his colleagues, Prof. Ward is conservative in the sympathies of his essay. We have been engaged for many years in breaking down the venerable theory of the Balance of Power in Europe, and we have been attempting to build up in its stead a sort of Temple of Doctrinairism—sacred to a goddess of international arbitration, who is to be capable of the cure of all international ailments. Prof. Ward applies the touchstone of his comprehensive historical knowledge to both. He is utterly hostile to the doctrine of Spinoza that, as the natural state of man is a state of war, no nation is bound to observe a treaty longer than the interest or danger that caused it continues. But the old treaty basis of the peace of Europe having broken down, "the remedy for the danger accruing with new force to the peace of Europe is to be sought, not in an abandonment of the principle of joint action, but in an enlargement and elevation of it, and in the progress of that enlightenment which, instead of enfeebling, strengthens the common action of men and of states. For it is with nations as with individuals. The cultivated, and by culture enlightened, mind is and must be on the side of progress and peace against that of darkness and conflict. The obscure men, like the unformed nationalities, are at once materials and causes of that which disturbs, unsettles, and retards personal and national and international life. Where the education, and more especially the higher education, of a country is fostered, there lie the best promises of progress and of peace."

We do not attempt any detailed criticisms of the several essays. The subjects chosen by fourteen professors on which to address the world are likely to be reasonably well chosen, and the addresses delivered on them are pretty sure to reward the attention of the reader. They strike us as very well chosen; they sufficiently represent the real variety of teaching and of manner of teaching in the institution; they contain complete and occasionally brilliant discussions of subjects of very considerable general interest. They are the expressions of the inner spirit of a seat of learning in which science holds a higher place than she has usually done but in which there is the most emphatic and continual protest against the degradation or neglect either of literature or of science. They show a body of teachers full of modern life and at the same time singularly moderate, truthful, and reverent. Several of the essays are historical studies, and in these cases the reputation of the writer is a sufficient guarantee of completeness. In their collected form the "Essays and Addresses" warrant high hopes of the future of the Owens College. In a sense perhaps a somewhat too literal sense—it is what it was once called in a journalistic epigram, the University of the Busy. With its present staff it will certainly continue the tradition which connects the older Universities with the highest learning of the time.

W. J.

LETTERS TO THE EDITOR

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

Sir John Herschel's Letters

It is known to many through the numerous applications I have made, that a collection of the letters of Sir John Herschel is in progress. For the many and valuable contributions, as well as for the kind and sympathetic expressions which I have been favoured with, I cannot be too ready to express once more my sincere acknowledgment; and when I recall these to mind I hesitate to take any less private step to further the end in view, or, by venturing on a public appeal, to forego the advantage of more direct communication. Several considerations however—which not even your courtesy in allowing this letter to appear in the columns of NATURE would justify me in dwelling upon—forbid me to depend solely on the activity of a single importunate pen. The correspondence in question covers more than half a century. Many of the correspondents were of a former generation, and their present representatives are known to but few. I may instance the names of Davy, Young, Wollaston, —not to mention many continental savans—in illustration of this. Many others, less eminent, but not the less recipients of letters which the student of scientific history will prize as containing the germs of much of the force whose impetus we now feel, were hardly known by name beyond their own immediate circles. Many more, as I would fain believe, who either themselves corresponded with my father, or knew him in his letters to their relations, are even now in possession of such letters, and may not be unwilling to let them be seen. Lastly, I hear too much of autograph collectors not to feel a keen desire to make their instant acquaintance. Have they not devoted themselves to preserving individual letters, no matter how trifling, from the fate which has—alas too often—overtaken others, no matter how numerous, or how valuable!

In my applications hitherto I have been constrained to repress the expectation of immediate publication. I am not at liberty to depart from that now. But that the materials which I may now be permitted to store up *will* eventually help to form the foundation of such a monument as may be fitting—this requires no student of history to tell us. That it may be amply provided for now, before it is too late, is my chief anxiety. For my time is limited, and I have drawn too many blanks not to feel that every year increases their number, let who will take my place.

I apologise for so long a story, and will only add in the most general terms that I appeal to all who possess, or know of the existence of, autograph letters of Sir John Herschel—no matter how insignificant they may seem, for collation with others can alone supply a true test—but of course with due regard to personal consideration—to communicate with me at once. It is hardly necessary to say that all autograph letters will be returned, and that any restrictions will be attended to.

21, Sumner Place, Brompton, S.W

J. HERSCHEL

Coggia's Comet

YOUR readers may be interested to learn that the light of the comet is by no means strongly polarised. On the 2nd and 4th instant I examined it with a double-image prism, but could not with certainty detect any difference between the brightness of the two images. I also examined it with a plate of right- and left-handed quartz in the principal focus of the 4-inch telescope and a Nicol's prism packed among the lenses of the eyepiece, but could not detect any traces of colour. With a Savant placed between the eyepiece and the eye no bands were detectable. But on the 6th, about midnight, when the comet was shining very brightly, I could perceive a difference in the brightness of the two images with the double-image prism, indicating polarisation *in* the plane passing through the sun's estimated place. But I was still unable to detect any traces of polarisation either with a Savant or Biquartz, or with a plate cut from a natural crystal of right- and left-handed quartz giving a band across the field in which the two crystals overlap; a form of polariscope which has been found on other occasions very delicate for faint lights.

If the tail of the comet consisted of a *fine* dust not in a state of incandescence reflecting or dispersing the sun's rays, we should expect its light to be completely polarised. We seem, therefore, driven to assume, either, 1, that the tail consists of fine incandescent particles; or, 2, of particles whose diameter is not small compared with the wave-length; or, 3, of incandescent gas; or, 4, possibly of all three of these states combined.

A. COWPER RANYARD

Photographic Irradiation

IN a letter to NATURE, vol. ix. p. 183, I gave a short description of some experiments on photographic irradiation. The conclusion to which these experiments pointed was that there is a kind of photographic irradiation, caused either by the bright light producing an intense state of chemical activity, which has the power of extending itself in every direction; or what seems more probable, the parts of the collodion on which the bright light is falling become luminous and reflect light to the surrounding parts of the sensitive film, and thus extend the chemical change on each side of the true optical boundary line. As the subject is at present under discussion, I send you the results of the following experiments, which seem to support the above conclusion. In a darkened room a vertical opening 18 in. by 5 in. was made in the shutter; over the opening was fixed a piece of paper thick enough to stop most of the light, and only allow as much to pass as would give a decided but not deep photographic impression. Three long, narrow, parallel openings were cut in the paper, one opening was left clear to the sky, the next was covered with one thickness of tissue paper, and the third with two thicknesses of tissue paper. There was thus produced three parallel bars of different brightness on a uniform and darker ground. Sensitive wet plates were prepared in the usual way on glass and opaque black plates; across the front of the plates, and almost in contact with the collodion, was fixed a horizontal bar of thin blackened metal in such a position that it would cross the image of the luminous bars in the camera. The photographs, after exposure, were developed in the usual way, and it was found that the shadow cast by the horizontal opaque bar was not bounded by straight lines, but the ends of all the bright bars projected into the shadow, and the brighter the bar the farther it projected. I had no means of measuring accurately the bar and its shadow, but there seems but little doubt that the bright bars extended underneath the opaque bar, whilst the edge of the darker ground at the side of the bright bars gave the correct line of the shadow. Now this extension of the bright bars could not have been caused by the reflection from the back of the plate, as this result was always got whether glass or opaque black plates were used. Nor could it have been caused by the oblique pencils referred to by Lord Lindsay and Mr. A. C. Ranyard, because, the opaque bar being close to the collodion, these pencils could not get underneath. The natural conclusion seems to be, that this extension of the bright bars must have been caused by some molecular reflection taking place in the collodion. This form of irradiation can easily be distinguished from the irradiation produced by reflection from the back of the plate, as the latter is simply a sort of haze surrounding the bright object, extending some distance from it, and gradually fading away, whilst the former extends a very short distance and has a well-marked outline, though not so sharp as those parts of the image where there is no irradiation. The irradiation produced by reflection from the back of the plate, and some forms of irradiation due to the imperfections of the lens, though fatal to artistic photography, yet do not interfere much with its scientific value, as they do not affect the accuracy of outline, though they do affect the clearnesss of the photograph. Molecular irradiation, on the other hand, whilst it scarcely affects artistic photography, is fatal to scientific accuracy. The manner of preventing this latter form of irradiation has been already pointed out, namely, by reducing the intensity of the light falling on the sensitive surface to only that necessary to produce a distinct impression. In artistic photography this is almost never possible on account of the different amount of light on the different parts of the subject, while for scientific purposes this may almost always be done. The imperfections of the image due to the lens seem to be as various as the forms of lenses; one lens used in the experiments gave a curious double hazy-image of the bright object. When the image is near the centre of the "field" the double image fits over the true image, producing an effect somewhat similar to, and was at first mistaken for the effect of reflection from the back of the plate. At first this double image was somewhat puzzling, as it always made its appearance even when opaque plates were used. The two images were, however, afterwards separated by bringing the true image near the outside of the "field," when the true image and its double were photographed alongside of each other.

The following simple experiment illustrates this molecular form of irradiation, and shows how much the definition of the image depends on the nature of the surface which receives it. Take a camera obscura and throw the image on some translucent substance such as opal glass; paint a small part of the glass with some opaque white substance; bring into the "field" some brilliantly illuminated subject, such as branches of trees against the sky; examine the image from the lens side of the glass, when it will be found that the image over the opal glass is hazy and indistinct, whilst the part of the image on the paint shines out brilliant and sharp.

Darroch, Falkirk, N.B. June 16 JOHN AITKEN

Lakes with two Outfalls—A Caution

LLYN CREIGENEN (the larger of the two lakes of that name), situated about five miles S.W. by W of Dolgelly, has *apparently* two natural outlets—one at the east, the other at the west end of the lake; both streams ultimately fall into the estuary of the Mawddach. The two outlets are on nearly the same level, the one at the east end being perhaps a trifle higher than that at the west end. The whole of the waste water at present passes through the western outlet in consequence of an artificial dam of turf having been made across the eastern channel. There are no indications on the ground which would lead anyone to suspect that either of the outlets had been artificially formed; the general contour of the surrounding country would rather favour the contrary view.

I was, however, informed last week by a man who had lived eighteen years in the district *that he had been told* that originally the only outlet was that at the west end of the Llyn, and that the other outlet had been made many years ago for the purpose of getting a better supply of water to some mills which then existed, but which do not now exist, on the stream to the east of the lake. If this story prove to be correct it shows how important it is to make full inquiries before stating positively that any lake has two natural outfalls.

From the ordnance map one would imagine that two streams issued from Llyn Arenig (five miles W.N.W. of Bala), but the one shown as starting from the extreme north end of the lake has no existence in fact.

Chester, June 3 GEORGE R. JEBB

FERDINAND STOLICZKA, PH.D.

A BRIEF telegram from India, which arrived just in time for notice in last week's NATURE (vol. x. p. 172), announced the death on the 19th ult., at Shayok, between the Karakorum Pass and Leh in Ladak, of Ferdinand Stoliczka, Palæontologist to the Geological Survey of India, who was returning from Kashgar and Yarkund with the other members of Mr. Forsyth's mission.

Thus has passed away, at the early age of thirty-six, a naturalist who, if his life had been spared, would certainly have attained a very high position amongst the leaders of science. Few men have accomplished an equal amount of work in the same brief space of time. A glance at the Journal and Proceedings of the Bengal Asiatic Society, and the publications of the Geological Survey of India, especially the "Palæontologia Indica," will show the wonderful variety of subjects treated by Dr. Stoliczka. In the course of the last ten years, besides geological memoirs on parts of the Western Himalayas and Thibet, he has published numerous papers on Indian mammals, birds, reptiles, amphibia, mollusca, bryozoa, arachnida, coleoptera, and actinozoa; and these papers are no lists of names or mere descriptions of new species, but they abound with accounts of the life history of the different animals, details of their anatomy, and remarks on classification, and show that their author was as good an observer in the field as he was patient and accurate in the cabinet. His greatest work is undoubtedly his account of the fossil fauna discovered in the Cretaceous rocks of Southern India, in which he proposed the most complete general classification of Gasteropoda and Pelecypoda (Lamellibranchiata), including both fossil and recent forms, which has hitherto been attempted. This classification was largely supplemented by original anatomical research, and it has been adopted in one, at least—we believe in two—of the principal museums in Germany.

Dr. Stoliczka was born in Moravia in May 1838. After completing his university course he joined, whilst quite young, the Imperial Geological Institute of Austria, where he soon distinguished himself by his palæontological work, and became especially known for researches amongst the Bryozoa, fossil and recent. The collection of specimens belonging to that class obtained by the Novara expedition was intrusted to him for description. Amongst his principal early contributions to palæontology were papers on the fossil fauna of the Hierlatz and Gosau beds.

In 1862 he joined the Geological Survey of India, and at once commenced the study of the magnificent series of Cretaceous fossils obtained by Messrs. H. F. Blanford, C. Oldham, and the other officers of the Survey engaged in the Madras Presidency. The descriptions of these fossils have only recently been completed, and extend altogether to about 1,500 quarto pages illustrated by 178 plates. There can be no doubt of the rank of this work; it is one of the most complete monographs ever published of any fossil fauna whatever. The numerous duties connected with the post of Palæontologist to the Survey occupied so much of Dr. Stoliczka's time that he was only able to devote a few months in three different years to field-work. To this field-work we owe valuable reports on the western Himalayas, Thibet, and Kachh, the last not yet published. In the year 1868 he accepted the honorary secretaryship of the Asiatic Society, and during the five years he held the post he raised the natural history portion of the Society's journal to a position it had never approached before, this improvement being due no less to his own contributions than to the aid he was always ready to afford to all engaged in zoological inquiry.

When, last year, a mission was despatched by the Indian Government to Yarkund and Kashgar, Dr. Stoliczka was selected to accompany it as naturalist and geologist. It would have been impossible to have found anyone more competent for the post, but many of his friends knew the risk he ran, and he was well aware of it himself, for his health had been seriously affected by exposure in former years in the higher regions of the Himalayas, and he needed rest and a change to Europe. His life has been a sacrifice to the study to which he had devoted it. He was seriously ill at one time when crossing the high passes on his way to Yarkund, but recovered, and his letters from Kashgar gave glowing accounts of his discoveries, and now when returning loaded with the spoils and notes of nearly a year's research in one of the least-known parts of Central Asia he has fallen, just as his friends were in hopes of welcoming him back amongst them. This is not the place to speak of his many amiable qualities, but few men were more widely known in India or more universally beloved and esteemed, and the gap he has left in the little band of Indian naturalists and geologists, as well as amongst the far wider circle of his private friends, will be long unfilled. W. T. B.

OBSERVATORIES IN THE UNITED STATES

ONE of the most salient points in the scientific progress of America is undoubtedly the marvellous multiplication of first-class observatories during recent years. The genius of her people, the skill of her artists, and the wise liberality of states and individuals have combined to bring about a state of things which those interested in Astronomy in any country on this side of the Atlantic may regard with the intensest envy. Undoubtedly our own observatories are already distanced in everything except activity. In number, instrumental equipment, breadth of design, the American institutions are unsurpassed; and although the Americans themselves say they want men with such world-wide names as Peirce, Winlock, Newcomb, Young, Peters, and many others that we might mention, who know no resting on old laurels, it is difficult for an Englishman to acknowledge that the idea is well founded.

A very interesting and well-illustrated article on United States Observatories appears in a recent number of *Harper's Monthly*. Some of the illustrations, which we are enabled to give by the courtesy of the Editor, give a good idea of the scientific wealth to which we refer, and of the progress that has been made, for while little more than thirty years ago it could not be said that there was one astronomical observatory in the United States, to-day it is safe to place the number of all classes, public and private, beyond fifty.

Cincinnati Observatory.—One of the most strenuous advocates for the establishment of public observatories in the United States was John Quincy Adams, who had made astronomy a favourite pursuit. He had very just conceptions of what ought to be the character and aims of a true observatory. It must steadily labour for *discovery*. It must be fully equipped for this, and be provided with a *personnel* who could give their whole energies to that series of observations, running through many years, which alone can secure valuable additions to astronomical knowledge and insure its benefits to men. For the establishment of such an institution he had made his well-known appeal to Congress in 1825. He was ridiculed; but he remained as strenuous an advocate as ever for the establishment of observatories of the first class both at Washington and at Cambridge. In the very year before this address at Cincinnati he had urged, in his place in Congress, the perpetual appropriation of the whole interest of the then unappropriated Smithsonian fund for an observatory for the people.

"The express object of observatories," said he, "is the increase of knowledge by new discovery. It is to the successive discoveries of persevering astronomical observations through a period of fifty centuries that we are indebted for a permanent standard of time and for the measurement of space."

The year 1843 was, however, an era in the history of United States observatories, and Cincinnati was their birthplace. Her institution and those of Cambridge and Washington sprang up, and the enthusiasm of the era started others, whose equipment has been secured largely by their success.

As early as 1805, Cincinnati may be said to have had a practical working observatory. In that year the first Surveyor-General of the United States, Colonel Jared Mansfield, received, after a delay of at least three years in their construction and transportation from London, astronomical instruments ordered by Albert Gallatin, Secretary of the Treasury, and paid for by President Jefferson out of his *own contingent fund*, "since no appropriation for them had been made by law." The instruments, which were said to have been excellent of their kind, were a 3-foot reflecting telescope, a 30-inch portable transit instrument, and an astronomical pendulum clock. Years afterward, they were placed in the philosophical department of the Military Academy at West Point. In the house of the Surveyor-General, at Cincinnati, they were used in making numerous and interesting astronomical observations. The orbit of the comet of 1807 was calculated, eclipses of different kinds were observed, the longitude of the observatory determined, and other observations of importance made from 1807 to 1813, all of them outside of the usual duties of the mere surveyor.

Our next date is at the end of the lapse of forty years. We are brought then to the marked era in astronomical interest already referred to, and to the labours of those who awakened that interest, especially of Ormsby M'Knight Mitchell.

Mitchell was a native of Kentucky. He graduated with honour at West Point, in 1829. Resigning from the army, and practising law in Cincinnati, he was made professor in the City College. He was an enthusiast in astronomy. He gave a series of lectures to the citizens in 1842, which created their Astronomical Society.

As the astronomer of the Society engaged for a ten-years' work, Prof. Mitchell sailed for Europe to purchase a telescope superior to any then in America. In the optical institute of Merz and Mähler, successors of the great Fraunhofer, at Munich, he found an object-glass of 12-inch aperture, which, after Lamont's test in his own tube, was pronounced superior to that of the Munich telescope. It was mounted, purchased for about 9,400 dols., and arrived in Cincinnati in 1845.

The Astronomical Society of that town meanwhile had secured from their fellow-citizen, N. Longworth, the gift of four acres of ground on one of the beautiful and commanding hills on the east of the city, and a fund of 11,000 dols. in shares of 25 dols. each.

Prof. Mitchell, on his return, devoted his whole energies to the erection of an observatory. Its corner-stone was laid November 10, 1843, on the site given by Longworth, on Mount Adams.

The observatory presented a front of eighty feet, ornamented with a Grecian Doric portico, and a depth of thirty, showing a basement and two storeys, with a central dome, covering an equatorial room twenty-five feet square, the roof being capable of entire removal when observations were to be made. The object-glass of the telescope had, as we have said, an aperture of twelve inches; its focal length was seventeen feet.

The equatorial room received the Munich instruments in March 1845. Prof. Mitchell began his labours with the enthusiasm of hope. Other necessary instruments were received: a 5-foot Troughton transit, lent by the Coast Survey, an astronomical clock, presented by Mr. M'Grew, of Cincinnati, and a chronometer lent by Messrs. Blunt, of New York. At the request of Prof. Bache, the telegraph company connected the observatory with their stations for the determination of longitude, Cincinnati being then a central point in such work. The Astronomer Royal, under whose instruction Mitchell had passed three months in 1842, urged, in an encouraging letter, that "the first application of his meridional instruments should be for the exact determination of his geographical latitude and longitude, and that his observing energies should be given to the large equatorial." With this advice, he directed his attention largely to the remeasurement of Struve's double stars south of the equator.

Airy and Lamont had invited him to make minute observations of the satellites of Saturn, since in the latitude of Cincinnati the planet is observed at a more favourable altitude than at Pulkova, twenty degrees farther north. To these, and chiefly "to the physical association of the double, triple, and multiple suns," he gave his close attention. He made interesting discoveries in the course of this review. "Stars which Struve had marked as oblong, were divided and measured; others marked double were found to be triple." He proposed a new method for observing, and new machinery for recording north polar distances or declinations. Prof. Peirce reported favourably on this method at the meeting of the American Association in 1851, and Prof. Bache, as Superintendent of the Coast Survey, indorsed their approval in his report for that year, presenting also a full account of work done by the new method, in observations made by the enthusiastic astronomer and his patient wife, who assisted him through all. It was claimed that the results rivalled the best work done at Pulkova. Mitchell was the first "to prepare a circuit interrupter with an eight-day clock, and to use it to graduate the running fillet of paper;" and to invent and use the revolving disk chronograph, for recording the dates of star signals. Profs. Bache and Walker had declined to adopt the first of these improvements in astronomical appliances, through an apprehension of injury to the astronomical clock. Mitchell's work proved the apprehension to be groundless. His revolving disk is an invaluable invention. To the perfection of such methods and instruments, together with the routine work of observation, he gave all the energies not of necessity employed in outside labours devolving on him for his support. Unhappily these, at an early date, became almost absorbing. For the Astronomical Society, having secured their observatory and their director, had failed to secure a basis for his support. Mitchell relied on his professorship in the Cincinnati College: in two years the college was burnt down. He then relied on publications and lectures. He published the *Sidereal Messenger*, a work of three volumes. He delivered lectures of rare power and beauty in the chief cities of the Union. He stirred up an enthusiasm by these lectures, which quickened the movements resulting in the establishment of some of the first observatories of this day in the United States. But for his support, unhappily for the observatory, he was compelled to accept the position of chief engineer of the Mississippi and Ohio Railroad from 1848-52; and finally, in 1853, that of director of the magnificent Dudley Observatory at Albany, New York. He did not, however, remove from Cincinnati till 1859. In 1861 his country claimed him from astronomy for her own service. The observatory remained in charge of Mr. Henry Twitchell, of Cincinnati, who was Mitchell's chief assistant for twelve years

On February 1, 1869, Mr. Cleveland Abbe, formerly employed at the Pulkova Observatory, and more recently at the United States Naval Observatory at Washington, accepted the place of director. His first annual report submitted a plan of wide and useful astronomical and magnetic and geodetic investigations. On these he entered vigorously. He first adopted for the United States the issuing of daily meteorological bulletins, now so widely known as adopted and used by the United States Signal Service Bureau.

During the years since Prof. Mitchell's leaving the institution, its future had appeared dark enough. In taking charge of the Dudley Observatory in 1859 he announced his expectation that "the Cincinnati Observatory was soon to be placed on a permanent foundation, and that each observatory would be occupied on a star catalogue down to the tenth magnitude." But it is not surprising that the interval of the war should retard the plans he had formed, and prevent, under all circumstances, their subsequent execution by his successors.

But in 1870 a movement was originated by Abbe, which, at the time this article was written, promises by its development to secure results worthy of the noble founder of the observatory, and of the West. A tripartite agreement has been secured between Mr. Longworth's heirs, the Astronomical Society, and the city, by which the sale of the old site was permitted, and the city pledged to maintain the observatory in connection with the university; original investigations, and not mere educational uses being guaranteed as its object. On Mount Lookout, one, of the highest points in Hamilton County adjacent to a park not likely to be built up to the injury of astronomical observations, the corner-stone of the new observatory was laid, August 28, by the mayor of Cincinnati. The observatory is to be 71 ft. by 56 ft., with an elevation of 60 ft. It will be built of brick, trimmed with freestone. The pier of the Munich equatorial is to be of solid brick, with like capping; its height 30 ft., and its diameter 17 ft. The iron revolving turret dome adds half a storey. The meridional instruments occupy the wings.

The whole new enterprise owes its success thus far to the munificence of Mr. John Kilgour, of Cincinnati, who granted the site and a liberal grant of money. Cincinna holds that she has good ground of expectancy of success. What they need, what every observatory needs, is, first of all, an astronomer with provision for his maintenance, that he may be "free from other avocations and cares."

FIG. 1.—Ormsby McKnight Mitchell.

A true astronomer, then, first of all—before even the most imposing edifice or instruments. An astronomer with a true conception of his work, with the splendid objects before him, and the advantages of our day, may largely repay the benefactions of the liberal by the lasting benefits not of mere theory, but of the practical usefulness of discovery.

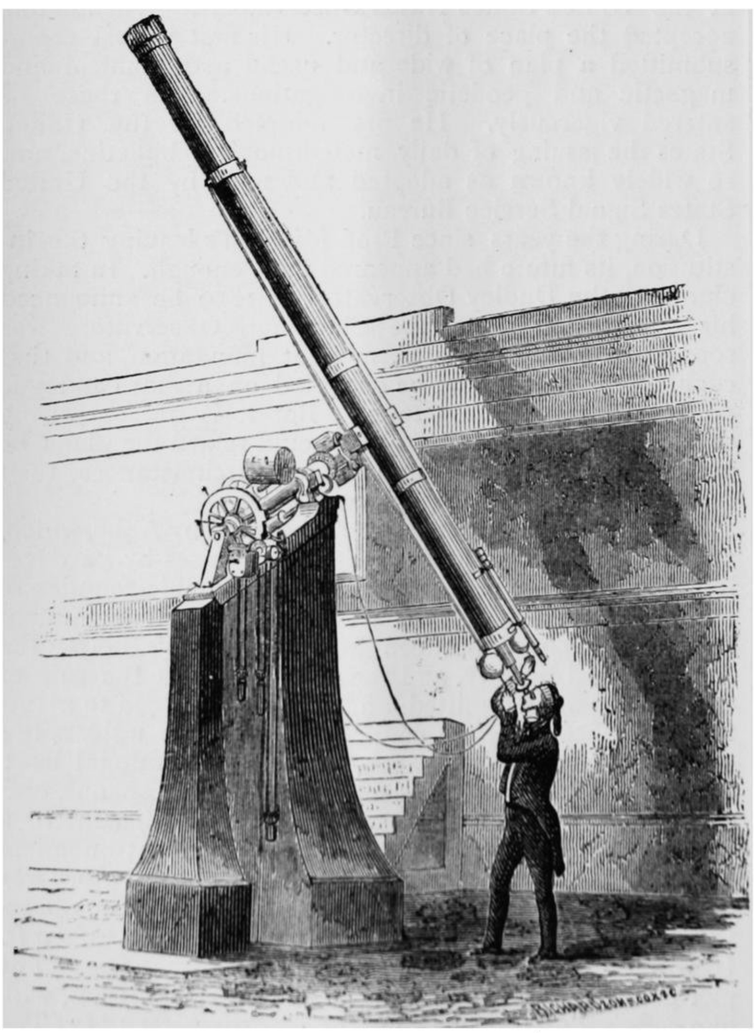

FIG. 2. The Equatorial of Cincinnati Observatory.

The U.S. Naval Observatory.—The history of this Observatory is not a little remarkable.

Close on the isle on which stood what was known as the "Washington property," near the old Capitol, stood, in 1833, an unpretending wooden building but 16 ft. square, erected at the expense of a lieutenant of the navy, and equipped with a 5-foot Troughton transit instrument. This was the United States Naval Observatory in embryo.

The transit was one of the instruments made for the Coast Survey, under the supervision of Mr. Hassler, its first superintendent, during his long detention in England, by the breaking out of the war. Returning only in 1815, and the survey itself being soon arrested by Congress, his instruments and the "fixed observatory," the establishment of which he was the very first in the United States to propose, rested quietly *in statu quo ante bellum.* In 1832 the Coast Survey was revived; but as an observatory was peremptorily forbidden by the law, the transit was lent to Lieut. Wilkes for his observations.

Lieut. Wilkes's observations were, however, at first only for obtaining clock errors, needed for determining the true time for rating the naval chronometers then under his charge. This testing of all the chronometers and other naval instruments used by the United States ships (begun in 1830 by Lieut. Goldsborough) had been at once found a wise and useful economy for the navy. The Secretary, therefore, established this little receptacle for charts and instruments by placing an officer in charge' permitting him to build his own little observatory and do

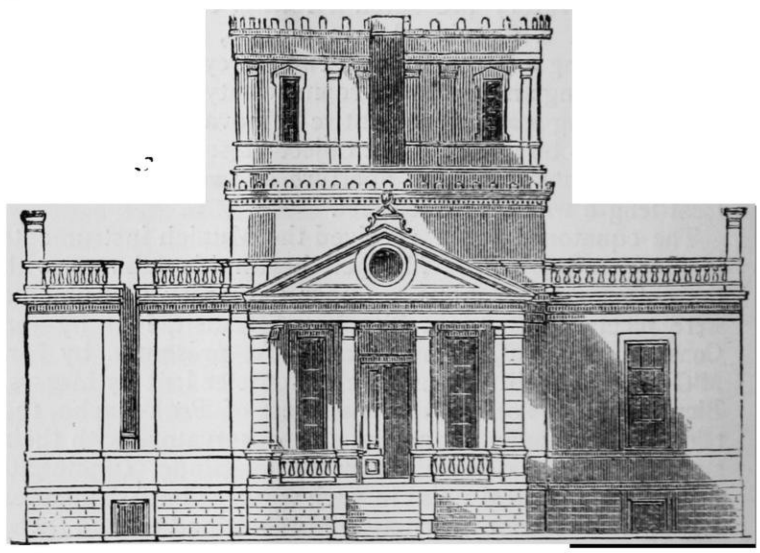

FIG. 3.—New Cincinnati Observatory—Front elevation.

his own work. The "Depôt" was the christening then given to the establishment. This was all that Wilkes or any one of his successors dared call it even as late as 1842, when establishing the present astronomical institution.

But in 1838 a new call was made upon the Depôt, which turned the whole current of its future. The exploring expedition was about to sail for the South Seas. It would be of prime importance, in determining the longitude of places to be visited by the expedition, that corresponding astronomical observations should be made at home, to be compared on its return. Secretary Paulding gave the observations in the United States to Lieut. Gilliss, Wilkes's successor at the Depôt, and to Prof. Bond, of Cambridge. For the years 1838-42 Gilliss worked most accurately and unremittingly. With the help of an achromatic telescope, added by the Navy Department, and the transit before mentioned, he observed and recorded 10,000 transits; and his observations, afterwards tested by Prof. Peirce, were ranked by him among the highest then made. They are in the libraries of the astronomers of Europe. They procured, in fact, the founding of the present Naval Observatory.

For this, however, hard work in abundance was to be done. Gilliss urged the unsuitableness of his building erected alongside of Wilkes's wooden square room, and his want of space to erect a permanent circle. He won over the old Navy Commissioners and the indorsement of the Secretary to their recommendation for something better. He pressed the Naval Committees frequently and closely, but enlisted scarcely one, except Mallory, of the House. Almost to a man they kept away from the Depôt, although it was "so near," and no help seemed available. But a celestial visitant now appeared, as, singularly enough, another did in 1843 for the benefit of the Cambridge Observatory. It gained the day for Gilliss, and for an observatory at Washington. He had closely observed Encke's comet, and read a paper on it before the National Institute. When he made, shortly after this, his last intended visit to the Senate Committee, Preston of South Carolina asked, "Are you the one who gave us notice of the comet? I will do all I can to help you." In a week a bill passed the Senate; and, strangely enough,

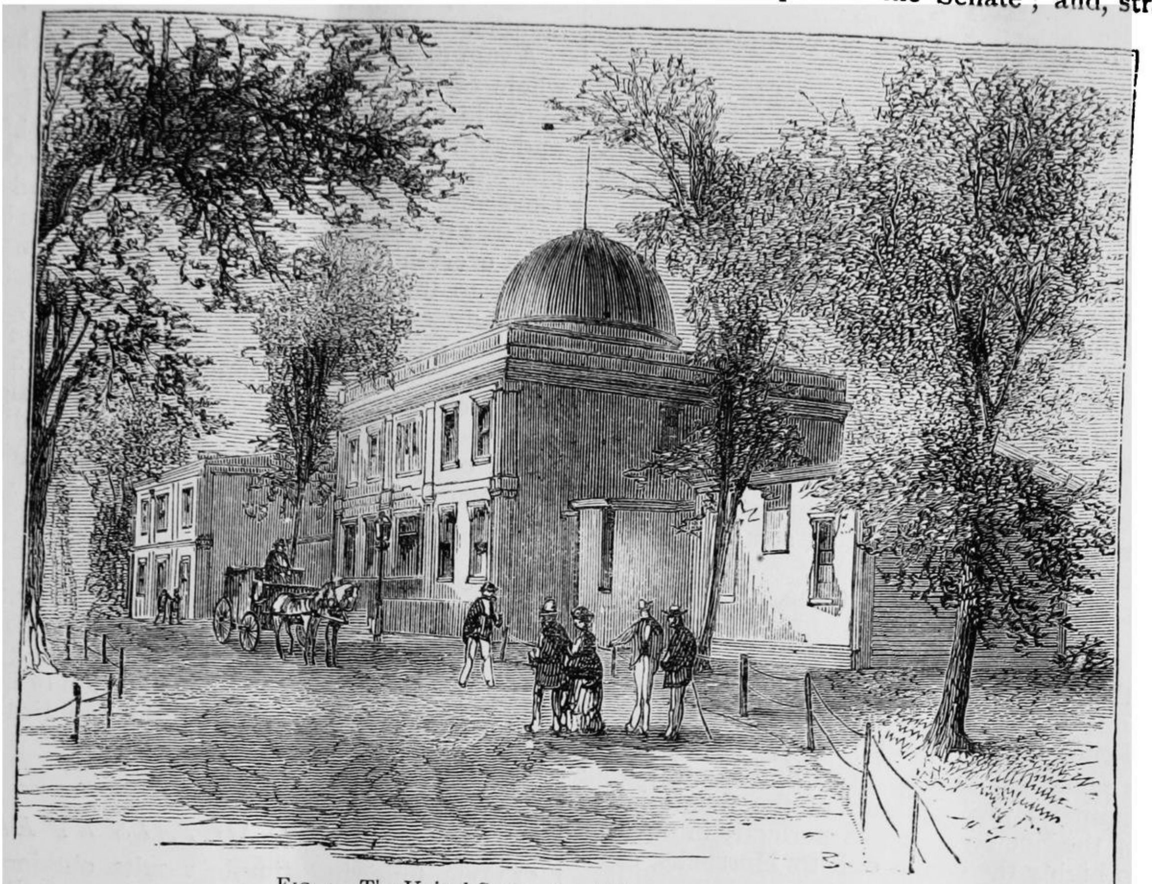

FIG. 4.—The United States Naval Observatory, Washington.

passed the House also, without discussion, on the last day of its session. It appropriated 25,000 dols.; but still "for a Depôt of Charts and Instruments."

But the Secretary of the Navy was no longer officially bound by the name. The report of the committee, which secured the bill, was so expressly in favour of astronomical, meteorological, and magnetic objects, that Congress was justly understood to sanction them. Gilliss was sent abroad for instruments and plans for an observatory.

The site chosen by President Tyler for the building was fraught with historic interest. The square embraces a little more than nineteen acres in measurement. It is now tastefully laid out and ornamented. Nearly central within it stands the building represented

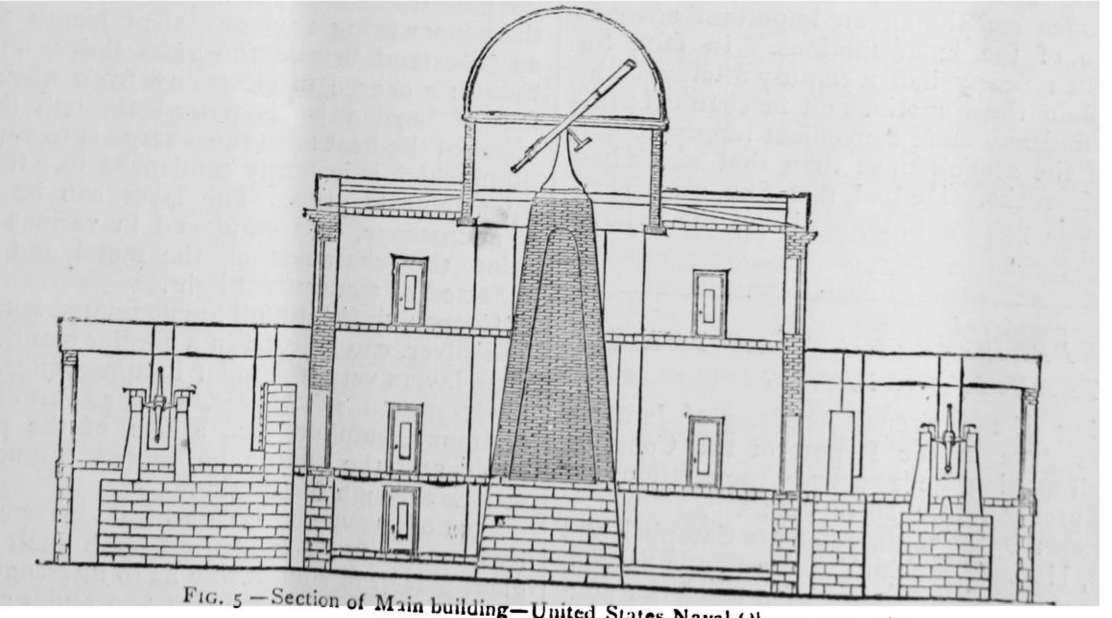

FIG. 5—Section of Main building—United States Naval Observatory, 1844.

in Fig. 4. It is on the second highest eminence within the city limits, commanding the view of the public buildings, of the neighbouring cities of Georgetown and Alexandria, and of Arlington.

In 1844 Gilliss reported the completion and equipment of the central building. He had secured the excellent equatorial, the meridian circle, the transit, prime vertical, and mural circle on which so much valued work has been done. He had begun a library, to which nearly 200 volumes of the highest standard works were presented by the Greenwich, Paris, Berlin, and Vienna institutions.

(*To be continued.*)

A MONUMENT TO JEREMIAH HORROCKS

AT the last meeting of the Royal Astronomical Society Prof. Adams said that he had been requested to call the attention of the Society to a petition which was about to be presented to Dean Stanley. It would speak for itself, and he would therefore read it to the meeting. It ran thus:—

To the Very Reverend the Dean of Westminster.

Reverend Sir,

It appears to us that the approaching transit of Venus offers a fitting occasion for the erection of a memorial to Jeremiah Horrocks, curate of Hoole, in Lancashire, to whom the science of astronomy is indebted for the earliest observation of Venus upon the sun's disc. He predicted, by his own calculations, the transit of the year 1639, which he and his friend Crabtree had the exclusive privilege of witnessing. The labours of Horrocks in connection with this memorable occurrence, as well as the originality of his views on other astronomical subjects, have, by the unanimous consent of scientific men, assigned to him a high place in the roll of illustrious astronomers who adorned Europe in the seventeenth century.

We therefore venture to request your permission to place in Westminster Abbey a tablet or some other memorial of Jeremiah Horrocks.

We have the honour to be,

Reverend Sir,

Your obedient Servants,

(Signed) by the Astronomer-Royal, the President of the Royal Astronomical Society, and a number of the most distinguished Fellows of the Society.

Prof. Adams remarked that he need not say anything further to recommend the signature of the memorial to the Fellows of the Society. It was perfectly impossible to estimate too highly the credit due to Horrocks, especially when his age and opportunities were taken into account. Not merely had he been successful in observing the transit of 1639, but he had first corrected the tables of Venus, from his own observations, and had thereby rendered his prediction of the transit possible. Had he merely followed the tables which had been published by Kepler, he could not have predicted the transit, and it would probably have slipped by unobserved. And this was by no means the only astronomical service rendered by Horrocks. His discovery of the law of libration of the moon's apogee constituted an important advance in the knowledge of the lunar motions. In fact, Sir Isaac Newton, when nearly half a century afterwards he attempted to explain those motions on mechanical principles, could not find any more convenient representation of the motion of the moon's apse than that which had been given by Horrocks. He had, therefore, great pleasure in bringing this petition to the notice of the Fellows of the Society

FRENCH PREPARATIONS FOR THE TRANSIT OF VENUS

AT the meeting of the French Academy of June 29, M. Dumas gave in the Report of the Commission charged with making the necessary preparations for observing the approaching transit of Venus.

The stations chosen by the commission are Campbell and St. Paul Islands, Nouméa, Pekin, Yokohama and Saigon. Each expedition is under the charge of a chief, the conduct of the first having been intrusted to M. Bouquet de la Grye, the second to M. Mouchez, the third to M. André, the fourth to M. Fleuriel, the fifth to M. Janssen, and the sixth to M. Hérault. The observers altogether number twenty five, accompanied by twenty-five assistants. M. Bouquet de la Grye has already left; M. Fleuriel is on the point of setting out for Pekin. M. Janssen loses no time in leaving for Yokohama, from which he will not return directly to Europe, having undertaken to go to Siam to observe the eclipse which will be visible there.

As Campbell and St. Paul Islands are perfectly barren, the expeditions destined for them have been specially cared for, being furnished with fuel and provisions for six months.

A sum of 300,000 francs was allotted by the State for the whole of the expeditions; but this sum having been found insufficient, the Minister of Marine has abundantly and generously provided for the wants which have been pointed out by the Commission. Indeed, the French Government has acted in the most handsome manner towards the various expeditions, which have been furnished with everything that is in any way necessary.

As to instruments, besides those which have been specially constructed for the enterprise, the depôt of Marine has placed at the disposal of the expeditions a large number of instruments, among which are thirty-one tested chronometers. Four of the expeditions have each received an equatoreal of 8 in. No expedition from any other country, the Report states, will be possessed of instruments so powerful. Equatoreals of 6 in. have been furnished to the six expeditions, and telescopes of the same power as those adopted by the various expeditions of other countries.

Various photographic apparatus and methods of observation have beer proposed. The Commission has decided in favour of the system of M. Fizeau, who has himself superintended the construction of instruments and initiated the operators in all the practical details which they ought to follow.

ON VAPORISING METALS BY ELECTRICITY

THE following simple results obtained by frictional electricity may be of interest, perhaps too of use in the investigation of certain minerals and the action of intense heat upon them.

The description of a characteristic experiment is all that will be necessary to explain the process and to show how similar results may be obtained from other substances. A very fine thread of sheet platinum, of about an inch in length, is placed between two microscopic slides of glass, and two pieces of thin sheet copper with rounded ends are placed in contact with the extremities of the platinum, the copper being any convenient length and breadth, so as to extend beyond the glass slides, but not to be as broad; a charge of electricity from about eight square feet of Leyden jar is passed through the metals; the effect of the heat from the charge is to vaporise the platinum, which is instantly condensed in a transparent layer upon the cold glass. The layer can be investigated by a microscope, and employed in various ways to determine the character of the metal and its effect upon reflected or transmitted light.

Copper, tinfoil, tinfoil amalgamated with mercury, gold and silver, can be used in a similar manner, but they produce layers very dissimilar in appearance. To act upon finely-ground substances, such as vermilion, sulphate of antimony, sulphur, &c., a line of the powder must be made and the charge be passed through in the same way as through the platinum.

Part of the vapour escapes from between the slides, but this can easily be condensed upon each of two pieces of glass placed in such a way as to intercept the vapour as it passes from between the two slides; it is then condensed in a long but narrow line. The manner in which the glass is affected by the heat, and the concussion produced by the expansion of the vapour, are worthy of notice.

Considerable difficulty will be found in vaporising copper, doubtless from its being such an excellent conductor. Some of the powdered substances appear to require a small spark to be passed through them before they allow a larger charge to pass, as if the particles needed polarisation.

G. H. HOPKINS

THE HERPETOLOGY OF NEW GUINEA*

DR. ADOLF BERNHARD MEYER, who, as most of the readers of NATURE will be aware, has lately returned from a very successful expedition to New Guinea, has published in the "Monatsberichte" of the Berlin Academy a short account of his herpetological discoveries, which present several points of interest. Previous investigators of the natural history of this wonderful land have paid more attention to its birds than to its reptiles and amphibians—a circumstance perhaps scarcely to be wondered at in the land of paradise-birds and so many other anomalous forms. Dr. Meyer, however, while he has by no means neglected the class of birds, as shown by his recent communications upon that branch of zoology to the Academy of Vienna, has likewise paid much attention to the representatives of the inferior orders of reptiles and batrachians which he met with in New Guinea and the adjacent islands. Although this branch of the Papuan fauna is well known to be comparatively poor, Dr. Meyer's labours have been by no means without result. Of sixty-three different forms belonging to these orders of which he collected specimens, thirty-four have turned out to be new to science; and of the remaining twenty-nine, the greater part were previously not known to occur in this locality.

Of tortoises, besides the marine *Chelone imbricata*, only one was obtained in New Guinea, which, however, was of a new species belonging to an Australian form. Of lizards, upwards of thirty species were collected, amongst which Australian types are again predominant. Amongst the sixteen serpents met with in New Guinea, Jobi, and Mysore, were several of special interest. The Australian carpet snake, *Morelia*, is represented by an allied form, proposed to be called *Chondropython*, besides which two other new genera are described, one belonging to the boas, and the other to the colubrine snakes.

Of batrachians, Dr. Meyer collected specimens of nine species in New Guinea and its islands, five of which he considers to be hitherto undescribed.

It will be thus evident that Dr. Meyer has made a by no means inconsiderable addition to our knowledge of this branch of the Papuan fauna. At the same time it cannot be supposed that we are, as yet, by any means perfectly acquainted with the herpetology of New Guinea when so little is known of the vast interior of this strange country.

COGGIA'S COMET

AN observation taken here on July 4, shows so close an agreement with the position calculated from my parabolic elements in NATURE (vol. x. p. 149), that it appears unlikely the comet can have so short a period as 137 years, and consequently that, notwithstanding similarity of orbits, it probably is not identical with the body observed by the French Jesuits in China in July 1737. Between April 17, the date of discovery, and July 4 it had traversed an arc of just 90° of true anomaly, and if any decided ellipticity existed, so wide an arc must have shown it, the stellar appearance of the nucleus having admitted of very exact observation throughout. On July 4, twenty-one days after the last position I employed in determining the orbit, the computed right ascension differs only 20", and the declination 14" from the observation. In all probability, therefore, the comet has not visited these parts of space within many centuries.

Measures of the diameter of the nucleus on July 4 gave nearly 14 seconds of arc, the distance of the comet at the time, by my elements, being 0·6016, which indicates a real diameter of about 3,750 miles; it has, perhaps, slightly contracted within the last fortnight.

This morning Mr. W Plummer, at this observatory, found the comet equal in brightness to *α* Persei, a second magnitude star in Argelander's Atlas.

I may here mention that for calculation of actual dimensions or distances I take the sun's parallax, after M. Leverrier = 8″·86, which, combined with Capt. A. R. Clarke's value of the earth's equatorial semi-diameter, gives for the mean distance of the earth from the sun, 92,268,000 miles, a figure that I believe to be as probable as any now to be attained. The moon's mean distance from the earth, adopting Prof. J. C. Adams's parallax, is thus found to be 238,800 miles, or 60·273 equatorial radii of our globe.

J. R. HIND

Mr. Bishop's Observatory,
Twickenham, July 7

DE CANDOLLE'S PROPOSED "PHYSIOLOGICAL GROUPS" OF PLANTS

IN the *Archives des Sciences Physiques et Naturelles*, No. 197, M. de Candolle proposes a new classification of the vegetable kingdom, based on the physiological relations of plants to heat and moisture, which he believes affords a means of tracing the connections of recent and fossil floras in a way which neither botanical nor geographical grouping do. He makes six divisions altogether.

1. The first of his "physiological groups" consists of those which need much heat and much moisture, and to them he gives the name Hydromegatherm, or, for short, Megatherm. These at present live in the tropics, and sometimes as far as 30° N. and S., in warm and damp valleys, where the temperature is never below 20° C., and the rains never fail. The predecessors of the existing Megatherms were widely spread, but at the commencement of the Tertiary period they became confined pretty much to the equatorial zone. Their botanical characters vary considerably, and they are represented in almost all cases by different species in Asia, Africa, and America. The most characteristic families are Menispermaceæ, Byttneriaceæ, Ternstrœmiaceæ, Guttiferæ, Sapindaceæ, Dipterocarpeæ, Sapotaceæ, Apocinaceæ, Aristolochaceæ, Begoniaceæ, Piperaceæ, &c.

2. His second group requires heat with dryness—Xerophiles he proposes to call them. Their present distribution is in dry and warm regions of from 20° or 25° to 30° or 35° on each side of the equator (their particular districts are carefully noted). The group includes a large proportion of Compositæ, Labiatæ, Boraginaceæ, Liliaceæ, Palmæ, Myrtaceæ, Asclepiadaceæ, Euphorbiaceæ; but the most characteristic are Cactaceæ, Ficoideæ, Cycadaceæ, Proteaceæ, and Zygophylleæ. There are few large trees, few annuals, and the aspect of vegetation is but meagre. The palæontology of the regions where Xerophiles now exist is too little known for us to be able to trace the former migrations of plants forming this group.

3. The third group includes those plants which require a moderate heat, 15° to 20° C., and moderate moisture, and are named Mesotherms. They are now found around the Mediterranean, in the slightly elevated regions of India, of China, Japan, California, Central United States,

* "Uebersicht der von mir auf Neu Guinea, und den Inseln Jobi, Mysore, und Mafoer im Jahre 1873, gesammelten Amphibien." Von Dr. Adolf Bernhard Meyer. (Berlin: Monatsb. Akad., 1874.)

the Azores, and Madeira, and in the plains and low valleys of Chili, Monte Video, Tasmania, and New Zealand. Their characteristic families are the Laurineæ, Juglandeæ, Ebenaceæ, Myricaceæ, Magnoliaceæ, Aceraceæ, Hippocastaneæ, Campanulaceæ, Cistiaceæ, Philadelphiniæ, Hypericaceæ, mixed however with a large number of Leguminosa, Compositæ, Cupuliferæ, Labiatæ, &c.

4. The fourth group is of plants of temperate climates having annual means of 14° to 0° C., and these are named Microtherms. In Europe they occupy plains from the Cevennes and Alps to the North Cape, in Asia from the Caucasus or Himalaya, to 65°, in America from 38° or 40°, to 60° or 65°. They are also met with in Kerguelen, Campbell, and the Malonine Islands, and the mountains of New Zealand. No characteristic families are enumerated, as it is the absence of forms that are usually Mesotherms and above all of Megatherms or Xerophiles, which distinguishes this group.

5. The fifth group is of plants living in arctic or antarctic regions, or high on mountains in temperate regions. They need but little heat, and hence are called Hekistotherms. One of their important characteristics is that they can endure the absence of light during the time they are covered with snow. Though no family belongs entirely to this group, Mosses, Lichens, Grasses, Crucifers, Saxifrages, Roses, and Composites bear a large proportion to the whole. Some species of Betula, Salix, Empetrum, Vaccinium, and certain Conifers also are Hekistotherm.

6. The sixth group includes exceptional plants; those requiring a mean annual temperature of more than 30° C., for which the name Megistotherm is proposed.

After the description of his proposed groups, M. de Candolle at once faces an objection he sees is sure to be raised, and that is the difficulty of classing a species under any one particular group. His reply is that it is always possible to do so if due attention is paid to the conditions under which it lives, both by studying the climatal conditions of its native country, and by experimental culture. Fossil plants, he admits, can only be classed by analogy; but he very justly adds that in determining their botanic affinities in like manner there is generally nothing but analogy to rely on, flowers and fruits being wanting. In answer to the possible objection that there are transitions from one group to another, and that the limits are arbitrary, he is content to reply that though a classification based on botanical characters may be more precise, the limits of geographical groups and of geological periods are equally wanting in exactness.

The fact that his physiological groups in no way coincide with established botanical or geographical groups is worth notice. All families that are at all numerous in species are represented in more than one of these physiological groups, and sometimes in them all. To give only one instance, the Primulaceæ live in almost all cold and temperate regions, and yet the Myrsineaceæ, which are their woody representatives, are found in the tropics. Even in genera which have not many varieties of form, the same is the case. The Cassias, for example, are mostly Megatherms or Mesotherms, yet *Cassia marylandica* flourishes at Geneva, where the winter minimum is sometimes 25° C. Some willows flourish far north, yet *Salix humboltiana* is met with in the district of the Amazon, and *Salix safsaf* grows in Egypt.

Is there any connection between the physiological properties of plants and the form of their organs of vegetation? M. de Candolle thinks not. For example: there is no recognisable difference between the forms and tissues of ferns which we have to preserve in hot-houses and those which will grow in the open air. There are many facts such as these which seem to show that there is no direct relation of cause and effect between the form and those physiological qualities of plants which have reference to climatal conditions. There is rather a dependence on some common cause which has influenced both sets of phenomena, which M. de Candolle refers to heredity. A species has a particular form because its ancestors had a form more or less the same. It has certain physiological qualities with reference to climate because the exterior conditions which have been imposed on it through innumerable ages have prevented other qualities from being developed and have secured the heredity of those which have enabled it to live. This, he considers, is the key to the explanation why a flora of any particular climate does not present in the totality of its species any distinctive peculiarities. Arctico-Alpine plants are of different families, and it is impossible to point to any development of an organ which cannot also be met with in tropical plants. The ascendants of Arctico-Alpine plants have lived together, and only certain of them have lived together through changes of temperature. Physiological qualities may be changed in length of time when exterior conditions have not changed in such a way as to cause a species to perish. M. de Candolle lays great stress on the fact we learn from the experience of horticulturists, that it is much more rare to obtain any change in the power of a plant to endure modifications of climate than it is to obtain change of form. A period of greater length than the historic period of Europe seems to be needed for a modification of physiological conditions; witness the fact that for some 3,000 years the date has been grown in Greece and Italy without any success in getting the fruit to ripen. The fact that physiological conditions are so much more permanent than form is to M. de Candolle a strong argument in favour of his physiological groups. The impossibility of making geographical groups perfectly true, together with the fact that the climates of each region have changed from one period to another, is also claimed as additional argument in favour.

For the purpose of showing that these groups make the facts of geographical botany, both of geological and present times, more precise and more easy of discussion as regards general laws, their distribution in Europe since the commencement of the Tertiary period is taken as an illustration. The works of Gœppert, Heer, Unger, Garovaglio, Ch. T Gaudin, Saporta, &c., have supplied M. de Candolle with his data, and on comparing the fossil floras with recent forms he has had no difficulty in classifying them according to his groups. He, of course, goes on the hypothesis that like forms have sprung from like antecedents possessing like hereditary physiological properties. As an illustration that any uncertainty there may be is within limits, he points out that though a fossil Ficus might be taken for a Megatherm or Mesotherm, it could never be mistaken for a Microtherm or Hekistotherm, since we do not now know any Ficus capable of resisting such cold. A fossil Betula may have been Microtherm or Hekistotherm, but not Megatherm.

Acting on these hypotheses he has reduced his results to tabular form, prefacing the remark that his great difficulty has been to class the different fossil floras according to geological periods that could be relied on; stratification and not palæontology being the only safe basis of relative age grouping.

Different climates prevailed in different parts of Europe during the Tertiary period as well as now, and he urges it must be recollected that when two fossil floras (faunas equally so) which are much alike are met with in widely separated latitudes, they cannot have been contemporaneous. In the same latitude, too, difference of elevation will have had a similar effect to difference of latitude. Floras of quite different facies may therefore have been contemporaneous.

In transcribing the following table and explanations we have given only the name of the author who has described the floras. M. de Candolle gives exact references to the works where the descriptions may be found.

Distribution of Physiological Groups in Europe since the Commencement of the Tertiary Period according to our present knowledge of Existing and Fossil Floras

Lat. N.	Tertiary: Eocene Lower	Eocene Middle	Eocene Upper	Miocene Lower	Miocene Upper	Pliocene	Quaternary: Glacial	Recent	Lat. N.
90								E	90°
85								E	85
80				? $C^{13}+D^{4}$			? E^{4}	E	80
75								E	75
70				$C^{14}+D^{5}$				D	70
65								D	65
60							E^{1}	D	60
55	A^{6}			C^{9}			D^{3} E^{2}	D^{1} D	55
50	$A^{5}+C^{12}$	? A^{4} $A^{3}+C^{11}$		$A^{1}+C^{8}$	C^{7} C^{6}	C^{2}	D^{2} E^{3}	D	50
45			$A^{2}+C^{1}$	C^{5}	C^{4}		C^{1}	C+B	45
40								C+B	40
35						? C^{3}		B	35
30								B	30
25								B A	25
20								A	20
15								A	15
10								A	10
5								A	5
0									0

EXPLANATION OF THE TABLE

A.—*Megatherms.*

A. Existing Megatherms.
A^1. Beds of Monod, Paudeze (Heer). Mesotherms are mixed with Megatherms.
A^2. "Gypses d'Aix." Megatherms with Mesotherms C^{10}.
A^3. Chiavone and Salcedo (Massalongo). Mesotherms are mixed with Megatherms but the former are in large proportion.
A^4. "Sables supérieurs du Soissonnais" (Watelet), containing a large proportion of Megatherms. The stratigraphical position of these beds, it should be noted, is inferred from palæontological evidence rather than from superposition.
A^5. Bolca (Massalongo), although mixed with Mesotherms, Megatherms preponderate.
A^6. Sheppy (Bowerbank, Ad. Brongniart, Lyell).

B.—*Existing Xerophiles.*

The countries where fossil floras of this character are to be expected have not been worked geologically, and no bed containing Xerophiles is known.

C. *Mesotherms.*

C. Existing and recent Mesotherms.
C^1. Many floras in the south-east of France worked out by Saporta.
C^2. Meximieux (Saporta).
C^3. S. Jorge, Madeira (Heer).
C^4 and C^5. South-east of France (Saporta). Some Megatherms occur in his lists, but they do not form a fourth part of each flora.
C^6. Piedmont (Sismonda).
C^7. Œningen (Heer).
C^8. Monod, Paudeze (see A^1).
C^9. Dantzig (Heer). The lower bed contains Sequoid, Smilax, Myrica, Ficus, Lauraceæ, Juglandaceæ, &c.
C^{10}. "Gypses d'Aix" (see A^2).
C^{11}. Chiavone and Salcedo (see A^3).
C^{12}. Bolca (see A^5).
C^{13}. Spitzbergen (Heer), mixed with Microtherms D^4
C^{14}. Iceland (Heer), mixed with Microtherms D^5.

D.—*Microtherms.*

D. Existing and recent Microtherms.
D^1. Cannstadt alluvial deposits.
D^2. Laminated lignites of Durnten (Heer).
D^3. Cromer forest bed (Lyell, Heer).
D^4. Spitzbergen (Heer), mixed with C^{13}.
D^5. Iceland (Heer), mixed with C^{14}.

E.—*Hekistotherms.*

E. Existing Hekistotherms.
E^1. Southern Sweden, Denmark (Nathorst).
E^2. Mecklenburg and Cromer below the forest bed (Nathorst).
E^3. Glacial clay of Schwerzenbach—between Zurich and Constance—(Nathorst).
E^4. Superficial diluvium of Spitzbergen (Heer).

Signs.

+ When two groups are united by the plus sign it means that at least one-fourth of the flora is made up of the second group indicated.
? The note of interrogation is used to imply that the geological age of the bed is doubtful.

Setting out with the belief that at a most remote period there was all over the globe a high and nearly uniform temperature, followed by a gradual cooling and the development of diversities in climates M. de Candolle proceeds to show that the earliest plants must have been Megistotherm. With the exception of the carboniferous, we are too imperfectly acquainted with the floras of Primary and Secondary periods to trace their distribution. At the commencement of the Tertiary period Megatherms occupied all the then land surfaces up to 58° The other groups became gradually separated, and migrated as increase of cold drove them from their former areas. The means by which this was effected is a matter of hypothesis, but it is not hypothesis to say that the various groups never sprung from a single group. It cannot be proved that there formerly existed a single form of vegetation, while M. de Candolle urges that the surface of the globe certainly had formerly one uniform climate. The distribution of physiological groups indicates two sorts of floras, one migratory, the other fixed. Intertropical floras have had but few vicissitudes, arctic and antarctic have experienced many.

We submit this *résumé* of M. de Candolle's proposal and illustration without at present offering any remarks.

NOTES

The usual programme of the forthcoming (the 44th) meeting of the British Association at Belfast has been issued. The First General Meeting will be held on Wednesday, Aug. 19, at 8 A.M. precisely, when Prof. Williamson, F.R.S., will resign the chair, and Prof. Tyndall, F.R.S., President-elect, will assume the presidency, and deliver an address. On Thursday evening, Aug. 20, at 8 P.M., there will be a Soirée; on Friday evening, Aug. 21, at 8 P.M., a Discourse by Prof. Huxley, F.R.S.; on Monday evening, Aug. 24, at 8.30 P.M., a Discourse by Sir John Lubbock, Bart., M.P., F.R.S.; on Tuesday evening, Aug. 25, at 8 P.M., a Soirée; on Wednesday, Aug. 26, the concluding General Meeting will be held at 2.30 P.M. The following are the officials of the various sections:—A, Mathematical and Physical Science.—President: Rev. Prof. J. H. Jellett, M.R.I.A. Vice-Presidents: Prof. Everett, F.R.S.E.; Prof. Purser, M.R.I.A. Secretaries: Prof. W. K. Clifford, F.R.S.; J. W. L. Glaisher, F.R.A.S.; Prof. Herschel, F.R.A.S.; Randal Nixon; G. F. Rodwell, F.R.A.S. B, Chemical Science.—President: Prof. A. Crum Brown, F.R.S.E. Vice-Presidents: Prof. Maxwell Simpson, F.R.S.; Dr. Debus, F.R.S. Secretaries: Dr. J. F. Hodges, F.C.S.; W. Chandler Roberts, F.C.S.; Prof. Thorpe, F.R.S.E. C, Geology.—President: Prof. Hull, F.R.S. Vice-Presidents: Prof. Harkness, F.R.S.; Prof. Geikie, F.R.S. Secretaries: Louis C. Miall; R. G. Symes. D, Biology.—President: Prof. Redfern, M.D. Vice-Presidents: Dr. Hooker, C.B., Pres. R.S.; Sir W. R. Wilde; J. Gwyn Jeffreys, F.R.S. Department of Anatomy and Physiology.—Prof. Redfern (president) will preside. Secretaries: Dr. J. J. Charles; Dr. P. H. Pye-Smith. Department of Zoology and Botany.—Dr. Hooker, C.B., Pres. R.S. (vice-president), will preside. Secretaries: Prof. W. T. Thiselton-Dyer, Prof. R. O. Cunningham, F.L.S. Department of Anthropology.—Sir W. R. Wilde (vice-president) will preside. Secretary: F. W. Rudler, F.G.S. E, Geography,—President: Major Wilson, F.R.S., Director of the Topographical Department of the Army. Vice-presidents: Sir Bartle Frere, G.C.S.I., K.C.B., F.R.G.S.; Admiral Ommanney, C.B., F.R.S.; Major-General Strachey, F.R.S.; Secretaries: E. G. Ravenstein, F.R.G.S.; E. C. Rye; J. H. Thomas, F.R.G.S. F, Economic Science and Statistics.—President:——. Vice-presidents: W. Donnelly, C.B.; Prof. T. E. Cliffe Leslie. Secretaries: F. P. Fellowes, F.S.A.; E. Macrory. G, Mechanical Science.—President: Prof. James Thomson, F.R.S.E. Vice-presidents: Sir John Hawkshaw, F.R.S.; Sir Charles Lanyon. Secretaries: James Barton; E. H. Carbutt; J. N. Shoolbred, F.G.S.

THE announcements for holding the twenty-third meeting of the American Association for the Advancement of Science at Hartford, Connecticut, on Aug. 12, have been issued by the secretary, in which we are informed that the head-quarters will be at the State House. Dr. John L. Leconte, of Philadelphia, is president of the coming meeting; Prof. C. S. Lyman, vice-president; F. W. Putnam, of Salem, permanent secretary; Dr. A. C. Hamlin, general secretary; and William S. Vaux, treasurer. The Hon. H. C. Robinson is chairman of the local committee.

A MARBLE *replica* of Woolner's remarkably fine bust of the late Prof. Sedgwick has just been placed in the hall of the Geological Museum in Jermyn Street, the gift of a lady who wishes to be anonymous. The School of British Geology is now well represented in this museum by the busts of the following geologists:—Hutton, Playfair, Sir James Hall, William Smith, Greenough, Buckland, De la Beche, Forbes, Murchison, and Sedgwick.

IT will be heard with regret that Dr. J. Hughes Bennett has been obliged, on account of his health, to intimate his resignation of the Chair of Physiology in the University of Edinburgh. It is understood that Dr. McKendrick, Dr. Bell Pettigrew, and Prof. Rutherford will offer themselves for the vacant chair.

PROF. SCHROEDER of Erlangen (*Deutsche Archiv fur Klinische Medicin*) confirms, by a remarkable case occurring in his own practice, the previous observations of Winkel and C. Braun, of the occasional occurrence of small cysts in the mucous membrane of the vagina of pregnant females containing some kind of air. These cysts he proposes to call air-cysts. When they are opened the air escapes with a report or crack. These observations, if verified by subsequent inquirers, will form a remarkable addition to the pathology of gaseous secretion or production.

THE Observatory at Kiel, of which Dr. C. A. F. Peters is director, is to be removed to Altona, in order to be in closer connection with the University.

THE death is announced of Mr. Henry Grinnell, of New York, whom the English public will remember in connection with the Grinnell Arctic Expedition.

AT the distribution last week of prizes at King's College, Mr. W. E. Forster, M.P., gave an address in which, among other subjects, he contrasted the expense of educating a boy from the age of nine to twenty-two at the older schools and universities with the cost of education during the same period at King's College; in the former case it is between 1,600*l*. and 1,800*l*., in the latter only 400*l*. Mr. Forster also referred to the superior advantages, in some respects, of German over English schools; he might at the same time have pointed out that a German boy can obtain the best education which his country can give at a cost of something like 5*l*. a year, which for the thirteen years between nine and twenty-two amounts to the ridiculously small sum of 65*l*.

AT St. John's College, Cambridge, in April 1875, there will be offered for competition an Exhibition of 50*l*. per annum for proficiency in Natural Science, the Exhibition to be tenable for three years in case the Exhibitioner have passed within two years the Previous Examination as required for candidates for honours: otherwise the Exhibition to cease at the end of two years. The candidates for the Exhibition will have a special examination (commencing on Saturday, April 3, at 1 P.M.) in (1) Chemistry, including practical work in the laboratory; (2) Physics, viz. Electricity, Heat, Light; (3) Physiology. They will also have the opportunity of being examined in one or more of the following subjects—(4) Geology; (5) Anatomy; (6) Botany, provided that they give notice of the subjects in which they wish to be examined four weeks prior to the examination. No candidate will be examined in more than three of these six subjects, wherof one at least must be chosen from the former group. It is the wish of the master and seniors that excellence in some single department should be specially regarded by the candidates. They may also, if they think fit, offer themselves for examination in any of the Classical or Mathematical subjects. Candidates must send their names to one of the tutors fourteen days before the commencement of the examination. The Exhibition is not limited in respect to the age of candidates, and is not vacated by election to Foundation Scholarships.

THERE will be an examination at Queen's College, Cambridge, on Thursday, Oct. 8, 1874, for an Exhibition for proficiency in Natural Science, open to all persons under twenty years of age who shall not have commenced residence in the University. The Exhibition will be of the value of 40*l*. per annum. Candidates will be required to pass an examination in elementary classics and mathematics. No Exhibition will be given unless the examiners report that a candidate merits such a distinction. Each candidate must forward to the President of the College before the day of examination a certificate of birth or baptism, and a certificate of good conduct from a graduate of Cambridge, Oxford, or Dublin. The successful candidates will be required to enter their names on the boards of the College and to commence residence at once. Further particulars will be furnished by the Rev. Dr. Campion, or the Rev. G. Pirie, Tutors of the College.

THE first number of a new journal, which promises to be an important organ on an important subject, appeared on Saturday last. The *Sanitary Record*, a weekly journal of public health, proposes for its object, to collect and digest information relating to the health of the people, now much scattered, and therefore in a condition much less available for reference and study than it might be. It is also to contain original papers in which sanitary points are discussed in their scientific, social, and legislative aspects; together with reviews of the British and foreign literature of the subject. The staff of contributors includes names of many who hold the highest scientific position, and who are well known as authorities on hygienic matters. Miss Octavia Hill and several other ladies are also included; a paper by Miss Beale, Principal of the Cheltenham College for Ladies, appearing in the first number, while others are promised shortly by Miss Stanley, Miss Hill, and Mrs. E. Maurice. We are convinced that this new journal will fill a gap which has existed for some time; and, from the introductory number before us, we think that no one will have reason to complain of the manner in which it has been organised and started.

PROF. O. C. MARSH, of Yale College, has directed attention, at a recent meeting of the Connecticut Academy of Arts and Sciences, to the peculiarly diminished capacity of the brain-case in some of the Tertiary mammalia of North America. This is most marked in the Eocene genus Dinoceras, an animal which must have been nearly as bulky as a full-sized elephant, and yet its brain could not have been more than one-eighth the average bulk of that in the Indian rhinoceros. In the Miocene Brontotherium the brain-case was considerably large proportionately; and in the Pliocene Mastodon bigger still. These facts have an important bearing on the evolution of mammals, and open an interesting field for further investigation.

AN important addition to ornithological literature has just appeared in the form of Mr. Sharpe's "Catalogue of the Birds in the British Museum," of which the first volume, comprising the Accipitres, or Raptorial birds, is before us.

WE believe that at a recent meeting of the Council of the Zoological Society it was determined that a new building, on a large and much improved scale, should be commenced next spring and completed during the summer, to contain the lions, tigers, and other large feline animals.

THE Senate of the University of London, at a meeting on July 1, adopted the following amendment by 17 votes to 10 on a proposal to obtain a new charter enabling the University to confer degrees on women:—"That the Senate is desirous to extend the scope of the educational advantages now offered to women, but it is not prepared to apply for a new charter to admit women to its degrees."

THE well-known German ethnologist, Dr. A. Bastian, is about to publish a work with maps and illustrations, giving the results of the German expedition to the coast of Loango.

M. LEVERRIER has asked for an authorisation to attend or to send a representative to the Maritime Congress, the programme of which we gave in a recent number.

THE comet is beginning to attract the notice of the general public. Telescopes are let on hire in several parts of Paris to get a view of it.

THE balloon of the Observatory of Paris is undergoing repairs under the superintendence of M. W. de Fonvielle. It will be used by him in making ascents in order to verify the law of Barometric pressure calculated by Laplace. Trigonometrical measures will be taken of the balloon by the astronomer of the Paris Observatory. The balloon is a silk one worth 1,600*l.*, which was built during the war and was used for making captive ascents by the *armée de la Loire*. It is to be called the *Neptune*.

SCIENTIFIC ascents are becoming numerous in Paris. Last Friday a balloon was sent up from La Villette gasworks to try an apparatus invented by M. Jules Godard to ascertain whether the balloon is descending or ascending. The motor of the apparatus is a large horizontal disc, which is pushed by air pressure and puts in motion an electrical signal. The contrivance is rather heavy and bulky, and the rate of motion gives no idea of the numerical value of the movement.

WE take the following from the *Academy*:—"Some of the American papers state that Prof. Huxley is likely to be the successor of Prof. Agassiz, at Harvard. We hope there is no truth in this. Are the English Universities so rich in really eminent professors, and so poor in money, that they can or must allow Prof. Huxley to go to America in order to find leisure for work? It would require nothing but the will for either Oxford or Cambridge to offer Huxley two or three thousand a year, without anybody suffering for it. There are hundreds of non-resident Fellows, doing no good to the University, doing harm to themselves in resting on their oars, when they ought to be pulling with all their might. Why not give five or ten such Fellowships to men like Huxley, and make the Universities again what they were in the middle ages, the very centres of intellectual force and light in the country? The Universities are so rich that they could beggar the whole world. Will they allow themselves to be beggared by Harvard?"

THE first number of the *Linguist and Educational Review*, a monthly journal devoted to language, antiquities, science, and education, has appeared; its object is the popular treatment of the various branches of ethnology, folk-lore, and kindred subjects. This first number contains an interesting article on practical education, in which the wider use of the natural sciences in schools is advocated and the disproportionate amount of time spent on the study of the classics deprecated. It also contains several other interesting articles in ethnology, &c. We gladly note that the editor intends to give a portion of space monthly to the proceedings and papers of local scientific societies.

AT the General Monthly Meeting of the Royal Institution, on Monday, the Secretary reported that Lady Fellows, the widow of Sir Charles Fellows, who was long a member and frequently a manager of the Royal Institution, had bequeathed to the Institution her drawings of Sir Charles's celebrated collection of watches, bequeathed to the British Museum.

ARRANGEMENTS have been concluded between the proprietors of the *Daily Telegraph* and Mr. Bennett, proprietor of the *New York Herald*, under which an expedition will at once be despatched to Africa, with the objects of investigating and reporting upon the haunts of the slave-traders, of pursuing the discoveries of Dr. Livingstone, and of completing if possible the remaining problems of Central African geography. This expedition has been undertaken by and will be under the sole command of Mr. Henry M. Stanley.

AT the fortieth Annual Meeting of the Statistical Society, held on June 30, the report showed an increase of seventy-six Fellows in the year ending December 31, 1873. By consequence, the financial state of the Society is satisfactory, the surplus of assets over liabilities being 2,508*l.* Dr. Guy was re-elected president.

IT was reported last week that the cable steamer *Faraday* (see NATURE, vol. x. p. 64) had struck on an iceberg off Halifax and became a total wreck. Happily this rumour has been proved to be without foundation.

ON Saturday last, July 4, a meeting of the Council of the Royal School of Mines was held at the Jermyn Street Museum, at which the reports of the examinations of the students connected with that institution were received and considered, and the prizes awarded. The following gentlemen received the diploma of Associate of the Royal School of Mines:—Mining, Metallurgical, and Geological Divisions, S. A. Hill and W. Saise; Mining and Metallurgical Divisions, R. Cowper, A. R. Guerard, C Lloyd Morgan; Metallurgical Division, W. Pearce; Geological Division, A. R. Willis and W. Frecheville. The two Royal Scholarships of 15*l.* each for first year's students were awarded to Henry Louis and E. Fisher Pittman; H.R.H. the Duke of Cornwall's Scholarship was awarded to A. R. Willis, and the Royal Scholarship of 25*l.* to W. S. Lowe; the Edward Forbes Medal and prize of books were awarded to A. R. Willis; the De la Beche medal and prize of books to C. Lloyd Morgan; the Murchison Medal and prize of books to A. R. Willis.

THE Quarterly Weather Report of the Meteorological Office has been issued, containing the observations of the seven observatories from April to June 1873.

THE additions to the Zoological Society's Gardens during the last week include a Himalayan Bear (*Ursus tibetanus*), presented by Mr. George Lockie; two Red Kangaroos (*Macropus robustus*) from Australia, presented by the Acclimatisation Society of Melbourne; two Audouin's Gulls (*Larus audouini*) from Sardinia, presented by Lord Lilford; a Kappler's Armadillo (*Tatusia kappleri*) from Surinam, deposited; two Musquashes (*Fiber zibeticus*) from North America, received in exchange; a Harpy Eagle (*Thrasaëtus harpyia*) from Paraguay; seven Ariel Toucans (*Ramphastos ariel*) from Brazil, purchased; a Collared Fruit Bat (*Cynonycteris collaris*), born in the Gardens.

SCIENTIFIC SERIALS

THE current number of the *Journal of Anatomy and Physiology* contains several papers of interest. Dr. Binz commences with an article On some effects of alcohol on warm-blooded animals, in which he supports the non-heating action of alcohol, considering the subjective impression as partly the consequence of the irritation of the nerves of the stomach, and of the enlargement of the cutaneous vessels. The cooling effect of alcohol on febrile conditions is demonstrated and shown to depend on its direct diminution of the activity of the cellular elements of the body, on the increase of the cutaneous circulation which arises from strengthening of the heart's action, and in the diminution of muscular activity which follows its exhibition. —Dr. J. Blake continues his observations On the action of inorganic substances when introduced directly into the blood, endeavouring to show that in the same isomorphous group of elements, the intensity of physiological action increases as the atomic weight of the elements. but the relative atomicity of groups which are not closely related shows no corresponding gradation. The salts described on the present occasion are those of the alkaline earths.—Prof. Cleland discusses double-bodied monsters (kittens), and the development of the tongue in them, that organ being frequently found situated in the nasal passages, the palate at the same time being cleft.—Dr. C. Reyher described points connected with the cartilages and synovial membranes of joints, showing that the "synovial process," or portion of the synovial membrane which lies over the borders of the cartilages, is not to be looked upon as an ingrowth of the synovial membrane but as being formed *in situ* as the development of the joint proceeds. Mr. Reoch endeavours to account for the presence of free hydrochloric acid in the gastric juice, the constant presence of which he gives experiments in proof of, on the far-fetched assumption that the oxidation of the sulphur which is contained in albumen takes place in the walls of the stomach; that the sulphuric acid thus formed decomposes the sodium chloride, liberating free hydrochloric acid to form part of the gastric juice.

Prof. Turner having had a second specimen of the Greenland shark (*Laemargus borealis*), is enabled to give an account of parts omitted in the original description, to be found in the same journal of the year previous. He gives a drawing of the animal, which was six feet long. It was male, and the sexual organs are described. The testes possess no vasa-deferentia, their products must therefore be shed into the peritoneal cavity, whence they reach the exterior water through the abdominal pores. The ureters were found to combine before they entered the cloaca by the single duct.—Prof. Savory has a paper On the use of the ligamentum teres of the hip-joint, in which he endeavours to prove the idea, which, as he remarks, had been previously suggested by the late Prof. Partridge and by Prof. Turner, that the body is slung on the two ligaments as a carriage is on C-springs. Prof. Humphry criticises Mr. Savory's results, restating his former remarks that the ligamentum teres is not tense in the erect posture.—Prof. Turner, in description of variations in the arrangement of the nerves of the human body, mentions a branch from the fourth cranial nerve to the orbicularis palpebrarum. In another instance the same nerve sent a branch to the infra-trochlear of the nasal. Peculiarities in the various plexuses are also noted.—A loquacious paper follows by Dr. Radcliffe on the syntheses of motion, vital and physical, in which it is attempted to be shown, that in muscle the state of rest is that of contraction, the state of action relaxation. —Mr. Ogilvie and Mr. Cathcart give the dissection of a malformed lamb.—Prof. Crum-Brown gives an ingenious explanation of the sense of rotation and its connection with the semicircular canals, connecting it with the inertia of their contents affecting the peripheral ends of the auditory nerves.—Dr. Brunton proves the value of external warmth in preventing death from an over-dose of chloral.—Mr. F. Champneys gives a detailed description of the septum of the auricles of the frog and the rabbit.—Mr. J. C. Ewart describes the epithelium in front of the retina and the external surface of the lens.—Dr. J. Ogle describes and figures a man born without legs.—Prof. Turner gives a drawing of the surface of the brain in its relation to the skull, which is followed by part of his paper on the placentation of the sloths, which we have noticed on a former occasion.—Notes on some muscular irregularities, follow, by Prof. Curnow; and the papers of the number end with three short notes by Mr. G. J. M. Smith, Mr. J. A. Russell, and Mr. Bellamy, on the dissection of an excised elbow, on unusually large renal calculus, three inches long, and a fusion of some of the carpal bones, repectively.

Bulletin Mensuel de la Société d'Acclimatation de Paris.—In his anniversary speech, reported in the Bulletin for April, M. Drouyn de Lhuys, the president, gives an interesting account of the victories of acclimatisation in the case of the coffee plant, the product of which, now universally esteemed, would never have been general but for its transplantation from its native home, Abyssinia, into other parts of Africa, into Europe, Asia, America, and those East and West Indian Islands which are now its best producers.—M. H. Bouley follows with an exhaustive paper on the subjection of animals by man to his own purposes. He analyses the various effects of food, of climate, of locality, of selection, and other influences on the natures of animals, and shows how our principal useful animals, such as the horse and the dog, have gradually, by dint of the constant exertion of various powers, been brought to their present state of subjection.—The annual report of the Society gives a retrospective glance at the year's work. Among birds the principal acquisitions have been varieties of pheasants, black swans, and Chilian geese. Among fishes, the telescope fish, the rainbow fish of China, and the *gourami*, are the most remarkable. Among plants, numerous Australian trees, acacias, and others; various kinds of bamboos; the *Eucalyptus*, fairly acclimatised in Algeria; and China grass, which promises to form a useful textile fabric, have been introduced.

Zeitschrift für Ethnologie.—Recent numbers of the *Zeitschrift für Ethnologie* have been continuing and concluding the series of papers in which its readers have been put in possession of a very minute summary of Col. Dalton's official report on the ethnology of Bengal, translated by Herr Oscar Flex, missionary in Ranshi. These valuable reports proclaim the remarkable dissimilarity which prevails in the domestic habits and national customs of tribes presenting strong linguistic and psychical affinity with one another. Thus amongst the Manipuris, who may possibly, however, be of Aryan descent, although they have long been followers of the religion of Brahma, and claimed him for their proto-genitor, the women enjoy perfect freedom, both in regard to their control of the household and their participation in games in which men take part; and although the husband may divorce his wife on good grounds, if he ventures to do so witho out valid reason the woman may leave him and appropriate to herself all his possessions, with the exception of a cup and his loin-cloth. These people also celebrate feasts at which meat is partaken of, contrary to the proscriptions of their present form of religion. Among the neighbouring Kukis no such practices prevail, the men drinking and smoking apart in their festive gatherings, and celebrating solemn festivals by visiting the graves of their forefathers to consult oracles and seek for omens. In the country of the Kasias, where Lieut. Bedingfield was murdered two years after its annexation to our Indian empire, monoliths and other stone memorials are common, and for the most part present great similarity to the menhirs and cromlechs of Cornwall and Brittany. The Garos, whose country lies west of Kasia and extends in the south and east as far as the Brahmaputra, are but little known beyond their own frontiers, while the mountainous districts of their settlements continue to be almost wholly unexplored. These tribes claim to be a primitive people, while, like the Brits, they pretend to have affinity with the English races.—Dr. J. G. Wetzstein gives an interesting account of the ancient Hebrew threshing board, still in use in Syria, where every village has its communal threshing ground to which the neighbouring landowners—both great proprietors and the small peasants—bring their grain, mostly on camels, to be prepared on these curious tables or boards. Dr. Wetzstein has laid before the Anthropological Society of Berlin a sample of the stones in use for this simple mechanical contrivance, which appears to be almost unchanged in its structure and mode of use from Biblical times to the present day, and may be seen amongst the Berbers, the Cypriots, and in other parts of Asia Minor, besides Syria.

SOCIETIES AND ACADEMIES

London

Royal Society, June 18.—On the Employment of a Planimeter to obtain Mean Values from the traces of continuous Self-recording Meteorological Instruments, by Robert H. Scott, F.R.S.

The usual method of dealing with barograms and thermograms is to measure them at certain intervals by appropriate scales, and to treat the numerical values so obtained by arithmetical processes so as to arrive at mean results.

At the suggestion of Mr. Francis Galton, the Meteorological Committee gave instructions that measurements should be made of the curves by means of Amsler's Planimeter, in order to test the accuracy of unpublished means.

It is perfectly obvious that the measurement of the area of the curve, if it can be executed with sufficient accuracy, must give a far more satisfactory mode of ascertaining the value of the mean ordinate of the curve, than the calculation of the average of any number of measured individual ordinates, while the economy of time insured by the use of the planimeter forms a most important recommendation for its use.

The mode of employing the instrument is as follows:—The entire perimeter of the curve, down to the base line, is measured, and the value noted. Then *using the same base line*, a rectangle of known height, in units of the scale of the curve, is next measured in the same way, and the value noted again.

The ratio of these two values is the mean value of the ordinate of the curve, or the mean pressure or temperature for the interval embraced by the curve.

The table subjoined to the paper shows for a period of eight months the means of temperature for Kew Observatory obtained by the planimeter, as well as those yielded by the old method, both for daily and for five-day means. It will be seen that the difference in 242 determinations of daily means only amounted to $0^{\circ}.5$ on six occasions, and to $0^{\circ}.6$ in one instance, while out of 49 cases of five-day means the greatest difference was only $0^{\circ}.4$, and this was only once attained.

At the end of the table a column headed "Wr. Rep. Plates" gives the values obtained by measurement of the plates published in the "Quarterly Weather Report" for the period embraced by the measurements to which I have just alluded. It will be seen from it that the five-day means so obtained hardly differ from those which are yielded by the direct measurement of the photographic curve by means of the planimeter.

The plates in question are obtained by the use of Mr. Francis Galton's Pantagraph, which transfers the seconds at a reduced time-scale to zinc plates, which plates are subsequently further reduced and transferred to copper by Wagner's Pantagraph, as explained in the report of the Committee for 1870.

Such a test as this affords a satisfactory proof of the accuracy of the reproduction of our automatic records which are executed in the Meteorological Office.

The result of these preliminary experiments is that the planimeter means are practically identical with those obtained by treatment of the values of the hourly ordinates.

On the diuretic action of *Digitalis*, by T. Lauder Brunton, M.D., and Henry Power, M.B.

The object of this communication is to show that the diuretic effects which follow the exhibition of digitalis depend on the reactionary relaxation which follows the spasm of the smaller renal arteries consequent on the influence of the digitalis, instead of on the direct increase in the arterial blood-pressure, the direct effect of the drug.

An account of certain Organisms occurring in the Blood, by W. Osler, M.D.

In many diseased conditions, and sometimes in health, careful investigation of the blood proves that, in addition to the usual elements, there exist pale granular masses, which on closer inspection present a corpuscular appearance, varying in size from a quarter that of a white blood-corpuscle to enormous masses, with an oval or rounded form, sometimes elongate or irregular. The author watches these bodies at a temperature of 37° C. and finds that they undergo remarkable changes. At first uniform and still, Brownian movements soon commence; fine projections from the mass develop; its edges become less dense, more loosely arranged; semi-free minor corpuscles form, which quickly break away, moving independently in the fluid. Other filaments undergo the same change, fresh detachments becoming so numerous as to fill the field of the object glass. Granules present themselves in abundance. The original mass has now become perceptibly smaller and more granular. The variety of the forms increases as the development goes on; and whereas at first spermatozoa-like or spindle-shaped forms were almost exclusively to be seen, more irregular forms appear later, possessing two, three, or more tail-like processes. It is to be noted that in blood without the addition of saline solution or serum, no change takes place in the corpuscles under consideration, even after prolonged warning. It must still be confessed that we know nothing of the origin or destiny of these corpuscles; they evidently cannot arise from the disintegration of white corpuscles, for they form individual elements circulating through the blood.

On Coniferine and its Conversion into the Aromatic Principle of Vanilla, by Ferd. Tiemann and Wilh. Haarmann. Communicated by A. W. Hoffmann, F.R.S.

Given the number of figures (not exceeding 100) in the reciprocal of a prime number, to determine the prime itself, by William Shanks. Communicated by the Rev. G. Salmon, F.R.S.

Description of the living and extinct races of gigantic Land Tortoises. Part I. and II. Introduction, and the Tortoises of the Galapagos Islands, by Albert Günther, F.R.S.

The author having the opportunity of examining remains of tortoises from the Mascarene Islands concludes that the several extinct gigantic species are different from the more recent ones, and that there is the greatest resemblance between the tortoises of the Mascarene and Galapagos Islands. An historical account is given, which shows that the presence of these tortoises at two so distant stations cannot be accounted for by the agency of man, at least not in historic times, and therefore that these animals must be regarded as indigenous. The second part contains a description of the Galapagos tortoises.

Edinburgh.

Scottish Meteorological Society, July 2. This was the Half-yearly General Meeting of the Society; the Marquis of Tweeddale, president of the Society, in the chair. The report was read by Mr. Milne Home, chairman of the Council, from which it appeared that the Society's stations number at present 104, of which 92 are in Scotland, and that the Society consists of 558 ordinary, 15 corresponding, and 8 honorary members. Observations are made at fourteen stations in Scotland at 12.43 P.M., in connection with the International scheme of Meteorology. The Hon. B. Primrose, secretary of the Fishery Board, who had entered with much zeal into the inquiry into the relations of meteorology to the herring fishery, having intimated that if the Society would furnish the necessary instruments he would endeavour that twenty sets of observations of sea temperature should be carried on during the fishing season, the Marquis of Tweeddale has liberally provided the instruments required. Dr. Arthur Mitchell stated that the Ozone Committee had resolved publicly to invite investigators to submit to them any scheme which in their opinion would increase our knowledge of ozone, and which they were desirous to prosecute if asserted. It is hoped that some line of inquiry likely to lead to satisfactory results will soon be suggested, and whenever this is done the Committee will be prepared to give assistance out of the fund of 100*l.* placed at their disposal by the munificence of the noble President. Dr. Arthur Mitchell and Mr. Buchan read a paper on the influence of seasons on human mortality, which we hope to give next week. Mr. Ballingall, Islay, exhibited and described a new pressure aneometer, invented by him. The instrument consists of a measured surface, which, exposed to the wind, registers its force by means of an index, acted upon by a wooden plunger in a bath of mercury. Mr. Thomas Stevenson, C.E., described a portable barometer made of malleable iron, which he suggested for portable purposes. The instrument also contained an ingenious arrangement suggested to him by Mr. E. Sang. Iron will also be very suitable for water or oil barometers in which a very large scale is desirable for showing sudden changes in the atmospheric pressure, the accurate observations of which are likely to grow in importance from year to year.

Berlin

German Chemical Society, June 8.—C. Rammelsberg, president, in the chair.—G. Langbein described the manufacture of iodide of potassium from iodide of copper, containing 60—66 per cent. of iodine, which is now largely imported from Peru. It is transformed into HI by treating it with SH_2 and then saturated with carbonate of potassium.—J. Thomsen maintains his view against that expressed by Berthelot, who believes the existence of definite hydrates of acids and alkalis to be proved by the heat of combination.—M. Nencky, by heating acetate of guanidine, has obtained a new monoatomic base, guanamine, of the formula $C_4N_5H_7$.—The same author has obtained a direct combination of oxalate of ethyl with sulpho-urea.—K. Heuman communicates observations on cinnabar. Light transforms it into the black modification, particularly when obtained by precipitation. Metallic copper at 100° separates mercury from it in the metallic state. —C. Liebermann, by treating benzoyl-benzoic acid $C_{14}H_{10}O_3$ with sulphuric acid, has transformed it into anthracen-sulphuric acid.—A. W. Hofmann has investigated residues of the aniline manufactory of M. Weiler in Cologne, consisting of pure phenylene-diamine.—K. Wippermann publishes new investigations on the condensed hydrocyanic acid $C_3N_3H_3$ lately obtained by Langé. It is always formed when hydrocyanic acid is kept with a small quantity of alkali, and then distilled. It is extracted from the residue by ether. Hydrate of baryta transforms it into glycocol. Its formula appears to be $N\equiv C-C(NH_2)H-C\equiv N$, the nitrile of amido-malonic acid.—H. Schiff assigns the formula of a dilaureate of glycerine to the fat of laurel, which has hitherto been considered as a derivative of allylic glycol.—L. Henry proves the formula of lactide to be doubly as large as has been admitted until now = $(C_3H_4O_2)_2$.—The same chemist described derivatives of propargyl C_3H_3 with Br, Br_3 and Br_5, of chloride of allyl with HBrO and of chloral with monochlorhydrin of glycol.—C. Kaiser showed a set of very exact weights cut in rock crystal and obtained from the manufactory of Hermann Stern in Oberstein, near Kreuznach.

Paris

Academy of Sciences, June 29.—M. Bertrand in the chair.—Gen. Morin communicated to the Academy a telegraphic despatch from the Emperor of Brazil, sent from Rio de Janeiro on June 23, and received in Paris on the 24th.—The following communications were read: On a new property of metallic rhodium, by MM. H. Sainte Claire Deville and H. Debray. When iridium and rhodium are precipitated from their solutions by formic acid or alcohol, the finely divided metallic powders possess remarkable properties. The rhodium thus obtained decomposes alcohol (in presence of alkali) hydrogen being liberated and an acetate produced. Formic acid is decomposed by the same substance into carbon dioxide and water. Platinum and palladium in the same condition do not attack formic acid, while iridium and ruthenium act like rhodium. M. A. Ledieu presented the concluding portion of his researches on the theory of the collision of bodies with consideration of atomic vibrations. —On the spectra of vapours at high temperatures, by Mr. J. N. Lockyer. This paper contains the results of experiments already communicated to the Royal Society and published in NATURE. —Report on the state of the preparations for the expeditions sent by the Academy to observe the transit of Venus on Dec. 9, by M. Dumas.—Report on the administrative measures to be taken for the preservation of territories threatened by *Phylloxera*, by the Commissioners. It is suggested to the Academy that a special law should be made compelling proprietors to declare the first appearance of the scourge, that experts should then be appointed to examine into the state of the infested vines, and that these should be destroyed when thought necessary by ministerial decision, the proprietor receiving adequate compensation. It is further suggested to destroy the vines surrounding the districts actually invaded, to disinfect the soil by chemical methods, and to burn the cuttings, leaves, and roots of the diseased plants as well as the plants themselves in the same district where the uprooting has taken place, and finally to prohibit with the utmost rigour the exportation from infested territories of anything that might serve as a vehicle for the insect.—M. Heis communicated a letter sent by him to M. Faye concerning the studies recommended to the observers of the forthcoming transit of Venus. The author suggests the observation of meteors and the zodiacal light with respect to colour, intensity, form, &c.; also of the milky way and of polar auroras.—On the temperature of the sun, by M. J. Violle. The author gave a description of the apparatus employed by him in this inquiry. A determination made at Grenoble on June 20 at 3.30 gave the temperature 1,354°, but to get at the true temperature of the sun this number must be corrected for atmospheric absorption and other causes. To eliminate these errors the author has made several ascents of the Alps, but the results are not yet made known.—Some remarks were made on the foregoing paper by M. H. Sainte-Claire Deville, and M Berthelot communicated a paper *à propos* of these remarks entitled "On high temperatures."—On the application of carbon disulphide mixed with tar and with alkalies for the destruction of *Phylloxera*, by M. C. Monestier.—M. Lecoq de Boisbaudran communicated a note on the use of carbon disulphide for the same purpose.—On a point in the theory of functions, by M. Halphen.—Geometrical integration of the equation $L(xdy - ydx) - Mdy + Ndx = 0$, in which L, M, and N designate linear functions of x and y, by M. Fouret.—New method for determining the index of refraction of liquids, by MM. Terguem and Trannin. The authors gave a description of their apparatus and some of the results obtained by it.—On electro-static phenomena in voltaic batteries, by M. A. Angot. —On the evaporation of liquids at temperatures above their boiling points, by M. de Gernez.—On new apparatus called *accelerometers*, for the study of the phenomena of the combustion of gunpowders, by MM. Deprez and H. Sebert.—Note on an intestinal calculus of the sturgeon, by MM. Delachanal and Mermet.—Results of the employment of phenol in burials, by M. Prat.—On the publication of the observations of meteors made by M. Coulvier-Gravier, a letter from M. Schiaparelli.—On the structure of the caudal appendage of certain ascidian larvæ, by M. J. Giard.—On the presence of lead in the brain, by M. Daremberg. This was found after cases of lead-poisoning.—M. Chatin was elected during the meeting to supply the vacancy in the botanical section caused by the death of M. C. Gay.

CONTENTS