THURSDAY, MARCH 9, 1876

CAROLINE HERSCHEL

Memoir and Correspondence of Caroline Herschel. By Mrs. John Herschel. (London: John Murray, 1876.)

ASTRONOMY may justly claim to be one of the most comprehensive branches of human knowledge, not merely from the immeasurable extent of the region which it undertakes to investigate, but from its embracing in a common boundary, and directing towards a common end, mental processes and lines of study which otherwise would have found but little ground for convergence and combination. It is, perhaps, not generally understood how varied are the courses, or how distinct the attainments, of those who are comprehended under the general title of "astronomers," or how strong, more especially, is the demarcation between the pursuit of theory and the practice of observation. Very different are the requirements of Greenwich and Parsonstown. The collection of facts, and the investigation of the laws which are gathered from those facts, are entirely distinct processes, and though the qualifications demanded separately for each have occasionally been found in combination, yet more frequently they have existed in individuals who have had little in common besides the general end of their pursuit. Laplace or Clairaut would have exhibited but little aptitude for wielding the instruments of Slough, and many an eye that has rested with the liveliest interest on the magnificence of the lunar scenery, or the mysterious glories of those regions where the great Creator has "sowed with stars the heaven thick as a field," would pore in vain on a page of intricate analytical formulæ, or perhaps turn from it with a feeling of positive dislike and annoyance.

At the head of the observing class in his own day everyone will recognise the name of William Herschel. He did not, indeed, stand as prominently alone as was formerly supposed in the adopted country which was so justly proud of him, for he had left a worthy rival in his native land, where Schröter, armed at first with his opponent's instruments, and afterwards with those of Schrader of Kiel, was doing most earnest and faithful work in his own way. On the moon, indeed, and on Venus and some of the planetoids, Schröter not only held his own, but gained an advantage which has been more fully appreciated as years have passed away. But in the starry heavens, where Schröter was inefficient, Herschel was supreme; and in his hands sidereal and nebular astronomy started out at once into a prominence which it has since fully maintained. Before his time some forty double stars had been casually noticed; his catalogues comprised about 700; and the host of nebulæ grew in far higher proportion, from 103 in Messier's list, to 2,500, a great part of them most delicate and difficult objects. Nor was our own system without its corresponding enlargement, in a new and important planet at an unsuspected distance, with a train of most minute attendants, to say nothing of two additional satellites of Saturn: nor had the solar phenomena ever been so fully investigated or so clearly described. No wonder that the records of English science should adorn the name of Herschel with a pre-eminent glory—

> "Gloria sideribus quam convenit esse coævam,
> Et tantum cœlo commoriente mori."

But other talents, and those of a high order, were combined in the case of this illustrious man. Inheriting a family gift, he had been originally a musician of considerable eminence—not only the organist of a fashionable chapel in Bath, and sometimes giving thirty-five and thirty-eight lessons per week to lady-pupils, but rising above the ordinary level as a writer of good music. It is matter of great regret that much of his composition has been irrecoverably lost: but a portion seems to be still existing, and we earnestly hope may yet appear in a public form. It was, however, of more importance to one of the very first astronomers that he should also be one of the very first opticians of the age, and in Sir W. Herschel this was fully carried out. In him a consummate knowledge of practical optics aided the keen vision of the observer. Others had indeed attained great and perhaps equal perfection in the manufacture of reflecting telescopes. Those of the celebrated Short, though on the inferior Gregorian construction, were remarkable for their distinctness; nor had he shrunk from 12-inch apertures, or nominal powers, even in this case, of 100 per inch, though it may be feared that actual measurement would have considerably reduced their value. And as regards mere size, the French optician Noël, after many attempts, succeeded, in 1772, with a mirror of 2 feet, which, mounted as a Cassegrain, bore a power of 528, though with what distinctness does not appear, nor where the remains of this Colossus may be now. But the multitude of specula that Herschel had wrought—more than 400 of 7, 10, and 20-feet focus—before he succeeded to his satisfaction, and the wholly unprecedented effort that placed the 40-foot telescope at his command, merely constituted him the chief optician of his day; to this was added the special talent of acute and most persevering observation, which he possessed in very full development, and employed to the utmost, even to a very advanced age, and with a result exceeding all anticipation.

Any one, however, who has some practical acquaintance with the labour of observation with the larger class of telescopes, will readily perceive that such researches, especially when combined with such heavy and continuous optical work, could never have been accomplished alone. This must be eminently the case when far-stretching tracts of sky have to be explored for unknown objects; the distinct and equally important tasks of observing and recording are so incompatible as to be beyond the grasp of the most accomplished astronomer. Assistance must be had, and that no ordinary kind of assistance, but such as may really answer to its name—carelessness, or tardiness, or awkwardness being fatal in such a case to the idea of effectual aid. That Sir W. Herschel found in his sister Caroline such an assistant as materially contributed to his own success has long been familiarly known; but it has not been so generally understood how able was her co-operation, how laborious her night-watchings, how persevering her attention, how utterly unselfish in its absorbing and generous attachment her devotion to her brother's pursuits. It was to bring into due notice so uncommon a character, which from its very constitution ever shunned the exposure of publicity, that the book now lying before us has been written. We will not predict for this memoir a brilliant but ephemeral popularity; it may be thought deficient in attractiveness by general and unscientific readers; and perhaps a very natural partiality may have led to the introduction of a good deal of unimportant and rather heavy detail; but it is a book full of interest for those on whose account we may suppose it to have been especially written; whose scientific tastes and leanings, particularly if connected with astronomical or optical pursuits, will awaken in them a ready sympathy with the difficulties, the labours, and the triumphs of those with whose domestic habits and inner life they are thus brought into familiar contact, and for the first time; for, as the authoress remarks, no good biography of Sir W. Herschel exists—a reproach, surely, to our astronomical literature.

As to the interest excited by the portrait of her own very remarkable and original character, exhibited in her own correspondence; how the talent, hidden during a neglected and almost menial youth—for she speaks of having tasted the drudgery of the scullery—was developed and cultivated by the brother who fully appreciated her abilities; how her unwearied industry and diligence could only be surpassed, if they were surpassed, by his own; how she gladly did his behests as a public singer; how they were for many years inseparable companions; how she attended upon him during the tedious polishing of his mirrors, often feeding him bit by bit when he was unable to leave off for meals, in one such instance for sixteen consecutive hours; how she prepared his astronomical work, watched with him through nights when the ink was frozen by her side, and calculated for him in days when others would have sought repose or amusement; as to all these evidences of talent and skill and patience, dedicated simply and humbly, and with the most complete disregard of health and even of personal safety, and utter abnegation of every selfish thought and feeling, to her dear brother's service, we would refer our readers to the book itself. In the portraiture of a very uncommon character they will assuredly not be disappointed.

But it contains also much interesting detail as to that brother's life, and draws a picture of his proceedings in many respects unlike what we, for our own part, had been used to suppose. Very little, we find, did he enjoy of that "retired leisure" which such a man should have had at command. His privacy is exhibited as mercilessly interrupted by the natural, but inconsiderate, curiosity of visitors. The munificence of his royal patron was interfered with very unjustifiably by "shabby, mean-spirited advisers." The labour and anxiety connected with the 4-foot mirrors, on which at one time no less than twenty-four men in two relays were kept polishing day and night, while he personally superintended the whole, and never allowed himself to sit down to table, told seriously on his health, and once caused his life to be for some time despaired of; and speaking of his latter days his sister remarks, "we have all had the grief to see how every nerve of the dear man had been unstrung by over-exertion; and that a farther attempt at leaving the work complete became impossible." Much of explanatory and connecting material would be required for such a memoir as is due to William Herschel; but what is here given is especially characteristic and valuable. We are led, while on the subject, to introduce a few anecdotes long ago communicated to us by one who in youth knew Sir William well, and which, we believe, are comparatively unknown. His regular after-dinner toast, according to the custom of those days, was "Success to astronomy." There was a vein of humour in his disposition, as is frequently seen combined with eminent talent; and on one occasion he sent his young companion upstairs to his wife's room to look at an extraordinary star, on which a telescope, which was called hers, was pointed. He did so, and found it was the figure of a star, fastened to, or represented in, the wall of Windsor Castle. When he had discovered the planet formerly called by his name, Sir Joseph Banks and other Fellows of the Royal Society attempted, to no purpose, to catch a sight of it. Finding this to be the case, he had a portable tube constructed of silk, packed it up with his mirrors, travelled to London, appointed a meeting with the doubters on the roof of Somerset House, and there exhibited to them the object which they had sought in vain; on which Sir Joseph took off his hat and made him a bow, an example which was followed by the rest of the company. It is greatly to be regretted that the biography of his illustrious parent was never taken in hand by one so especially qualified to fulfil the task as his equally gifted and equally celebrated son, some of whose beautiful letters, addressed to his aunt after her return to Hanover, form a great attraction in the volume of her Memoirs.[1] But we yet hope that the task may be accomplished, and that his most valuable papers, now stowed away, as it were, in the "Philosophical Transactions," may be published in a collected and more accessible form; and thus a monument raised to his well-earned fame, more permanent, at least as far as optics are concerned, than the works of his hands. For these, unfortunately, were of a perishable nature, owing to the defective character of the material which alone he could make subservient to his purpose. No specimen of the alloy of tin and copper employed can be expected to remain untarnished for any considerable time; and the restoration of its brilliancy can only be attained by the destruction of its original figure: if rendered by extraordinary skill as perfect as before, it will still not be the unaltered result of the great master's hand. We do not know whether a single mirror of Herschel's may now be remaining untarnished and untouched: an especially sad fate, we are reluctant to add, has befallen the much-valued 6-inch mirror which Caroline Herschel used so frequently, and bequeathed to the Royal Astronomical Society as an especially safe depositary for so precious a relic. Tarnished by a singular accident while in the temporary care of other parties, it was, we understand, attempted to be repolished without the Society's knowledge; but so unskilfully was this done, that it has not only lost its original figure, but now possesses none of any value at all; the very tube had to be patched to accommodate the lengthened focus; and the donor would hardly recognise her favourite instrument again.

One cannot but regret that such wonderful skill and

[1] There is a singular error in one of these letters (p. 288) describing the re-discovery of Enceladus, where *bdoro* has been printed for *below*. At p. 317 the word *tubes*, which has been introduced as a correction or explanation in one of Miss Herschel's letters, is a mistake.

labour should have been expended upon a material so little capable of doing it justice, when the employment of silvered glass would have given entire permanency to the beautiful curves which Herschel knew how to bestow. But that invention was reserved for Foucault at a later day. Had Sir W. Herschel known of it, the 4-foot mirror would not only have been of far easier workmanship, but would still be ready for a comparison of its merits, as to which there has been much discussion, with the productions of modern days. This, however, is rather matter of curiosity than of real use. It is no detraction from Herschel's well-deserved reputation to suppose that the four MS. volumes which he left behind, containing all the details of his experiments and processes, would be found to add little to the knowledge now possessed by our most successful reflector makers. As to metal-working, difficulties equal, and greater, have been encountered and vanquished by Lassell and the Earl of Rosse: as to silvered glass, Steinheil indeed has abandoned the undertaking, and of the quality of the great French reflectors we know little on this side of the Channel; but the near approach to perfection in the hands of English artificers, and especially of With (who, we are glad to hear, is contemplating an increase in his apertures), leaves no room for regret on that score. Never, probably, were reflecting telescopes more faultless than now; never could they challenge so fearlessly a comparison with the great achromatics of the day. May astronomers be found who shall be capable of working them to their fullest capacity and for their noblest end. But whatever future advances may be in store for us, whether in the optician's or the observer's hands, nothing in either respect will ever detract from the honour of Sir William Herschel, or of her whose memoirs we have now been perusing with so much interest. Her brother's place indeed might more easily be supplied: one equal to herself, as the most efficient, unwearied, self-denying, devoted of assistants we can scarcely expect to see again.

T. W. WEBB

MORESBY'S "NEW GUINEA AND POLYNESIA"

Discoveries and Surveys in New Guinea and the D'Entrecasteaux Islands. A Cruise in Polynesia and Visits to the Pearl-shelling Stations in Torres Straits by H.M.S. *Basilisk.* By Capt. John Moresby, R.N. With Maps and Illustrations. (London: John Murray, 1876.)

NEW Guinea has been much before the public recently. As our readers know it has been the field of a number of small exploring expeditions, the somewhat fragmentary results of which have only served to whet our appetite for more information. Most of these expeditions, under such men as Meyer, Beccari, D'Albertis, and Miklucho Maclay, have been occupied with the western part of the island, our knowledge of the eastern and larger half having been practically almost a blank. Capt. Lawson's wonderful work (NATURE, vol. xii. p. 83) with its abundance of astounding statements can scarcely be regarded as a contribution to our knowledge of the island, though it has made us still more anxious to know the truth about a land which, even in the present advanced state of geographical knowledge, seems to have unknown wonders to reveal. Quite recently we heard of the discovery of a large river debouching on the south coast, and of a gigantic bird, and the signs of an equally gigantic quadruped having been seen. Only last week we were able to give some news of the indefatigable D'Albertis. Then the Australian colonists are casting longing eyes on the fertile island, and a proposed colonising expedition recently made a considerable stir in this country. All these circumstances have made us anxious to obtain trustworthy information concerning a country of three times the area of England, Wales, and Scotland combined.

Capt. Moresby's work is one of the most important contributions which have been made to our knowledge of the geography of New Guinea. It records in a simple and direct manner the results of four years of thoroughly painstaking and careful work, and, as far as it goes, may be relied on as perfectly trustworthy and accurate. Capt. Moresby does not pretend to give any information as to the natural history of the islands visited, his attention having been directed to their geographical and physical features, their industrial products, and the characteristics of the natives. On all these points valuable and substantial information will be found in the extremely interesting work before us. The time during which the *Basilisk* was at work in Polynesia and New Guinea was between the beginning of 1871 and the end of 1874.

The part of New Guinea to which Capt. Moresby mainly devoted his attention was the coast of that south-eastern projection, about most of which absolutely nothing certain was known, and the islands lying off it. Commencing at the bay shut in by Yule Island, some careful survey work was done, and two considerable rivers explored as far as obstructions would permit. From this point south-eastward the coast was diligently examined, and its main features will be found plotted in the map which accompanies the volume. The greater part of the length of the coast is fringed with reefs, which are the great obstruction to navigation in that part of the world. At several points along the coast more minute explorations were made of various inlets, and one or two other rivers were opened out leading into the interior. Coming to the south-east coast, Capt. Moresby definitely solved the problem as to its shape. The island ends in a wide fork, from which the north coast sweeps in a series of magnificent bays in a north-west direction, the outline of which, to a distance of between three and four hundred miles, Capt. Moresby has had the honour of laying down for the first time. Around the south-east termination of the island are clustered hundreds of beautiful islands ranging in size from a tiny speck up to the three considerable islands which are named after D'Entrecasteaux, and which until Capt. Moresby's visit were vaguely and inaccurately located; indeed it was not certainly known that they were islands at all. The south-eastern prong of the terminating fork is continued in three islands—Hayter, Basilisk, and Moresby—and all the islands of any size seem to support a large population of tractable and intelligent savages. While part of the south coast surveyed by the *Basilisk* is covered with unhealthy mangrove swamp, a large portion of it is a healthy and beautiful coral beach backed by tree-covered hills. Towards the south-east the coast gets mountainous, a range of mountains running north-west through the centre of the island, having its culmination in Mt. Owen Stanley, 13,205 feet. The three islands mentioned above, as also the D'Entrecasteaux Islands, contain mountains of considerable altitude, and along a great portion of the north coast densely wooded mountains come right down to the coast. The north coast is marked by an almost entire absence of the reefs which are so characteristic of the south coast. Some minute survey work was done among the islands in the south-east, with the result that a passage has been found which will shorten most materially the voyage from Australia to China. Another important service done by Capt. Moresby to navigation was the accurate survey of the channel in Torres Straits.

Captain Moresby landed on many points of the coast surveyed as well as on the islands, and invariably he and his officers and men became the best of friends with the natives. Captain Moresby's skill in managing savages cannot be surpassed. By tact and patience he in almost every instance managed to obtain a cordial welcome from the natives not only of New Guinea, but of the many islands which he visited to the east of Australia. Not in a single instance was it found necessary to take life, and we would recommend all who have to deal with uncivilised people to study Capt. Moresby's tactics. The natives of the part of New Guinea visited Capt. Moresby speaks of as belonging to the Malay type, lighter coloured than the Papuans, and with the characteristic and elaborately done-up long frizzled hair. They are probably a modification of the genuine Papuan, possibly in the direction of the Malay type, though more probably the modification may be the result of circumstances or of mixture with or gradation into a more distinctly Polynesian type. They are well-made, gentle in demeanour, and stand comparatively high in the scale of uncivilised men, both in intelligence and in art. They are evidently comfortable and happy, living in good houses built on piles, and having abundance at hand to supply all their wants. Many of them seemed not to possess the bow—the spear, club, and hatchet being the chief weapons on the south coast. The officers and crew of the *Basilisk* brought away quite a shipload of weapons, utensils, and ornaments, some of them of really exquisite workmanship. The use of the metals is quite unknown among most of the people visited, who in many cases turned up their noses at the hoop-iron with which the ship was so abundantly supplied, and who with difficulty could be made to see the superiority of the iron hatchet. Capt. Moresby gives many valuable notes on these interesting people, which we commend to the notice of ethnologists. One very curious custom is referred to in the south-east, which, when first seen, roused the indignation of those on board the *Basilisk*, but which Capt. Moresby wisely tolerated. A native, followed by a number of others, rushed on board bearing a dog, which, before anyone could interfere, he caught by the legs and dashed out its brains on the deck. This was horribly shocking, but Capt. Moresby rightly surmised that it was meant as a pledge of friendship. Indeed, the poor natives were evidently utterly bewildered when the officer on duty bundled them out of the ship and threw the poor dog's body after them, and it was only on Capt. Moresby's going on shore and professing friendship that they were quieted. Another method of friendly salutation is to squeeze the nose and the navel simultaneously with the fore-finger and thumb of each hand; the natives were quite ecstatic when Capt. Moresby and his men, with excellent tact, returned the grotesque salutation. This pleasant people extend all along the south and north coast visited, the black Papuans differing in many respects from the former, and seemingly quite untractable, not having been met with till about 148° E. on the north coast. Though Capt. Moresby does not profess to be either botanist or zoologist, and unfortunately none of his staff seem to have had the necessary qualifications, still naturalists will be able to glean some information from his notes as to the nature of the flora and fauna to be met with on the coast. We have referred to the signs which a recent expedition saw of some large quadruped living on the island; similar traces were found by the *Basilisk* expedition near the head of Collingwood Bay, the second large bay from the south-east, on the north coast of New Guinea. "Here Lieut. Smith observed the droppings of some large grass-eating animal in a spot where the bushes had been heavily trampled and broken. Our opinion was decided that a rhinoceros had haunted there; and we were much surprised, as the animal has never been believed to exist in New Guinea." This and other secrets of this interesting island cannot surely now remain long unrevealed.

We have referred at length to Capt. Moresby's account of his work in New Guinea, but the first half of the book contains a most interesting account of a cruise among the islands to the east and north-east of Australia, upwards of fifty of which were in this way visited. Almost everywhere was the *Basilisk* welcomed, and Capt. Moresby made excellent use of his opportunities in noticing the characteristics of the islands and the people, and in impressing upon the latter the desire of England to befriend them. In several places sad results were seen, and harrowing stories told of the visits of the Polynesian kidnappers, whose inhuman traffic Capt. Moresby set himself to put down. It seems doubtful whether some of the islands called at by the *Basilisk* have been visited by white men before. The natives were mostly fine-looking people, evidently allied to the gentle inhabitants of Southern New Guinea. On many of the islands white traders and missionaries are settled, in others the natives are still in their pristine and contented state. We assure both the physical geographer and the ethnologist that in this part of Capt. Moresby's work, they will find a very great deal to interest them.

The work altogether must be regarded as one of the most valuable recent contributions to geography. Capt. Moresby possesses many of the qualifications which go to make an explorer of the first rank, and he has the gift of telling his story in clear simple language, indulging in no theories, and filling every page with valuable information. In an Appendix he draws attention to the suitability of New Guinea for colonisation, and urges upon the imperial government, we think with justice, the annexation of it and all the neighbouring islands to the south and south-east. While portions of the island are evidently unsuitable for habitation by white men, a very large proportion of the country would be found perfectly salubrious and productive in the highest degree. We cannot see the force of some of the arguments with which Capt. Moresby supports his plea for annexation. His strong attachment to the natives and his desire for their welfare we think mislead him as to how this is to be accomplished. If New Guinea is to be colonised by white men, all previous experience teaches us that the natives will inevitably suffer, will be demoralised, and ultimately extinguished. It is inexpressibly sad to think of such a fate overtaking these gentle and altogether superior natives of New Guinea; but how can it be helped, unless it is resolved to put a stop to the increase in the white portion of the world's population. We commend the Appendix to the notice of all interested in Australia, which already is beginning to feel itself overcrowded, and must sooner or later overflow, for, as is well known, the interior is a blank. If this country does not speedily annex New Guinea, some other country, with possibly less regard for the interests of the natives, certainly will. We hope at least that Capt. Moresby's work will be the means of giving a new stimulus to the exploration of this abundantly interesting island. Why don't the governments of the various Australian colonies combine to organise an expedition for its thorough exploration, with the countenance and assistance of the imperial government? With a man like Capt. Moresby at the head of such an expedition, how much might be accomplished.

OUR BOOK SHELF

Sketches of British Insects. A Handbook for Beginners in the Study of Entomology. By the Rev. W. Houghton, M.A., F.L.S. (London: Groombridge and Sons, 1875.)

THIS is an attractive little volume, suitable for a child's prize; it contains much useful and carefully selected information, accompanied by some excellent woodcuts, and six gorgeously coloured plates.[1] Although not wholly free from errors, most of them are happily confined to the chapter on Lepidoptera. It may not be amiss to point them out, as they are likely to mislead, and should be corrected in a subsequent edition.

It is doubtful whether the general reader will comprehend the author's statement that "there are no hermaphrodites in the class" of insects; the frequent occurrence of gynandromorphous specimens in collections being a seeming contradiction to this assertion.

The description of the oviposition of *Chrysopa* (pp. 62, 63) is not accurate. The insect, touching the surface of the plant-stem with her abdomen, draws out a thread of viscous matter, and by not at once excluding the egg attached thereto, gives it time to harden; it is *only by not removing* her body, or depositing the egg too soon, that the upright hair-like thread is produced.

In the chapter on Lepidoptera a number of statements are made, which (however seemingly true to the mere tyro in entomology) are perfectly erroneous: thus it is not true that butterflies ever have less than six legs, although the first pair are, in some families, aborted; butterflies cannot be separated from moths by any distinctions but those which serve to divide their families; for a butterfly has not always a pair of *club-shaped* antennæ, the antennæ of some moths are distinctly clubbed. Although most butterflies carry the wings upright when in repose, the *Ageroniæ*, many of the *Erycinidæ* and *Hesperiidæ* settle with the wings flat and extended; some of the *Geometridous* moths on the other hand close them in an upright position over the back. The *Vanessæ* among the butterflies frequently fly by night, and are sometimes taken at sugar;[1] whilst the *Castniidæ*, *Agaristidæ*, *Zygænidæ*, *Ægeriidæ*, many *Sphingidæ* and *Lithosiidæ*, some *Bombycidæ* and *Noctuidæ*, the *Uraniidæ*, some *Geometrina*, *Pyralidina*, *Tortricina*, and *Tineina* all fly by day.

The termination *inæ* should be used for sub-families; therefore it is incorrect to say that "the family *Papilionidæ* consists of two sub-families, the *Papilionidæ* and the *Pieridæ*."

The tails of the *Theclinæ* are not a sufficient distinguishing character, since these appendages occur also in the British *L. bæticus* and its allies.

The Camberwell-beauty has, of late years, been seen on the wing by most entomologists, and the manner in which the squeaking of *Acherontia atropos* is produced has been fully described in a previous volume of NATURE. The wings of the female Vapourer-moth, although very minute, are clearly distinguishable; this insect therefore cannot be said to be "entirely destitute of wings."

The female stag-beetle bites somewhat sharply, but the male has comparatively little power; it is frequently taken to school by mischievous boys to alarm their fellows, but we never knew of a case in which it caused actual pain.

[1] The plates are rather sticky, and consequently the tissue-paper occasionally adheres to them; this is, however, a matter for congratulation, as it subdues the excess of colour.

[1] *Hesperiidæ* have also been taken at light.

The Year Book of Facts in Science and the Arts for 1875. Edited by C. W. Vincent. (London: Ward, Lock, and Tyler, 1876.)

THE present volume is a decided improvement on its predecessor, though it is yet far from being what we hope to see ere long—an annual record of science similar to the excellent American publication edited with so much ability by Mr. Baird. We are glad to observe that this year Mr. Vincent has embraced a wider range in his excerpts, though the newspaper reports of the papers read at the last British Association meeting seem to have been a little too heavily laid under contribution. But then one must remember what a godsend such reports must be to the editor of scientific scraps: two copies of each paper, a pair of scissors, and a gum-bottle, and the thing is done. It would, however, be an injustice to Mr. Vincent to leave our readers under the impression that this book is carelessly edited. Extracts from our own columns, the *Philosophical Magazine*, the *Comptes Rendus*, the *Chemical News*, the *Academy*, and other journals are largely made, and on the whole a wise discrimination and some care have been shown in the selection and arrangement of these scientific jottings. There are, at the same time, some striking omissions which ought hardly to have been passed over. No reference is made to Mr. Crookes's Radiometer and his experiments thereon, beyond a brief report of a discussion on the subject at the British Association. Nor is there any notice of the new system of quadruplex telegraphy, designed by Mr. Winter, nor of the largely increasing use of duplex telegraphy, owing to the valuable modification of that discovery—which really made the system a practical one—devised and carried out some time ago by Mr. W. H. Preece. We commend the editor to the columns of the *Telegraphic Journal* for information on these points. There are also other omissions of recent experimental researches, but as we have already said, this volume is not without its merits, and doubtless many will be glad to make use of the quantity of broken-up information it conveniently conveys. We presume Prof. Osborne, on p. 72, means Prof. Osborne-Reynolds.

LETTERS TO THE EDITOR

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

Professor von Siebold and the Freshwater Fishes of England

THE object of the present letter is to appeal to naturalists throughout the British islands to assist Prof. von Siebold—the eminent zoologist of Munich—in his studies of the freshwater fishes of Europe. Prof. Siebold is preparing a new edition of his well-known work on that subject, and is exceedingly anxious to obtain specimens of some of our British freshwater fishes to compare with the specimens which he has collected from all parts of Europe. In spite of various attempts, he has, I am very sorry to have to say, failed to obtain specimens from English naturalists. I am sure that this can be only owing to the fact that he has not been able to make his wants known directly to those who could help him. I have not myself been able to do much in supplying the specimens of which he forwarded to me a list, but from the Thames at Oxford have sent him Dace, Bleak, Pope, Miller's Thumb, and Sticklebacks. The list to which I refer included the Graining and the Azurine fishes which have been obtained in or near Knowsley Park; and I have received a kind assurance from Lord Derby that efforts shall be made to procure specimens for Prof. Siebold. Specimens of these and of the Powan, the Pollan, the Gwyniad, and the Vendayce, are the chief desiderata which I am anxious to obtain for Prof. Siebold; his list also includes the Sharp-nosed and the Broad-nosed Eel.

If any naturalist who possesses specimens of these fish which he can spare for the purposes of scientific investigation, or who can by reason of local opportunity obtain such specimens, will forward them to me at University College, London, preserved in spirit, I will transmit them to Prof. Siebold, taking care that he shall know to whom he is indebted in each case.

A more difficult task, I am afraid, is that of procuring specimens of the Brine Shrimp, *Artemia salina*. Prof. Siebold has made an extensive study of specimens of Artemia and allied Branchiopoda from various European localities, and is anxious to compare English specimens with those from other localities. He wishes especially to obtain "gatherings" of these Crustacea in order to determine the absence, presence, and relative abundance of the male sex in different localities. Specimens from Lymington or from Guernsey would be very welcome.

I hope that through the columns of NATURE I may succeed in reaching those naturalists who, I am sure, are not few in number, who will be willing to contribute material for the valuable researches which Prof. Siebold has so long been carrying on.

E. RAY LANKESTER

March 5

Seasonal Flower Distribution and the Radiometer Vagaries

ALTHOUGH apparently so dissimilar, there is an intimate connection between the seasonal order of colour in flowers and the seeming erratic behaviour of certain radiometers.

Whatever be the cause of the mechanical action of light which is now exciting so much attention, the kind of light remaining the same, the experiments show that different surfaces produce dissimilar effects, the results with pith discs applying to pith only and being different from those obtained with mica, which strictly apply to mica alone. This is due in all probability to the difference in inter-molecular conditions presented by the two substances. When these conditions are thoroughly understood and a proper margin allowed for experimental errors, the observations which seem now at variance will most likely be reconciled. To acquire the needed knowledge, it is my humble opinion that some modification of the present method will be required, because many of the comparative experiments which have been tried hitherto in the domain of radiant light and heat are open to the objection that heterogeneous bodies having been dealt with, a difference of chemical constitution has been introduced for which no allowance could be made. To obviate this in the present instance, and ascertain the result of such differences, would it not be well to employ the following typical mode of procedure:—

In preparing the radiometer, let the discs be dipped into melted sulphur, or other convenient colour-changing body, and the completed apparatus inclosed in a jacket for the convenience of raising the temperature. A series of observations made at the normal temperature, when compared with a like series made at a high temperature, would doubtless reveal many interesting facts. There are many difficulties in the way which would take much experiment to overcome.

Now turn we to the flowers. The former question seems to depend probably upon the reflection of light, and the latter on absorption, the one being complementary to the other. I would here call the attention of your readers to the behaviour of inorganic coloured bodies when heated and to the laws of colour-change given in NATURE (vol. xiii. p. 298). There is here such an identity of relations as nearly to preclude the possibility of its being a mere coincidence. I shall speak more particularly of this in another note in a few days.

In reply to Mr. Rogers' query (p. 326), it may be remarked that *absorbed light* seems to be the active agent in vital work, *e.g.*, it is the light absorbed by the retina which, as motion of some kind, is transmitted along the optic nerve. This being the case, it would seem highly probable that to exclude from a flower such light as it reflects would not affect it at all, although of course the only sure answer to such a query is experiment.

Feb. 28 WM. ACKROYD

D-line Spectra

WITH reference to Prof. Stokes's courteous but rather theoretical explanation in NATURE, vol. xiii. page 247 (which I have been prevented from acknowledging before), I would ask him or yourself for a practical explanation of the following simple experiment:—

1. If platinum wire be reddened from a constant source of heat, as that applied to it by means of a blowpipe and a candle, we find the D-line spectra indefinitely produced until incandescence takes place by *additional* heat, or, in other words, that their permanency is in direct proportion to the *bulk* of the wire used, and in inverse proportion to the amount of heat applied. We can therefore, by using a *thick* platinum wire and the ordinary flame of a blowpipe, produce D-line spectra as long as we like, or as long as the fuel lasts.

2. Now if this D-line producing flame be due to sodium, its action for a long period upon a reagent so sensitive to sodium as is *Boric Acid*, ought to give a reaction by which the presence of that alkali would be detected. Thus, if a pin's head speck of pure cobalt oxide be heated by a blowpipe in a bead of pure boric acid, it forms within it a *black ball* which the minutest trace of any *sodium* salt partially dissipates, causing a *pink* suffusion round the ball.

3. A boric acid bead fused upon the ring of a thin or ordinary platinum wire, which has previously been made incandescent by a blowpipe flame, *i.e.*, from which the D-line producing property has been previously removed, is clear, colourless, and refractive as a diamond; but if the same boric acid be fused upon a *thick* platinum wire with the same degree of heat, the bead is *opaline* and *almost opaque*; and this phenomenon seems evidently and only referable to the above-mentioned permanency of the D-line spectra produced in the latter case.

4. To settle this point, however, let us fuse a clear colourless bead of boric acid on an ordinary platinum wire, and screw that in a geometrical pen, along with, but a little *behind* (that is, *away* from the source of heat) a *thick* platinum wire, so that the D-line producing flame from the thick, hot wire, impinges constantly and for some time upon the clear boric acid bead; we find opacity produced as in the former case. Now, supposing sodium to be in this case, the producer of the D-line spectra, we ought to have, in the opalised boric acid, a tangible result of the effect of applying to it (according to Prof. Stokes) "free sodium," but, on heating in it, as before, a speck of cobalt oxide, there is *no* dissipation of any part of the resulting ball, nor the least pink suffusion, but, on the contrary, a reaction, decided indeed, but *almost exactly* the opposite of that caused by adding sodium to the bead in any proportion.

5. Let us now screw a platinum wire ring containing a boric acid bead with a cobalt-borate ball inside, into a geometrical pen behind another platinum ring containing a bead of some soda salt, and heat both together with a blowpipe, so that the orange flame from the latter impinges upon the former. Instead of opalescence, similar to that caused by the orange flame from the thick platinum (4), we find the viscid boric acid made *more*

fluid and clear, the cobalt borate ball partly dissipated, and, on cooling, the surface of the bead presenting a pink appearance, evidently caused by projected particles of soda, volatilised *per se*.

6. It would thus seem that the blowpipe is even a more delicate analytical weapon than the spectroscope, for it distinguishes between two flames exhibiting D-line spectra only, which spectrum analysis does not.

W. A. Ross

March 6

The Screw-Propeller in Nature

Now that the question of the best form of the screw as a propeller has become of such importance it is interesting to note what Nature has done in this direction.

The seed of the ash (*Fraxinus excelsior*) is provided with a wing very delicately twisted, and, when the seed falls, the action of the air upon this screw-like wing causes it to revolve rapidly. The result is that the seed is kept suspended in the air for a comparatively long time, and is wafted by the slightest breeze to a considerable distance from the parent tree. I do not know that this peculiarity is referred to in any botanical work, but it very beautifully fulfils the object which characterises more completely the lighter-winged seeds, viz., the dispersion of the seed beyond the limits of the plant or tree which bears it.

I am not by any means sure that the screw on the ash seed will not *by its own action*, independently of any wind, work itself away, in its fall, from the perpendicular line. But, when the wind blows strongly—and it takes a strong wind to blow the seeds off at all—their range is very extensive.

The seeds hang stubbornly to the tree through the winter months, reserving themselves for the March gales, of which the wind-fertilising plants avail themselves so largely.

I should much like to know if any of your readers have observed this screw and studied its pitch, and it would be very remarkable should it prove that the pitch of this natural screw is the one which will give the most power to the propeller of a steamer.

The seeds of the maple and the sycamore have somewhat similar appendages, but the screw is, in neither case, so marked. If anyone, at this season, will throw up a stick at the seed clusters of ash, maple, or sycamore, he will find the seeds come fluttering to the ground like a cloud of butterflies and alighting quite as softly on the ground.

Feb. 15 Alfred George Renshaw

The Migration of Species

In Nature, vol. xii. p. 86, I read a communication signed "W. L. Distant," in which the writer states that sea-going ships were frequently visited by both birds and insects.

In confirmation of this fact, I can mention from my own observation two instances of birds visiting ships in which I was making the homeward voyage from the West Indies, and one instance on a voyage to New Zealand, in which the visitor was a butterfly.

In the first case, the ship being off the Spanish coast, but not in sight of land, a very handsome bird came on board. It was a species of dove, blue being the principal colour, with darker markings. Some of the seamen called it a Spanish dove. It was caged and taken home by one of the passengers.

In the second case, being in the neighbourhood of Bermuda, a large flight of a species of swallow settled on the vessel. These poor birds were in a very exhausted condition, and numbers of them were captured by a large cat belonging to the ship. The survivors continued their passage at daybreak next morning.

In the year 186—, on a voyage to New Zealand, we were one morning visited by a butterfly, there being at the time a light breeze blowing. My sons made great efforts to capture this interesting stranger, but unfortunately without success, as it fluttered overboard, and was soon lost to sight in the hollows of the waves. They, however, got sufficiently near to ascertain it to be a true butterfly. The colour consisted of various shades of rich orange brown, and the margins of the wings were deeply indented.

I made careful inquiries of the officers of the ship as to the proximity of land, and was informed that the nearest was the rock of St. Paul's, then fully two hundred miles distant.

M. Dasent

Patea, Taranaki, New Zealand, Nov. 18, 1875

The Three Kingdoms of Nature

Some children were playing at a game called "The Kingdoms," which consists in the mention of various substances, and asking if they belong to the animal, vegetable, or mineral kingdoms. One little girl mentioned "water," and the company were puzzled as to which kingdom it should be assigned. Is there a sub-aërial or gaseous kingdom? Will you kindly enlighten the members of our Nursery?

March 4

OUR ASTRONOMICAL COLUMN

The Variable Star, β Persei (Algol). — Herr Julius Schmidt, Director of the Observatory at Athens, publishes in the *Astronomische Nachrichten* the results of observations on the times of minima of this variable star, extending from August 1846 to November 1875. The epochs are given in Paris mean time with correction for the light-equation. The probable error of a single determination of the time of minimum from 183 observations by Schmidt is ± 8·0 minutes; fifty observations of Argelander gave a probable error of ± 6·0 minutes, and fifty-five observations of Schönfeld, one of ± 4·6 minutes, showing by a mean of the 288 observations a probable error of ± 7·0 minutes. The period assumed by Schmidt in the discussion of his Algol observations between 1840–1875 is 2d. 20h. 48m. 53·6s.

Some interesting details respecting this star are found in Schönfeld's "Der lichtwandel des Sterns Algol im Perseus" (Mannheim, 1870). His comparison stars and their relative assumed brightnesses were :—

Star.	Brightness.
ν Persei	0·9 in grades.
α Trianguli	3·5 ,,
δ Persei	7·8 ,,
β Trianguli	9·1 ,,
γ Persei	10·9 ,,
ε Persei	12·8 ,,
β Arietis	16·7 ,,
ι Aurigæ	17·3 ,,
γ Andromedæ...	23·4 ,,

The following, extracted from the more extensive table given by Schönfeld in his treatise, will indicate the law of variation as derived from the light curve :—

Distance from Minimum. h. m.	Brightness. Before.	After.
4 30	20·7	20·8
4 0	20·2	20·2
3 30	19·6	19·2
3 0	18·7	17·7
2 30	17·4	15·8
2 0	15·3	13·2
1 30	12·1	9·8
1 0	8·5	7·6
0 30	6·3	6·2
0 0	5·6	5·6

The most probable period over which the variation extends is 9¼ hours, and the minimum lies very nearly in the middle of the same. The most perceptible diminution of brightness occurs 1h. 26m. before the minimum, when the star is somewhat fainter than the mean of γ and ε Persei, and the most perceptible augmentation when the star arrives at nearly the same degree of brightness, but 1h. 47m. after minimum. In this phase it is hardly fainter than the mean of δ Persei and α Trianguli. Schönfeld states that to his eye the variation of Algol is included between the magnitudes 2·2 and 3·7; he considers γ Andromedæ an average star of the second magnitude, δ Persei 3·5, α Trianguli about 3·1, and ν Persei 4·1.

For elements of Algol we may adopt at present the following, derived from Schönfeld's last catalogue. First minimum of 1876 .. January 2·23233 Greenwich mean time; period 2·867288.

CONJUNCTION OF JUPITER AND β SCORPII.—Mr. J. Birmingham, Millbrook, Tuam, writes as follows with reference to the near approach of Jupiter to the bright star β Scorpii on the morning of Feb. 28.—"The weather prevented any observation until 19h. 25m. Greenwich M.T., when the western limb of Jupiter had nearly, but scarcely quite, reached the R.A. of the star. The micrometer-wire through the star then just grazed the northern edge of the planet, and so closely that it could not be said for certain that there had not been actual contact. Clouds coming on again soon put an end to the observation." Allusion was lately made to the above phenomenon in this column.

NOTE ON BIELA'S COMET.—It will be remembered that when, on the appearance of Biela's Comet in 1805, the similarity of elements to those of the comet of 1772 had been remarked, it was pointed out by Gauss that the differences between the orbits, particularly the diminution of the inclination, could not be accounted for except on the supposition that in the interval the comet had undergone perturbations from one of the larger planets, and the necessary proximity could only have been consistent with the assumption that several revolutions had been performed in the interval between 1772 and 1805, as on the next observation of the comet in the spring of 1826 was proved to have been the case.

If we adopt the elements for 1772 assigned by the late Prof. Hubbard of Washington in his masterly investigation on the motion of this comet, we shall find the following distances from the orbit of the planet Jupiter:—

True Anomaly.	Radius vector.	Distance.
+ 156° 0′	5·029	0·316
157 30	5·143	0·281
158 0	5·180	0·283
+ 160 0	5·327	0·344

A true anomaly of 157° 30′ corresponds to 645·5 days after a perihelion passage, and the comet would arrive at this point of its orbit, which may be taken as that of nearest proximity to the orbit of Jupiter about 1794·21, while the planet would be in the same longitude about 1794·43, and it thus appears that it was in the spring of the year 1794 that the very material changes in the elements of the comet's orbit were caused by the attraction of Jupiter. Another near approach of the two bodies would appear to have taken place towards the end of the year 1746.

THE NEW GERMAN SCIENTIFIC EXPEDITION TO THE OBI

THE Expedition to Northern Siberia, fitted out by the "Verein für die Deutsche Nordpolarfahrt in Bremen"—the same Society which sent out the Second German North Polar Expedition, and published the excellent account of its results—left Bremen last week. The attention of the Council of the Society having been called to the immense unexplored area between the Jenisei and the Obi, it was resolved, as there were not sufficient funds for a naval expedition this year, to send out a small zoological and ethnographical expedition overland to the Obi, which appeared to be less known than the Jenisei. In this they received the warm support of the highest scientific authorities at St. Petersburg who were asked for advice on the subject. Dr. Otto Finsch, Director of the Zoological Museum at Bremen, was appointed leader of the expedition, and Dr. Brehm, the well-known author of "Das Thierleben" and many other natural history works was selected to accompany him. They were joined by Count Walburg-Zeil-Trauchburg of Stuttgardt, who made an expedition to Spitzbergen in 1870 at his own expense, and who is well acquainted with physics and is a good botanist. Professor Oscar Schmidt of Strasburg, who had likewise intended to go, was unavoidably prevented at the last moment. The route selected is by St. Petersburg and Moscow to Nishni, and thence in sledges viâ Kasan, Perm, Ekaterinenburg and Omsk to Semipalatinsk. Thence a detour will be made, if possible, into the Altai. From Ekaterinenburg they will go to Barnaul and down the Obi to the embouchure of this river. They will return to Germany in the autumn—certainly not without a rich harvest of results.

UNIVERSITY REFORM

(Communicated.)

THE speech of Lord Salisbury on introducing a bill to reform the University of Oxford, inaugurates a fresh epoch in the history of University reform. The speech nominally referred to Oxford only, but the principles enunciated in it apply equally to both Universities. The defects of the Oxford system, pointed out with such clearness by Lord Salisbury, are also the defects of the Cambridge system, and the remedies to be applied, must, in their broader features, be the same for the two Universities.

Lord Salisbury lays it down as the cardinal point in his scheme of reform that, till the requirements of the University for teaching and research are satisfied, no portion of the funds of the colleges ought to be employed for endowing idle fellowships.

"I do not know," he says, "that what is available from the whole of the idle fellowships will be required for University purposes, and I do not venture to lay down the principle that no fellowship should exist which would give the holder no educational work, and which should last for a few years. It may be wise to maintain a few of these, limiting the holding of them to a certain number of years, but I do venture to lay down that all the University wants in the shape of museums, libraries, lecture-rooms, and the proper payment of teachers, should be provided for before the subject of furnishing incomes to men who do nothing can be entertained."

The enunciation of such views as these by a Conservative Minister must be hailed by genuine University reformers as a most reassuring sign of the progress of public opinion. Up to the present time such principles as those contained in Lord Salisbury's speech have only been whispered in secret by a few men who have been generally regarded as extreme and unpractical; but it is to be hoped that for the future these principles will form the starting-point of University reform. It is to be regretted that they have not been more distinctly embodied in the Bill presented to Parliament. The indefiniteness of the plan of reform there laid down, and the powers of resistance secured to individual colleges, seriously detract from its efficiency. We trust that these points will be altered in Committee; otherwise everything will depend on the wisdom, union, and determination of the Commissioners.

Lord Salisbury alluded to the more pressing wants of the University of Oxford, which include a new library, museum, schools, and other permanent structures; and states that for these alone an immediate outlay of 210,000*l*. is required. In addition to this sum a large yearly income is needed to bring up the staff of University teachers to a suitable standard both in numbers and efficiency. Large as are the wants of Oxford, we believe that those of Cambridge are also very large both as regards permanent buildings and the professoriate. This is not only shown by the report of the Buildings Syndicate of the University of Cambridge, but also by the recent appointment of a Studies Syndicate, which indicates that the present staff of teachers is generally considered inadequate. The above facts are in themselves sufficient to demonstrate that, if the principles laid down by Lord Salisbury are firmly carried out by the Commissioners it will be necessary for them to abolish in a nearly complete manner the existing idle fellowships.

In fact the term "Fellow" will cease to be the name for a successful candidate in an examination, who, as a reward for his success, receives for a longer or shorter period a considerable income, and will become the title of one engaged in University work.

It must not, however, be lost sight of that the abolition of idle fellowships is only valuable as a means to an end —that end being the increased efficiency of the teaching and research in the Universities. On this account it becomes important to follow out the further changes which will be entailed by the abolition of idle fellowships.

On the abolition of these fellowships, all the colleges will be in possession of a large income entirely available for University purposes. A considerable part of this will no doubt be at once employed for the buildings and other permanent structures needed by the Universities, and will be handed over to the Universities either in the form of a yearly tax or a share of the college property. Of these two methods of contribution the former appears on the whole to be attended with the fewest inconveniences, and will have the further advantage of supplying at once an available income to the University.

On the most extravagant estimate it seems clear that, after all the requirements of the University for permanent buildings, &c., have been satisfied, the available revenues of the colleges will by no means be exhausted, but a considerable sum will still be left to meet the urgent need of fresh Fellows to carry on the work of the University.

Ought the money intended for the payment of these Fellows to be handed over to the University, or left in the hands of the colleges? Although some advantages might accrue from handing over the money directly to the University, yet the proposal cannot be entertained. No Conservative Government could thus despoil the colleges. The opposition would be too great and not improbably the whole scheme of reform might be ruined. If it is admitted that the money is to remain in the hands of the colleges, a further question arises as to the system under which the new Fellows are to be elected.

Is their election to be carried on by the colleges on the old system, or to be more or less directly under the control of the University? We believe that the value of the proposed reforms depends greatly upon the answer given to these questions.

In dealing with them in a practical way it is neither possible nor desirable to overlook the fact that a collegiate system of teaching exists. Were it proposed, while still leaving the money in the hands of the colleges, to remove the election of the Fellows completely from their control, they would feel greatly aggrieved and would offer the strongest opposition to the scheme. It certainly could not be looked on as otherwise than a hardship for the colleges, that they should have no voice in the election of the men who were to form their governing body.

It must not, however, be overlooked that so long as Fellows are elected on the present system, a great increase of efficiency in the teaching staff of the University cannot be anticipated.

The causes which render the present system unsatisfactory are for the most part easily detected. In the first place Fellows are not elected for their efficiency in teaching or in research, but on account of their success in an examination, a very unsatisfactory test either of their powers of research or their powers of teaching.

In the second place, the standard requisite to obtain a fellowship, especially at Cambridge, is very different in the various colleges. In some of the smaller colleges the standard is very low, yet were the present system to be continued, these colleges would go on appointing Fellows totally incompetent for their University position.

In the third place, the nature of the colleges as closed corporations causes it frequently to happen that, after a man has been elected to a fellowship and continues to reside, he is appointed to a lectureship in spite of evident incompetency. In addition to these inherent faults in the existing mode of election to fellowship, the present system labours under great defects owing to the absence of centralisation. So great are these defects, that both Universities have recognised, and to a certain extent attempted to cope with them. Cambridge has done so by starting what is known as the "intercollegiate system of lecture;" a system which consists in the combination of the greater number of the colleges for the purpose of having common lectures open to the students of all the combining colleges. Oxford possesses a somewhat similar system, including several combinations of three or more colleges with the same objects as the one combination at Cambridge.

We cannot enter into the details of these systems, but confine ourselves to pointing out that they are generally recognised as very imperfect substitutes for a completely centralised system. They contain no sufficient guarantee for the efficiency of the teachers employed, and in the case of subjects where the students are few, the very existence of these systems interferes with the appointment of fresh lecturers, however incompetent the existing lecturers may be; and lastly they afford no help whatever to research.

The past action of the Universities themselves, as well as other considerations, indicate that the present system of election to fellowships ought to be abandoned, and a system involving greater centralisation substituted for it.

Though Lord Salisbury does not distinctly state that he regards this centralisation as necessary, yet the general tenor of his speech clearly indicates that he does so; and the very argument he has used against permitting the colleges separately to reform themselves, applies equally against their separate action in the election of Fellows.

To meet the requirements of the University in the election of Fellows, it is necessary to devise some system in which a central board, directing and influencing the elections, shall work in concert with the colleges in whom the actual election must be vested.

The function of the central board ought not only to be the indication of the men to fill the fellowships, but also the settlement of the branches of study in which teaching or research is required. In the election of Fellows by a college, no preference ought to be shown to a member of the college, and the lectures of the Fellows ought to be equally open to all the students of the University. In such subjects as natural science, rooms ought to be assigned to the Fellows in the University buildings.

Whatever system of election of Fellows may ultimately be found advisable, the colleges will necessarily be left completely free to elect their Tutors, Bursars, Deans, and other officers, and the election of a certain number of Fellows for college teaching ought to be left in their hands.

The partial inefficiency of the present staff of University professors will probably be urged as an argument against the centralisation of teaching in the University. This inefficiency, so far as it exists, has mainly arisen from its not being possible for men who have obtained a University post to rise in their profession; and we believe that by instituting a series of grades, the highest of which shall only be held by distinguished men, it will be possible to supply the stimulus as necessary for efficiency in a University career as in all other professions.

The efficiency of the Professoriate in the German Universities appears to be mainly due to the existence of this stimulus, and we may therefore hope that the presence of this alone is necessary in order to render the professors in the English Universities as efficient as those in the German ones. Promotion ought of course to be granted for research as fully at least as for successful teaching, and a much-needed stimulus thereby given to learning in the Universities.

The remarks of Lord Salisbury on the question of research are quite as liberal as those on the questions of general education of the University. "The only point," he says, "in the connection to which I wish to call attention is that referring to research. We are of opinion that the mere duty of communicating knowledge to others does not fulfil all the functions of a University, and that the best Universities in former times have been those in which the instructors, in addition to imparting learning, were engaged in adding new stores to the already acquired accumulation of knowledge."

How best can research be combined with teaching? It will probably be found advisable to relieve from all teaching some of the professors who belong to the highest grade, and who have shown their capability for research; but we do not believe that this principle can with any advantage be generally adopted in the case of young and untried men. It would appear to be far safer to give opportunities of research by not demanding too much teaching work. With a large staff of lecturers it would not be necessary to demand from each more than two terms' teaching in the year. With only two terms' work and the remainder of the year free, ample time would be given for a teacher, not only to keep up with the progress of his subject, but also himself to advance it; but this point might be left for further consideration and experience.

The research we are anxious for is not confined to the natural sciences, but embraces all branches of learning, and we cannot better explain our view in this matter than by again quoting a passage from Lord Salisbury's speech. "What I am particularly anxious for," he says, "is that all branches of culture should have equal encouragement, and should be regarded not as rivals but as allies in the great and difficult task of cultivating and developing the human mind."

SCIENCE AND ART IN IRELAND

THE Royal Dublin Society held a special meeting on Thursday, March 2, to consider the Report of the Council on Lord Sandon's letter. In the absence of his Grace the Duke of Leinster, the President of the Society, the chair was taken by Sir George Hodson, Bart., one of the Vice-Presidents. Dr. Steele read the Report of Council, which concluded with a recommendation that the Society should sanction the Council's sending a deputation to London to press the following points upon her Majesty's Government:—

1. An assurance that the library, and the collections in the museums, shall be maintained in Dublin for the use of the public.

2. That ample accommodation shall be secured for the members of the Society for the purposes of their meetings, for their reading rooms, and for their officers; the whole being maintained for the Society, and under its own control.

3. That a suitable apartment as a reading room in connection with the library shall be provided for the exclusive use of the members of the Society.

4. That the members shall have the privilege, under reasonable restrictions and conditions, of borrowing books out of the library.

5. That the Agricultural Department shall be compensated by an equivalent for any space of which it may be deprived.

6. That the laboratory, with the services of an analyst, shall be preserved as heretofore for the purposes of the Society.

7. That the services of the present officers of the Society shall be retained; cr the salaries and emoluments which they now enjoy secured to them.

8. That, as heretofore, an adequate staff shall be maintained for the purposes of the Society, or an equivalent grant to enable it to provide itself with the same.

9. That the members shall have free access to the new Institution at all times that such s open (whether by payment or otherwise) to the public.

That as some equivalent for the property surrendered, and as a compensation for a possible falling off in the income of the Society, an annual sum be granted to enable it to continue its several works of utility.

Mr. Ferguson moved a resolution in the following terms: "By reason of the very recent date of Lord Sandon's letter (Feb. 9, 1876) relative to the establishing in Dublin of a 'Science and Art Museum,' and the consequent short period the Council of the Society have had to make the Report thereon as this day laid before the Society, it is desirable that the consideration of the Council's Report be now adjourned till this day four weeks, for the purpose of enabling the Council to lay before the members of the Society such necessary information as will enable due and proper action to be taken on the several matters therein." This resolution was at once seconded by Dr. O'Donovan, and the necessity of adjourning was urged by several members to whom the leading facts in reference to the Society's relation to the Government, as stated in the Council's Report, appeared quite new. Dr. E. P. Wright said that the mover and seconder of the resolution asked for more light; to him it appeared as if the light they already had had dazzled them. Let the terms of the minute of the Science and Art Department of Sept. 21, 1865, be remembered, and how could the Society indulge in the illusion that the so-called Departments of the Society belonged to it otherwise than as in trust for the public? As to representing that the Government were not fully aware of the position of affairs, was it not a fact that the Chancellor of the Exchequer, Lord Sandon, and Mr. W. H. Smith had within the last few months personally inspected all the arrangements of the Society for themselves? and did anyone present doubt that Sir M. H. Beach had not a perfect knowledge of the Society's wants and merits? and then there had been a Parliamentary inquiry in 1864 and a Royal Commission in 1868. Why then waste time in asking for more information? Lord Sandon's letter was clear and explicit. Why not boldly face the inevitable, and see in the proposed scheme a means of having in Dublin what all desired, a National Library and a Museum of Science and Art? Several of the points asked by the Council it seemed probable would be yielded by the Government; but he appealed to those who had the true interests of their country at heart to support and co-operate with the Government in this matter, and not to treat them as Greeks, though bringing gifts. As the feeling of the meeting seemed to be in favour of having the Council's Report *in extenso* before them, he would move as an amendment: "That Lord Sandon's letter and the Report of the Council just read be printed and circulated among the members; and that this meeting do adjourn until this day fortnight—then to consider the same." This amendment was seconded by Lord Powerscourt, but on being put was negatived, whereon the original resolution was put from the chair and declared duly carried. It was further resolved that the Council should send a deputation to London to obtain such additional information as they could as to the intentions of the Government.

At a special meeting of the Royal Irish Academy, held on Monday last, the following amendments were adopted by a large majority:—

1. That the Royal Irish Academy being desirous of cooperating with her Majesty's Government in the measures necessary for the establishment of a National Science and Art Museum in Dublin, provided that the independence and usefulness of the Academy be not injuriously affected by such measures, is willing to consent to the

transfer of its antiquarian collections commonly known as its Museum, to the Government upon the conditions—

a. That the arrangement of the Museum, as well as the purchase of additions, shall continue to be conducted by the Academy; and that adequate provision shall be made for the continued acquisition of Irish antiquities which may hereafter be discovered or offered for sale.

b. That the Museum of the Academy, together with such other Irish antiquities as may be added to it, shall be for ever kept apart from other collections, and be permanently maintained as a Museum of our National Antiquities, no portion of its contents being ever removed from the City of Dublin, unless by permission given under the seal of the Academy.

c. That the Academy shall be accountable, as at present, to her Majesty's Treasury, through the Irish Government, for all sums voted by Parliament, and shall not be subject, in the conduct of its affairs or the expenditure of its grants, to any control on the part of the Science and Art Department, or any of its officers.

2. That, considering the position which the Academy has long held, and will continue to hold, as the first scientific, literary, and antiquarian Society of the country, the proportional representation proposed to be given to it on the Board of Visitors (sect. 12 of Lord Sandon's letter), is altogether inadequate; and the Academy further think that no paid official of the Science and Art Department should be eligible to act as a representative on the Board.

3. That there should be provided in the yearly estimates, as laid before Parliament, instead of the several sums now annually voted, a sum at least equal to what is at present voted, to enable the Academy to discharge more completely its functions as a scientific, literary, and antiquarian body, by making grants in aid of original research, by publishing the results of such research, by maintaining a library specially adapted to assist learned investigation, and by editing and printing ancient Irish texts, &c.

SCIENTIFIC INSTRUCTION AND THE ADVANCEMENT OF SCIENCE.

ON Wednesday and Thursday last week two separate deputations from the Council of the British Association waited respectively on Mr. Cross and the Lord President of the Council, the Duke of Richmond and Gordon, both introduced by Dr. Lyon Playfair, and headed by the president of the Association, Sir John Hawkshaw. The object of the deputations was to induce the Government to adopt certain recommendations of the Royal Commission on Scientific Instruction and the Advancement of Science.

Dr. Playfair said there were three points in the Reports of the Science Commission to which they desire to direct attention—namely, the recommendations as (1) the study of science in elementary and endowed schools, (2) the endowment of research, (3) the administration by a Minister of Science and Art.

Sir John Hawkshaw said that the matters which they that day desired to mention were chiefly treated in the Fifth and Eighth Reports. He read a memorandum on these points approved by those he represented. This document set forth that the Government possessed, through the elementary schools and through the authorities charged with framing schemes for endowed schools, the machinery for insuring scientific teaching. The public schools will follow the Universities; the Universities in England and Scotland are about to be the subjects of inquiry by Commissions, and science ought to be adequately represented on these Commissions. University College and King's College, London, Owens College, Manchester, and Trinity, Dublin, would require special consideration, and if further pecuniary assistance were granted them by Government, guarantees should be taken for the further encouragement of scientific teaching. Direct endowments of research must be approached with caution. There would be no objection to the course of liberally endowing professorships in the several Universities, combining the duty of original research with a moderate amount of teaching to be attached to the professorship; an extension of the principle involved in the grant to the Royal Society might be advantageously resorted to, and the grant might be gradually increased. The Lord President of the Council was practically entrusted with the functions of a Minister of Education, responsible to Parliament; and it therefore seemed to follow that he should be made the responsible administrative head of the business connected with scientific institutions which receive their support from public grants, with the allocation of funds for scientific purposes, as well as of the business relating to the promotion of scientific instruction, as these matters all form an essential part of public education in science. Sir John Hawkshaw would only add to the document that it would be of great advantage if the State would establish, say, a laboratory for chemical science, and an observatory for physical investigations.

Prof. A. W. Williamson, Prof. Roscoe, Mr. Spottiswoode, Dr. De La Rue, and others spoke in support of the deputation's object, with which Mr. Cross said he sympathised very much indeed.

The Duke of Richmond and Gordon said the Government were well aware of the great importance of scientific education. With regard to the Reports of the Science Commission, he thought Lord Salisbury was now acting upon the Third Report, in respect to Oxford and Cambridge. It seemed to him that the endowment of professorships had not been altogether satisfactory so far as it had been tried. With regard to the Government grant to the Royal Society, that was a grant, not an endowment for those who work, but, as he understood it, a provision of apparatus. The sum of money was so expended. It was not an endowment of research. With regard to establishing physical observatories, the Government had taken action in the work connected with astronomical physics which Mr. Norman Lockyer was now carrying on, or beginning to carry on at South Kensington. With regard to the laboratories for chemistry and physics which Mr. De La Rue alluded to, it seemed to him they could not very well do more in that direction till they had the report of the Commission which was to inquire into the Universities' scheme proposed by Lord Salisbury. He concluded by assuring the deputation that the Government were quite alive to the great importance of the subject.

PHYSICAL SCIENCE IN SCHOOLS

I CONFESS I did not understand Dr. Watts's letter quite as Prof. Roscoe has done. But that is of little importance. Prof. Roscoe has opened wider questions as regards the position of Physical Science at Schools, and I should be glad of the opportunity, if you can spare me the space, of writing a little more at length on this matter, and, if possible, of thereby arriving at a distinct understanding what it is that the thorough-going advocates of science, like Prof. Roscoe, want. His letter is a good hearty grumble at things in general, and a good grumble from him wakes people up, and does us all good; but we want to know what specific changes he wants, and who is to make them. "Regulations" and "Examinations" and the "position accorded to science in schools," and the "discouragement to the teaching of science," want of "efficient means of teaching science," "difficulty of obtaining masters," are all in turn mentioned as obstacles. Some of these arise from one cause, some from another, and before any improvement can be effected, we must analyse the position of science at schools, see what the circumstances are which affect it, and understand where pressure can effectively be brought to bear.

The position of science at schools is dependent on—

1. The Public Schools' Commission.
2. The Statutes and Regulations of each School; *i.e.*, the Governing Bodies.
3. The Indirect Influence of the Universities and other Examining Bodies.
4. Head-Masters.
5. Parents.

1. The Public Schools' Commission enforce the teaching of science by requiring (Reg. 3) that "In any examination of a boy (not being one of the senior boys) in the school, or in any report of a general examination, the proportion of marks to be assigned to Natural Science shall be not less than one-tenth nor more than one-fourth, as the Governing Body shall think fit." Also that (Reg. 6) "There shall be one Mathematical Master, at the least, for every 100 boys in the school, and one Science Master, at the least, for every 200 boys learning Natural Science in the school." Also that (Reg. 7) "Every boy shall learn Natural Science continuously from his entrance into the upper middle form, Div. II., until he become one of the senior boys in the school." Further, that (Reg. 8) Senior boys may pursue special subjects of study and discontinue other subjects for that purpose: and that (Reg. 11) "Any boy in the school who may evince an aptitude for Natural Science shall have facilities for that study." Also (Reg. 10), "Any boy entering the school shall have the opportunity of showing acquaintance with Botany, Physical Geography, or some other branch of Natural Science."

It is evident that the all-important question here is, who are senior boys? Regulation 5 says "the Governing Body shall from time to time determine the point in the school list above which the boys shall be reckoned as senior boys for the purposes of these regulations."

These regulations are dated Aug. 4, 1874.

I do not think any reasonable fault can be found with these regulations from Prof. Roscoe's point of view, unless he finds fault with Regulation 7, which does not give natural science equality "as regards range," with classics and mathematics. To this I shall recur again.

2. The Statutes of Rugby School order that three Major Exhibitioners shall each year be elected—to pursue their studies elsewhere—for general proficiency in the studies of the school; and that four Minor Exhibitioners shall be elected, for proficiency in Classics, Mathematics, Natural Science, and Modern Languages respectively. The Regulations (37) order that "Natural Science shall be obligatory on every boy in the middle school, and either Natural Science or German on every boy above the middle school." Also (40) that "two Major and three Minor Scholarships shall be given for proficiency in Classics; one Major and one Minor for proficiency in Mathematics; one Minor for proficiency in French, and one in Natural Science." These are open to all boys between twelve and fifteen years of age.

I think it cannot but be felt that Natural Science has not been ignored in these regulations; it is not indeed put on an *educational equality* with Classics, but it is respectfully treated.

3. The Universities and other examining bodies affect us greatly. We at Rugby are principally influenced by Oxford and Cambridge, and it is of their influence only that I proceed to say a few words. It is plain that at the Universities some subjects must be universal, and some optional. The compulsory subjects are Latin, Greek, Mathematics, and Scripture Knowledge; optional subjects are numerous enough. Science ranks there with Law, History, Moral Science, Medicine, &c. Does Prof. Roscoe think that this is wrong? I really wish to know whether any thoughtful man who has considered the subject will say that science ought to be a *sine quâ non* for admission or for a degree at the Universities? *I* certainly think that science has its right position among the optional subjects. The point in this system that is more doubtful is the position of Greek, whether it might not be ranked with the optional subjects, and so give fair play to those schools and portions of schools which teach Science instead of Greek, and which are practically relegated to the rank of middle class schools (whatever they are called), because they have no outlet into the Universities. This is a change that has been already discussed more than once, and the opinions are, I believe, so nearly balanced, that the existence of a few more such schools, and a little pressure from without, will probably soon cause the change to be made. There is no doubt that the ready sympathy between the Universities and the educational needs of the country will be shown in this as in other things.

This is a digression, however. To return. Such being their system, the Universities are asked to examine schools and award leaving-certificates. I have reason for thinking that it was felt that this was not a time for fettering schools, or preventing educational experiments; they therefore declined to lay down *any* universal subject of education. They grant certificates without requiring a knowledge of even Latin and arithmetic. Every school may select its own studies. They will not, however, grant a certificate without a certain variety of attainment: four subjects must be taken, speaking generally, from three groups. Language, Mathematics, Literature, and Science form the groups.

It seems to me, therefore, not fair, not a statement of facts, to charge the University examination for certificates with "placing the science subjects in a distinctly inferior position to the older studies." The position is exactly identical. As a *leaving* examination nothing can be fairer.

What I pointed out in my first letter (Feb. 24) was that the *leaving* examination from school was in fact, to our boys, an *entrance* examination to the Universities; and in it they select, of course, the compulsory subjects of the Universities, for otherwise the certificate has no value. Science is not one of these compulsory subjects, and therefore the indirect action of these examinations is adverse to science. But I do not see how it can, or ought to be, otherwise; only I wish that their examination in science was a little more carefully arranged, with a view of forming at schools a sound method of teaching science.

The Universities of course affect us greatly by their scholarships in Natural Science, which do more to guide the teaching than anything else, and by their training masters. The influence of men like Maxwell and Clifton in inspiring teachers of Physical Science is very great; and when this influence is wanting in any subject at the Universities, the schools are the bodies which suffer. The Professors of Chemistry and Physics at the Universities are masters of the situation.

4. Head-masters have, of course, the chief power at schools of making science teaching effective or the reverse. This is a delicate matter for an assistant-master to speak of; and I have no right to discuss in this place—nor indeed elsewhere—how far the Regulations of the Commission and Governing Body are carried out in letter or in spirit, here or elsewhere.

But I may point out that, except in rare instances, head-masters follow, and do not lead, public opinion on educational points. The competition between schools is close; their prosperity depends on their meeting the demands of the public; and few men are bold and clear-sighted enough to make with success a move in anticipation of a demand from the public. At present a Balliol Scholarship, or other University Scholarship, are the grand advertisements; got at whatever cost to boy or school, they *pay*. And head-masters, being but men, are influenced by this. To get one such scholarship, except in cases of rare genius in a boy, costs the school a good deal, not in money, but in efficiency. To get one you must spoil several. First-rate proficiency in a subject, it is believed, can only be got when many are working together in it. Competition is stimulated by numbers. The success is less brilliant when the racers are few. A form is somewhat disorganised, it is urged, if some boys drop Greek, and others drop verses, or composition altogether; and thereupon many are kept to swell the triumph of the few. The possible disorganisation is an imaginary evil, I believe, but a real argument none the less, and science suffers much at schools from a want of freedom given to boys to drop some other subjects and pursue it as a principal study.

Then there is the inevitable silent disparagement of non-appreciation. Some men have genuine sympathy with learning of all kinds, and can make others feel that they respect a learning they themselves do not possess. But such men are rare. It is too often made plain to boys who "take to science," that they are regarded as failures—as we hear of some "ne'er-do-weel" that he has "taken to" sheep-farming in Australia. It is the entire and transparent honesty of this opinion that makes it so effective, and this adverse influence, which is deeper than words, and often in flat contradiction to them, will only be eliminated by the general growth of public estimation of science, and by the fruits that education in science can show. For this we must wait.

5. The last influence is that of parents and the public generally. From them, as far as I can judge, there is no trace of a demand for a revolution in education. The only subjects on which there seems to me to be a strong and tolerably united opinion, are the postponement of Greek in the education of young boys, and a desire for greater weight to be given to arithmetic, good writing, and geography. The teaching of science is desired, principally on grounds of utility, not of training; and choice of the time of introduction of it, the order of the subjects, &c., the stratification of science, in a word, has not been considered, except by very few.

Prof. Roscoe thinks science ought to have "educational equality both in range and time with classics and mathematics." Here I distinctly differ. I maintain, after trial, that it is unwise, and unscientific from an educational point of view, to attempt to teach science at school to boys till they have attained a certain standard of knowledge in arithmetic, and a certain power of reasoning and language, as shown by their attainments in geometry and Latin. Let science be held before them as a thing to be enjoyed w en they are older and more advanced. It is spoiled for them, and they are spoiled for it, by its being taught them too soon. The dicta of men like Faraday and Sir John Lubbock, and Roscoe are misleading opinion on this point, and I wish to record my protest against them. Do Sir John and the Professor know, have they the slightest idea what the standard of arithmetic is in the lower forms and among the new boys of a public school? I will tell them. This was the entrance paper I set in Arithmetic last January. By the Regulations, "No boy shall be admitted who cannot work sums in Fractions and the Rule of Three."

"RUGBY SCHOOL, JANUARY, 1876.

"*Entrance Examination.—Arithmetic.*

"You are required to satisfy the Examiners in this paper.

1. Subtract one hundred and seven pounds, nineteen shillings and sixpence three farthings from two thousand seven hundred and three pounds, and threepence halfpenny.

Multiply the result by seventeen.

2. Write out the table of square measure, and find the number of ounces in a ton.

3. If 49 tons 15 cwt. 1 qr. 13 lbs. of coal are distributed among 23 persons, how much will each receive?

4. Multiply 11*l.* 3*s.* $6\frac{5}{8}$*d.* by $3\frac{3}{7}$.

5. Simplify $2\frac{3}{4} \div 1\frac{5}{6}$ and $\frac{2\frac{1}{2} - 1\frac{1}{4}}{7 \div 5\frac{1}{4}}$.

6. If a man walk 4 miles, 1 furlong, 40 yards in one hour and 13 minutes, how far will he walk in two hours?

7. Multiply .105 by 3.027 and $.10\dot{5}$ by $3.02\dot{7}$.

8. Find the cost of 3,653 articles at 7*l.* 13*s.* $6\frac{1}{2}$*d.* each."

The plucking on this paper happily did not rest finally with me. But it may affect Prof. Roscoe's opinions if I tell him that if every boy had been required to answer one of the first three questions, and either 4 or 5, and 6, —[1] per cent. would have failed: and the average age of these boys cannot have been under fourteen. This is a stubborn fact. No doubt boys *ought* to know more. But they *don't*.

What, therefore, we insist on is that boys, when once in the school, shall not begin science till they know something of fractions, decimals, and square measure, and half the first book of Euclid. Does the Professor think our standard too high?

To sum up, therefore, what has been said. The commission and governing body secure fair play to science; the Universities do the same, though the new examination is, indirectly, rather adverse to it. Head-masters follow, and do not lead the public; and the public has no very decided opinions just at present.

If, therefore, I were asked what I think ought to be the programme of those who are interested in the progress of physical science and of sound education generally, in schools, I should reply that our great aim ought to be *the postponement of Greek in all schools, and its removal from the compulsory subjects in the examination for certificates that carry a University value*; that meantime we ought to use the certificate examination, and improve it; and to demonstrate, if possible, to unbelievers, the advantage it would be to some boys to drop Greek and composition for the purpose of scientific study, and that such a liberty would not injure the efficiency of schools in classics. It will be well also to watch with care the progress of schools in which Greek is not taught at all. No index to public opinion can be more valuable.

"The History of Education," Henry Sidgwick says,[2] "is the battle-ground and burial-ground of impracticable theories; and one who studies it is soon taught to abate his constructive self-confidence, and to endeavour humbly to learn the lessons, and harmonise the results of experience."

It is in this spirit—and I trust it is mine—that anything must be written that will now, in the present stage of the discussion, be a valuable contribution to the formation of opinion on this interesting and important question.

Rugby, March 6 JAMES M. WILSON

I should feel obliged if you would permit me to say that my views with regard to this question agree in the main with those of Mr. Hutchinson and Mr. Wilson.

The regulations of the Oxford and Cambridge Schools Examination Board were amended after the first examination in 1874, and the paper together with the practical work set last year was, in my opinion, sufficient in point of difficulty. Several of the candidates from Clifton, and doubtless from other schools, were quite prepared to work a much more difficult paper. That, however, is not the question which is to determine what shall be required of the average boy when he leaves school.

In Clifton College the Modern Side receives instruction in science at the rate of two lectures a week on chemistry and two on physics. Latin gets only three hours a week. A large number of boys (over fifty) attend voluntarily in the laboratory and thus have three or more hours a week of practical work, whilst a few of the more advanced receive two lessons in theoretical chemistry, besides doing a considerable amount of reading out of school. The subject is rewarded by marks at the same rate per hour as Latin, and also gets a fair share of prizes. In short, science at Clifton occupies a prominent and

[1] In the revise I have struck out this number. Its publication might be regarded as a breach of confidence. And it is almost incredible.

[2] "Essays on a Liberal Education." Macmillan, 1867.

honourable position in our curriculum. At other schools, as, for example, the Manchester Grammar School, I am told that even a larger proportion of the time of the boys is given to work of this kind; and on the whole I am inclined to think that, notwithstanding the reluctance of some of the old foundations to admit the interloper, yet that the prospects of science in connection with general education are exceedingly satisfactory and encouraging.

It would be a mistake to attempt to *displace* classical studies, as some people seem to wish, in favour of science or any other subject. It cannot be expected that all boys should have the same tastes or capabilities. It would be as much an error to compel a boy, who has shown no aptitude for science, to devote any large proportion of his time to that subject, when he might be getting on with his classics, as it would be to doom another to Latin prose when his heart was all the time in the laboratory. The true system I believe to be this. After passing through a junior school, in which all should be equally instructed in some branch of natural history or experimental science, boys should then be drafted off into one of three departments. There should be (1) a classical school, in which Latin and Greek should be the staple, though not to the exclusion of a certain modicum of mathematics and science; (2) a modern school, in which mathematics are predominant; and (3) a science school, in which languages, though subordinate to science, should not be altogether extinguished. This is very nearly the system pursued at Clifton, and I can testify to its practical convenience and success.

As regards the choice of subjects, though I believe chemistry is pre-eminent in its capacity for developing certain of the mental powers, I consider that the fullest advantage is not derived from it, unless it is taught in a certain way. I hold that teachers of chemistry *in schools* are wrong when they set about teaching boys according to the methods commonly in use in the instruction of ordinary chemical students. The latter have to apply their knowledge to practical purposes, and this is not the prime object to be kept in view in determining the educational value of a given subject.

And this leads me back to the question of examination papers. I consider that examiners have as much to learn as teachers in connection with their respective functions. At present it is too frequently, "How do you make this?" or, "What are the properties of that?" a style of question which is good enough in its way, but to answer requires very little intellectual effort. The preparation for such an examination is little better than "cram," and is of proportionately small educational value.

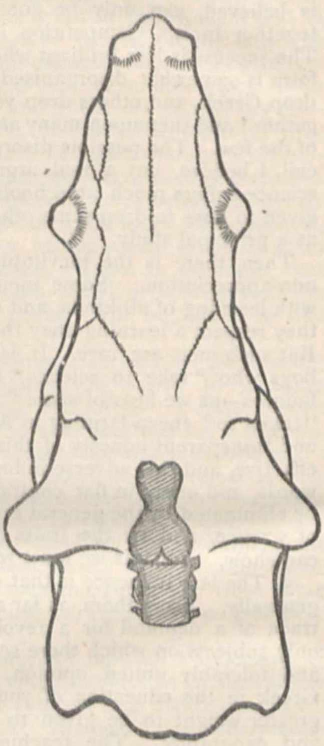
If examiners, whether in school or university, would take more pains in framing their questions so as to extract not alone that which is in the memory of the candidate, but to get the product of his brain, I believe great and important service would be rendered to scientific education. WILLIAM A. TILDEN

Clifton College, Bristol, March 6

PRINCIPAL CHARACTERS OF THE DINOCERATA

UNDER the above title, Prof. O. C. Marsh, of Yale College, has published several facts of great importance with reference to the structure of the huge Eocene Mammals of Wyoming, of which we have already given a short description (NATURE, vol. vii. p. 366) from the same author's memoirs.

We now learn that the brain as known from the inside of the skull was very remarkable, being proportionately smaller than in any other known mammal, the Spermaceti and some other whales alone excepted. In *Dinoceras mirabilis* the entire brain was not greater in any of its transverse dimensions than the spinal canal in the cervical region. Its relative size and position can be best estimated from the accompanying drawing, copied from one given by Prof. Marsh, the brain in it being shaded, with a portion of the spinal cord attached. From the figure it is also evident that the olfactory lobes are proportionately large, at the same time that the cerebral lobes are hardly bigger than in some reptiles. The cerebellum must also have been small, whilst the cranial as well as the spinal nerves and the cord were immense.



The teeth are figured with their prominent V-shaped ridges, the dental formula being given as:—

$$i\,\frac{0}{3}\;c\,\frac{1}{1}\;pm\,\frac{3}{3}\;m\,\frac{3}{3}\times 2 = 34.$$

The upper canines were very long and pointed, and peculiar expanded descending processes on either side of the lower jaw seem to have acted as guards to protect them whilst the mouth was closed. The condyles of the lower jaw were transverse, and therefore only allowed of an up-and-down movement. The molars were peculiarly small for the size of the animal and of the skull. The creature must have been carnivorous, as mastication could only have been slight, and the food therefore nutritious.

The feet are figured. They were very elephantine, there being five digits on each; these, with the carpus and tarsus, being short and compressed from above downwards. The terminal phalanges were well developed. The other bones much resembled those of the elephant in size as well as contour. Prof. Marsh tells us that the head could evidently reach the ground, and that there is no evidence of a proboscis.

These characters all point to the fact that in Eocene times there lived an order of animals which have no representatives at the present day, and that they were highly specialised in some points of their structure, whilst in others they were equally ill-developed.

NOTES

WE learn that a scheme is on foot for a memorial of the late Prof. Rankine. Students of Thermodynamics, Engineering, &c., will be doubly delighted to hear that the memorial is to take the form of an edition, in two handsome quarto volumes, of his valuable papers contributed to the various scientific societies and magazines.

A SERIES of lectures upon zoological subjects will be delivered after Easter in the Zoological Society's Gardens, in Regent's Park, on Thursdays, at 5 P.M. The following are the titles, together with the days on which they will be delivered by the respective lecturers:—April 27, Mr. P. L. Sclater, F.R.S., on the Society's Gardens and their inhabitants; May 4, Prof. Flower, F.R.S., Rhinoceroses and Tapirs; May 11, Prof. Flower, Horses and Zebras; May 18, Dr. J. Murie, the Manatee; May 25, Prof. Garrod, On Birds; June 1, Prof. Mivart, On Bats; June 8, Mr. Tegetmeier, On Homing Pigeons;

June 15, Prof. Garrod, on Reptiles; Mr. J. W. Clark, on the Beaver and its distribution; June 29, Dr. Carpenter, on the Zoological Station at Naples.

WE are in a position to state that M. Leverrier has not accepted a seat in the Berlin Academy of Sciences, as was announced recently in a London daily paper. He would have been present at the meeting of the Royal Astronomical Society, to receive his medal, had he not been prevented by ill-health. Although not serious, the illness was sufficient to keep him at home for a protracted period.

WE have received the *Atlas Météorologique de l'Observatoire de Paris* for the years 1872, 1873, and 1874, which has been prepared from documents received and discussed by the Departmental Meteorological Commissions, the normal schools, the observers, and others, and published with the concurrence of the Scientific Association of France. This very valuable publication, giving in detail results of much of the important meteorological work now undertaken by France, together with separate discussions on inquiries of great interest by such writers as Prof. Raulin, MM. E. Belgrand, G. Lemoine, and Brault, we shall take an early opportunity of more fully bringing before our readers.

A DAILY weather report, by the *Deutsche Seewarte*, began to be issued at Hamburg under the direction of Dr. G. Neumayer, on 1st January last, which shows on one map embracing nearly the whole of Europe, the distribution of pressure, wind, and cloud, and on another, temperature, rainfall, and sea disturbance, along with a general review of the state of the weather in the morning, the changes that have occurred since the afternoon of the day before, and occasionally a forecast of the weather to be expected. The reports are based on weather telegrams received from twenty-seven places situated in different parts of Germany, supplemented by reports from Great Britain, France, Italy, Austria, Russia, Denmark, Sweden, and Norway. The report is a valuable addition to the daily weather maps of Europe, and considering the great ability of Dr. Neumayer and his coadjutors, the system will be most efficiently worked.

WE have received from the South Australian Institute, Adelaide, six valuable meteorological diagrams, representing the main facts of the rainfall at Adelaide from January 1839 to October 1874, at Melbourne from January 1855 to July 1874, and at Sydney from April 1840 to July 1874. The diagrams for Adelaide are particularly full, showing the rainfall each day for the thirty-five years, the annual amounts, and the monthly averages and extremes.

THE Central Committee for the participation of Germany in the forthcoming Exhibition of Scientific Apparatus has up to the present admitted 260 applicants, who will exhibit altogether 2,300 instruments. The British Government has afforded every facility to the exhibitors, having sent specially-fitted carriages to Berlin for the safe conveyance of instruments of great value.

AT a recent meeting of the Sedgwick Memorial Committee at Cambridge, the treasurer announced that the fund amounted to 11,500*l*. This sum is, however, insufficient for the purpose of erecting a Museum worthy as a building to commemorate the late Professor, and it is hoped that additional subscriptions will still be forthcoming. It is intended that the Museum should form part of a group of buildings for Natural Science purposes. The whole question is under the consideration of a Syndicate.

AT a meeting of the Senatus Academicus of Aberdeen University, held on Saturday, it was resolved to confer the degree of LL.D. upon Mr. Charles Meldrum, the Observatory, Port Louis, Mauritius, and Mr. John Smith, Professor of Chemistry, University of Sydney.

A CROWDED meeting was held by the Italian Geographical Society on Tuesday morning in one of the large halls of the Collegio Romano for the purpose of taking leave of the Marchese Antinori, Signor Chiarini, Professor of Geology, and Capt. Martini, composing the expedition sent out to Central Africa. The President, Commendatore Correnti, ex-Minister of Public Instruction, addressed the meeting. Among the many distinguished persons present were Prince Humbert, Honorary President, and General Menabrea, member of the Council of the Society. In the evening a banquet was given to the members of the expedition, and yesterday they were to embark at Naples direct for Aden.

THE *Times* Berlin correspondent writes that Capt. Sosnovski, the Russian traveller, who has just threaded his way from the shores of China to the South Siberian frontier, has presented to his Government an explicit report upon new caravan roads to be formed through Mongolia.

M. GREARD, the Director of Public Instruction of the City of Paris, has just published his Reports, which contain a great number of interesting facts. In 1861, 48 children in each 100 were educated in the public schools of the city; in 1872 the proportion was 68 per cent.; but out of the remaining 32 per cent. only 20 per cent. are uneducated, the other 12 being educated in their families or in private institutions. The fact is all the more noteworthy that in the department of the Seine or suburban Paris, the number of schools and of pupils is diminishing. This is attributed to the impoverishment and sufferings resulting from the German and civil wars, which fell more heavily on the suburbs than on Paris itself.

M. ANSART, a captain in the French navy, has published, under the title "Anemology," an interesting article on the formation of winds, in the *Revue Maritime et Coloniale* for December. The principal aim of the author is to prove that the electrical attraction exerted on the clouds by the earth is an important factor in the generation of winds; the motions of the air being thus not merely dynamical as is generally supposed. Capt. Ansart is not the only meteorologist who has tried to take account of the electrical power of the earth. At the end of his essay he quotes the opinion published by M. Keller, who explains by attraction of the earth the production of waterspouts. He concurs in opinion with Capt. Ansart that the matter of the clouds under special circumstances is attracted by the negative electricity of the earth being strongly positively electrified. The rotation of a waterspout, according to Capt. Ansart, is caused by the attraction of the earth not being equally exerted on the whole of the surface of the cloud.

THE *Augsburg Gazette* states that the number of students registered in Berlin, of German nationality, is 1,884, in Leipzig 2,575, and in Munich, 1,087.

EARTHQUAKE shocks were felt in the province of Constantine, Algeria, at Philippeville and Gigelly, two sea-ports, on the night of Feb. 22-23. The exact times for Philippville were 1 and 1.30 A.M.; the direction north-west to south-east. Another motion was felt at Gigelly on the 23rd, at 4 o'clock in the afternoon. M. Bulard, Director of the Observatory of Algiers, expected other shocks on the 4th or 5th of March, and has published the prediction in the *Moniteur de l'Algerie*.

MESSRS. HENRY S. KING and Co., inform us that it was by an inadvertence that Bernstein's "Five Senses of Man" was advertised as ready; it will not be out for at least a fortnight.

WE have just received the first number of the Italian *Giornale del' Museo d'Istruzione e di Educazione*, containing forty pages of valuable matter connected with various departments of education. The Museum of which this journal is the organ, was founded at Rome by decree of Victor Emmanuel in 1874, and is probably one of the finest and most complete educational museums in the world. It is freely open to the public, and teachers have ample facilities for taking advantage of its circulating library, and of the various other means which it possesses for furthering the cause of higher education.

A NEW French geographical journal has been established by M. George Renaud, a member of the Paris Geographical Society, under the name of the *Journal Géographique Internationale*, which will be published twice a month. Each number will contain a coloured map.

MR. CUNLIFFE OWEN, the director of the South Kensington Museum, visited on Saturday last the photographic workroom established in the *Moniteur* office, Quai Voltaire, Paris. The peculiarity of the process used is the reproduction of colours by a series of chromo-printings. It is a combination of photography and chromo-lithography, which gives astonishing results, chiefly in the reproduction of models of engines and *natures mortes*.

THE March part of the *Geographical Magazine* contains two maps by Mr. Ravenstein, in connection with Lieut. Cameron's recently-accomplished journey across Africa. One of these is of a portion of South Africa, illustrative of Cameron's route from Lake Tanganyika to the west coast, and the other is a map of the country between Lake Tanganyika and Nyangwe, according to Livingstone and Cameron. The same number contains an interesting account by Lieut. Liardet of an ascent to the lake on the summit of the island of Taruini, in Fiji.

"THE Study of Natural Science" is the title of an address delivered to the Natural Science Classes in the University College of Wales, by Mr. F. W. Rudler, F.G.S., recently appointed Professor of Natural Science in the College. Mr. Rudler has sound notions as to the relations which ought to subsist between scientific and literary training in education, and of the methods which ought to be followed in the study of science.

WE have received a copy of the rules, list of members, and Papers read before the Cambridge Natural Science Club. The number of members is very limited, and the rules are sufficiently stringent to exclude all but men who mean to work. Some of the papers which have been read are of permanent value.

WE are glad to see that the Edinburgh Naturalists' Field Club, founded in 1869, is still in existence and evidently in a prosperous condition.

FROM its Tenth Annual Report, we are glad to learn that the North Staffordshire Naturalists' Field Club is in a prosperous condition; the number of members is now 330. The excursions and meetings during the past year appear to have been instructive and interesting. The Report contains the Annual Address of the President, Mr. C. Lynam, on the Sepulchral Monuments of Staffordshire. Other papers are: "The Geology of Needwood Forest," by Mr. W. Molyneux, F.G.S.; "Uriconium," by the Rev. J. S. Broad; "Ancient Church Bells in Staffordshire," by Mr. C. Lynam; and "Structural Features of Plants in relation to their uses in the Arts and in Medicine," by D. J. T. Arlidge.

PART 3 of Vol. I. of the *Transactions* of the Watford Natural History Society contains the following papers:—On the Botanical Work of the past Season, by R. A. Pryor, F.L.S., with a map of Hertfordshire; List of Works on the Geology of Hertfordshire, by W. Whitaker, F.G.S.; and A Few Words about some Local Ferns, by J. E. Littleboy.

IN the last-issued part of the Transactions of the Institution of Engineers and Shipbuilders in Scotland is a paper by Mr. James Brownlee "On the Action of Water and Frictional Resistance or Loss of Energy when flowing at various velocities through a nozzle with a converging entrance and diverging outlet," with two plates.

THE President and Fellows of Magdalen College, Oxford, have commenced free courses of lectures on botany, zoology, and chemical physics, for artisans resident in Oxford. They will be continued throughout the present and Easter Term and the Long Vacation on each Saturday evening. The lectures are conducted by Prof. Lawson and Messrs. Chapman and Yule.

MESSRS. LEWIS AND CUNNINGHAME, special assistants to the Sanitary Commissioners with the Government of India, have just published a Report describing a series of important observations on the Soil in its relation to Disease.

"LIST of Hemiptera of the Region West ot the Mississippi River" (extracted from the *Bulletin of the Geological and Geographical Survey of the Territories*, No. 5, second series, Washington, January, 1876) is the title of a pamphlet by Prof. P. R. Uhler, who has thus added one to the many valuable hand-lists now being published in various parts of the United States. The need of monographs and synonymic lists in the present day is constantly making itself felt; without them the entomologist can scarcely keep pace with the rapid growth of his study; so that he hails the appearance of such a paper as the above, with its well-executed and clearly-defined plates, as a godsend, for which he can hardly be too grateful.

THE additions to the Zoological Society's Gardens during the past week include a Brown Monkey (*Macacus brunneus*) from Siam, presented by Mr. Thos. G. F. Hesketh; a Tyrant Eagle (*Spizaëtus tyrannus*) from South America, a Many-zoned Hawk (*Melierax polyzonus*) from East Africa, two Brazilian Caracaras (*Polyborus brasiliensis*), white variety, from Patagonia, presented by Lord Lilford; two Common Pintails (*Dafila acuta*), three Spotted-billed Ducks (*Anas pœcilorhyncha*), eighteen Red-crested Whistling Ducks (*Fuligula rufina*) from North-west India, presented by Mr. E. C. Buck; a Ring-necked Parrakeet (*Palæornis torquata*) from India, presented by Mrs. Henry Kingston; a Cape Dove (*Æna capensis*) from Africa, presented by Miss Barrer; an Indian Elephant (*Elephas indicus*), a Secretary Vulture (*Serpentarius reptilivorus*) from South Africa, deposited; a Greenland Falcon (*Falco candicans*) from Greenland, purchased; a Great Kangaroo (*Macropus giganteus*), a Red Kangaroo (*Macropus rufus*), born in the Gardens.

ANNIVERSARY ADDRESS OF THE PRESIDENT OF THE ROYAL GEOLOGICAL SOCIETY, JOHN EVANS, F.R.S.[1]

II.

MR. EVANS, in continuing his address, spoke of stratigraphical geology and of palæontology, expressing his belief that all recent discoveries pointed to uninterrupted continuity in both regions. After briefly referring to the evidence found in Settle Cave of the pre-Glacial existence of man in this country, and to the Wealden boring, Mr. Evans spoke as follows:—

There is only one more subject on which I will say a few words, and which, as to some slight extent involving a question in which I am personally interested, I have kept for the end of my address.

It is one to which it appears probable that the earnest attention of geologists will immediately be called, namely, the water-supply of this vast metropolis. This is, indeed, not the first time that the attention of this Society has been called to it; for Professor Prestwich devoted to it a considerable portion of his presidential address in 1872. It has since been more fully discussed in the Sixth Report of the Commissioners appointed in 1868 to inquire into the best means of preventing the pollution of rivers, who have extended their inquiries somewhat beyond

[1] Continued from p. 356.

what appear to be the strict limits of their Commission. It is with their report that I am mainly concerned.

The Commissioners have expressed their opinion that the rivers Thames and Lea (or Lee, as the word is spelt in their Report) ought to be abandoned as early as possible, and especially the former, as sources of supply to London. They regard the condition of these rivers as hopeless, and point out that an abundance of spring- and deep-well water can be procured in the basin of the Thames and within a moderate distance of London; and they are further of opinion that the metropolis and its suburbs should be supplied, on the constant system, exclusively with this palatable and wholesome water.

They believe that within forty miles of St. Paul's a sufficient volume of deep-well and spring-water can be obtained for the present daily wants of the metropolis, but especially point to the chalk and upper green-sand above the Gault, as the sources of supply. They state that within thirty miles of London there is an area of 849 square miles "covered" by these formations, and that within 40 miles radius the area is 1,597 square miles.

They estimate, to a great extent guided by experiments carried on during many years under my superintendence, that the portion of the annual rainfall upon this large extent of porous rock, which sinks to reappear in springs and streams, may be taken at six inches annually, and point out that this amount of infiltration into the chalk area within thirty miles of the metropolis indicates the quantity of 202 millions of gallons daily, as the theoretical maximum supply available from that area. They suggest that the greater portion of this water, which now escapes in springs and in the river-beds at the lower levels of the absorbent district on which it falls, might be abstracted by a sufficient number of wells sunk below the present spring-heads of the district, and so constantly drawn upon, that there should always be a void for the reception of unusual rainfalls below the level at which the drainage of the district naturally escapes. They incidentally admit that any water drawn from the subterranean reservoir in the chalk by artificial means will be at the expense of the streams which now flow through the valleys in the chalk area, but do not give even a passing consideration to the effect upon that area of abstracting from it its natural supply of water, and conveying it —"convey, the wise it call"—to London—should the scheme they advocate ever be carried into effect.

It can hardly be believed that a proposal such as this, involving the diversion of the whole of the water from the natural springs and streams over an area of not less than 440 square miles—an area larger than that of several English counties—should have been brought forward without the slightest reference to what would be the result upon this vast extent of country, the inhabitants of which are to be sacrificed to the presumed needs of this overgrown city. It will, I think, come within the province of the geologist to point out not only where spring-water of good quality is to be obtained, but also what will be the effect of its abstraction upon the districts where it now exists in sufficient abundance to overflow into the streams. It will be for him to show what will be the effect of producing "a void below the level at which the drainage of the country naturally escapes;" how what are now fertile and even irrigated meadows will be converted into arid wastes; how watercress beds, now of fabulous value, will be brought to the resemblance of newly-mended turnpike roads; how in such a district all existing wells, many of them already some hundreds of feet in depth, will be dried, the mill-streams disappear, and even the canals and navigable rivers become liable to sink and be lost in their beds. And these results would, if the scheme were carried out, not be confined to some single spot, but would extend over hundreds of square miles.

It may perhaps be thought that I am exaggerating the size of the area, the natural water-supply of which it is proposed to abstract; but the calculation may be readily verified.

The quantity of water now daily supplied to London by the different water-companies, exclusive of the Kent Company, which already supplies deep-well water to the extent of 9,000,000 gallons daily, is stated to be 104,800,000 gallons. Now if the supply of 6 inches of rainfall per annum, absorbed over 849 square miles, be, as the Commissioners calculate, equivalent to 202,000,000 gallons daily, it is evident that it will require more than half that area to furnish 104,800,000 gallons daily, the exact figures being 440½ square miles.

It must, however, be remembered that the Commissioners regard this quantity as the theoretical maximum of water-supply available from such an area. And they are right in so doing; for in some years a far larger area would have to be exhausted in order to produce so large a water-supply, since not unfrequently the quantity of the rainfall which percolates to a depth of only 3 feet into the soil, instead of being 6 inches, as supposed in the calculation, is as low as 3 inches. For three years running I have known the percolation through a depth of 3 feet of ordinary soil covered with vegetation to have been on the average only 3¼ inches, and through chalk under the same conditions, less than $5\frac{1}{4}$ inches. It would appear then that it would be safer to regard the available spring-water supply as not representing more than 4 inches of the rainfall per annum, instead of 6 inches, in which case the area requisite to supply 104,800,000 gallons daily would be 660 square miles.

To avoid any possible error, let us look at the matter from another point of view. One inch of rain falling over a statute acre produces, as nearly as may be, 100 tons, or 22,400 gallons of water. Dividing this by 30 as representing the daily consumption of one person, there would be enough for one person for 743 days, or, say, for two for one year. Four inches of rain would render each acre capable of supplying the wants of eight persons, so that a square mile of 640 acres would supply 5,120 persons for one year. Calling the population of the metropolitan area 4,000,000, and dividing that number by 5,120, we arrive at an area of 780 square miles as necessary for their supply.

There can therefore be no doubt as to the vast extent of country which the proposal of the Commissioners would place under unnatural conditions with regard to its springs and streams.

No doubt wells may, in some few instances, be placed in such a position as to affect but slightly the neighbouring streams. The wells of the Kent waterworks, for instance, which supply 9,000,000 gallons daily, are so placed as mainly to derive their supply from water that would otherwise find its way into the Thames by springs along its bed; indeed, from the amount of chlorine present in the water, it may be doubted whether some portion of it is not derived from the Thames itself by filtration through the chalk. It seems probable that in the valley of the Thames immediately above London there may be spots from which a limited supply of water might be pumped without much injury to the neighbouring property; but a wholesale abstraction of the entire supply of spring-water from an area of even 300 or 400 square miles could not be otherwise than most disastrous.

On looking at the actual chemical analysis of the waters supplied by the different companies, as furnished by the Commissioners, there would at first sight appear to be some difficulty in understanding their reasons for so highly commending the Kent Company's water, and so unhesitatingly condemning that of the other companies, if we are to take as our guide the "previous sewage or animal contamination," on which so much stress is laid. It is hard to comprehend why, if river or flowing water which exhibits any proportion, however small, of "previous sewage or animal contamination," is to be regarded as suspicious or doubtful, the water in wells, say 100 feet deep, may be allowed 10,000 pints in 100,000, or 1 pint in 10, and may yet be regarded as reasonably safe. For, in these deep wells, if at no great distance from a river such as the Thames, it by no means follows that there is not some amount of comparatively direct communication through which water may trickle rather than filter, and not improbably the river-water below London is more objectionable for drinking purposes than it is higher up the Thames.

Let us for a moment compare the "previous sewage or animal contamination" of the water supplied by the different companies deriving their water from the Thames and Lea with that of the Kent Company's water. I take the average of the different analyses of each, as given at p. 270 *et seq.* of the Report:—

West Middlesex	3·083
Grand Junction	3·226
Southwark and Vauxhall	2·983
Lambeth	3·081
Chelsea	2·785
New River (excluding 1868)	2·751
East London	2·304
Average	2·888
Kent Company	6·480

or upwards of twice that of any one of the other Companies.

In this average, however, is included the water from the wells at Charlton and Belvedere, both of which are condemned by the Commissioners. Omitting these two, the average is 3·780, which is still far higher than any of the others.

If we refer to the headings Organic Carbon and Organic Nitrogen, there can be little doubt of the superiority of the Kent Company's water, but judging merely from the statistics under the awful heading of "Previous Sewage Contamination," that of the River Companies seems the purest.

Why the source of supply from the two rivers should be condemned as hopeless it is hard to determine. This startling recommendation to give up the supplies of water on which London for centuries has depended, is brought forward just at a time when the most strenuous efforts are being made to purify the rivers Thames and Lea, and but a few years after the Commissioners on the Water Supply of the Metropolis, within whose proper sphere this question lay, had reported that with perfect filtration and efficient measures taken for excluding from them the sewage and other polluting matter, these rivers will afford water which will be perfectly wholesome and of suitable quality for the supply of the metropolis.

It is not for me to enter into the chemical part of this question, but I may venture to express a doubt whether considerably more might not be done by increased reservoirs for subsidence, and by artificial aëration of the water, in addition to filtration, so as to carry still farther the oxidation of any organic matter it may chance to contain.

I have less hesitation in strongly insisting on the fact that, irrespective of the New River water, the metropolis is already supplied with 9,000,000 gallons per diem, or at least 2¼ gallons per head, of the deep-well water so highly commended, a quantity which would seem amply sufficient for dietetic and culinary purposes. I am, moreover, of opinion that the difficulty of distributing this water over the whole area by means of a second service distinct from that of the water for ordinary domestic purposes, though great, is by no means insurmountable. Even were the waters of the Thames and Lea unfit for drinking purposes, it is very far from being the case, that London is in the same plight as Coleridge's "Ancient Mariner," with—

> "Water, water everywhere,
> Nor any drop to drink."

Enough is already there for all culinary and dietetic purposes, could it but be distributed; and to lay out incalculable sums of money and inflict incalculable mischief, in order to import chemically pure water with which to lay the dust in our streets, and to flush our sewers, seems "a multiplying improvement in madness, and use upon use in folly." We might almost as well import wine for the purpose; and in that case the Commissioners might find a historical parallel in the proclamation of Jack Cade:—"Here, sitting upon London Stone, I charge and command, that of the City's cost, the conduits run nothing but claret wine the first year of our reign."

As deeply interested in the water-power and general prosperity of one of the chalk valleys within the fated radius of thirty miles, I may have spoken strongly on this question, and may not unfairly be accused of having done so from interested motives. No one, however, can submit silently to an insidious attack upon the property which he is fairly entitled to hold; and after carrying on experiments, for upwards of twenty years, as to the percolation of water to the underground springs in a chalk area, I may claim some experience in such a question, and much doubt whether my judgment is seriously distorted. Even should the abstraction of water be spread over a much larger area than has been supposed, so as to reduce the amount conveyed away from any particular district; or even should the gross quantity required prove less than supposed, it may be left to any one who will take the trouble to investigate the matter, to determine whether the effects if wider spread, or somewhat diminished in intensity, would be much less injurious. Any injury from this cause would moreover be felt with double intensity at those seasons, which are of by no means unfrequent recurrence, when even without this gigantic artificial abstraction, the water in the upper portions of the chalk district becomes short, and wells which during the previous season may have had fifty or sixty feet of water in them run absolutely dry.

It now only remains for me to thank the Council, the officers of the Society, and the fellows at large, for the uniform kindness and consideration which they have extended to me, not only during the two years I have had the honour of being your president, but during the eight preceding years, during which I was one of your secretaries. I look back with pleasure on the prosperity which, during those ten years, the Society has enjoyed, a prosperity which I hope may continue even in a greater degree, now that I quit this chair in favour of my old friend and fellow-secretary, Prof. Duncan, who is, in all respects, so thoroughly well qualified to fill it.

SCIENTIFIC SERIALS

THE *Journal of the Chemical Society* for January contains the following papers:—Isomeric terpenes and their derivatives (Part V.), by G. H. Beckett and C. R. A. Wright, D.Sc. The authors in this paper describe the results of their experiments upon peppermint camphor from Japan. This substance has been shown by Oppenheim to be an alcohol (menthylic alcohol) of the formula $C_{10}H_{19}OH$, which by the action of dehydrating agents yields menthene, $C_{10}H_{18}$, this latter substance when treated with bromine yielding a tetrabromide $C_{10}H_{18}Br_4$, which on heating splits up into hydrobromic acid and cymene. The cymene thus obtained is identical with those previously obtained from other bodies. The authors have examined also the toluic acid from seven different cymenes, and conclude therefrom that "by the action of a large number of agents on terpenes and bodies related to them, absolutely the same cymene results, this cymene being identical with the paramethylpropyl benzene recently obtained synthetically by Fittica." Clove oil hydrocarbons and the liquid oil from camphor sublimation have also been examined.—On the decomposition of stearic acid by distillation under pressure, by George Johnston. The oils produced contain, among other products, mixtures of seven paraffins with the corresponding olefines.—On tolyl-phenyl, a new hydrocarbon, by T. Carnelley, B.Sc. The hydrocarbon is produced by the action of sodium upon a mixture of bromobenzene and pure bromotoluene (1 : 4):—

$$C_6H_5Br + C_6H_4.CH_3Br + Na_2 = 2NaBr + C_6H_4 \begin{cases} CH_3 \\ C_6H_5 \end{cases}$$

The behaviour of this hydrocarbon on oxidation is described, and and also some of its nitro and amido substitution derivatives.—A simple form of gas regulator for maintaining a constant temperature in air-baths, water-baths, incubators, &c., by F. J. M. Page, B.Sc.—The remainder of the journal is devoted to abstracts from foreign periodicals.

THE January number of the *Ibis* commences with a paper by Mr. Robert Ridgway, of the Ornithological Department of the United States National Museum, Washington, entitled "Second Thoughts on the genus *Micraster*," in which he modifies his view previously expressed as to the reduction of the number of species, from an examination of the specimens in Messrs. Salvin and Godman's collection. The same author also writes on the genus *Glaucidium*, embodying the results of Mr. Sharpe's criticism of a previous paper by him on the same subject; *G. jardinii* is figured.—Mr. D. G. Elliot has remarks on some type specimens of Trochilidæ from the museums of Neuchâtel and Florence; and notes on the Trochilidæ. In the former paper three of Tschudi's types—*Bourcieria insectivora*, *Heliodoxa leadbeateri*, *Leucippus leucogaster*—are discussed. The male of the first is described; *Trochilus otero* (Tschudi) is the second; the third is one of two species only of the genus. Four of Sig. Benvenuti's types are described. *Mellisuga judith* is *Panoplites flavescens*; *Mellisuga salvadorii* is the female of *Cynanthus cyanurus*, *Mellisuga ridolfii* is a female of *Eriocnemis vestita*, and *Polytmus ceciliæ* is *Campylopterus lazulus*. Mr. Elliot's second paper is on the genus *Lampropygia*.—Mr. C. Bygrave Wharton has Notes on the Ornithology of Corsica, describing 113 species, mostly from the west coast.—Mr. R. B. Sharpe gives Part I. of Contributions to the Ornithology of Borneo, with a plate figuring *Orthotomus borneonensis* and *Calamodyta doriæ*, based on a collection made by Mr. Arthur Everett, *Circus spilonotus*, *Copsychus problematicus* (sp.n.), *Brachypodius immaculatus* (sp.n.), *Herpornis brunnescens* (sp.n.), *Henicurus ruficapillus* are the species described for the first time from the island. Mr. Sharpe also determines two new species of South African birds collected by Mr. F. A. Barratt near the Macamac gold-fields. They are *Andropadus flavostriatus*, and *Bradypterus barratti*.—Mr. J. H. Gurney continues his notes on Mr. Sharpe's Catalogue of the Accipitres in the British Museum, discussing the Buteoninæ.—Mr. H. E. Dresser gives notes on Severtzoff's Fauna of Turkestan.—Prof. Newton writes on the assignation of a type to Linnean genera, with especial reference to the genus *Strix*.—Messrs. H. Seebohm and J. A. Harvie Brown give notes on the birds of the Lower Petchora, based on an expedition made there last summer.

SOCIETIES AND ACADEMIES

London

Geological Society, Feb. 23.—Prof. P. Martin Duncan, F.R.S., president, in the chair.—The Rev. David Charles, D.D., Thomas Musgrave Heaphy, C.E., William Smethurst, Edward Horatio W. Swete, M.D., and John Thomas Young were elected Fellows, and Prof. Joseph Gosselet, of Lille, a Foreign Correspondent of the Society.—The following communications were read:—On the greenstones of Western Cornwall, by Mr. John Arthur Phillips, F.C.S. In this paper the author brought forward evidence to show that the so-called "greenstones" of Penzance really belong chiefly to the following three classes:—*a*. Gabbros or Dolerites, in which the originally constituent minerals are either to a great extent unchanged, or, sometimes, almost entirely represented by pseudomorphic forms. *b*. Killas, or ordinary clay-slates. *c*. Highly basic hornblendic rocks, exhibiting a tendency to break into thin plates; these under the microscope present the appearance of metamorphosed slates. Slaty rocks of a character intermediate between *b* and *c* also occur. In the Cape Cornwall district the "greenstones" are chiefly hornblendic slates, sometimes with veins or bands of garnet, magnetite, or axinite. The rocks near the Gurnard's Head are almost identical with those of Mount's Bay. The crystalline pyroxenic rocks and metamorphic slates of the St. Ives district exactly resemble those of Penzance. The greenstones between St. Erth and St. Stephen's are probably altered ash-beds or hardened hornblendic slates; unlike the hornblendic and augitic rocks of the other districts, they do not occur in the immediate vicinity of granite, but elvan courses are always found near them. The percentage of silica in the two series of rocks is nearly constant; the hornblende slates contain about 10 per cent. less silica than the crystalline pyroxenic rocks, and there is an excess of iron oxides to nearly the same extent, their composition in other respects being very similar. The Killas is an acidic rock of essentially different chemical composition.—On columnar, fissile, and spheroidal structure, by the Rev. T. G. Bonney. Some of the above structures have comparatively recently been discussed by Mr. Mallet and Prof. J. Thomson. Both these authors agree in attributing columnar structure to contraction due to loss of heat while cooling, but differ in their explanation of cross jointing and spheroidal structure. In this paper it is sought to show that the principle proved by Mr. Mallet to be the explanation of the columnar structure is capable of a wider application. After a brief notice of some instances of columnar structure, the author described cases of a fissile structure seen in certain igneous rocks (especially in the Auvergne phonolites), closely resembling true cleavage, and often mistaken for it; also the tabular jointing of rocks; a peculiar form of this, where most of the segments are of a flattened convexo-concave form; spheroidal structure and cup-and-ball structure. He showed by examples that Prof. Thomson's explanation of spheroidal structure was inadequate, and gave reasons for considering all these structures to be due to contraction. He also discussed more particularly the cup-and-ball structure, giving reasons for thinking that the spheroidal and the horizontal fissures were often to some extent independent of each other.

Physical Society, Feb. 26.—The president, Prof. G. C. Foster, F.R.S., in the chair.—The following candidates were elected members of the Society:—The Rev. R. Abbay, M.A., and Mr. W. Bottomley, sen.—Mr. A. Haddon exhibited and described a form of tangent galvanometer, so arranged that by the aid of an electric lamp an image of the needle can be projected on the screen, and its deflections thus made evident to large audiences. A horizontal beam of light falling on a mirror inclined at 45° is thrown vertically upwards. In its path it meets with a glass box containing a lozenge-shaped magnet about three-quarters of an inch long; above this needle is a graduated semicircle. The pivot supporting the needle is fixed in the centre of the glass plate which forms the bottom of the box. Above this box is a lens, and on the top of the whole is a second reflector parallel to the first. On either side of the needle is a hoop of stout brass wire, fourteen inches in diameter, one end of each hoop being insulated by a piece of ebonite, while the other end is in metallic connection with a brass ring which slides easily over the circular base of the instrument. The hoops are separated from each other by a distance equal to half the diameter of either hoop, *i.e.*, 7 inches. The instrument having been placed at a distance from the screen equal to the focal length of the lens, and the needle brought to zero by rotating the graduated scale, the hoops are placed parallel to the magnetic meridian, and the instrument is ready for action. As an illustration of the manner in which the galvanometer is employed, Ohm's Law was proved in the cases of large and small external resistance.—Mr. O. J. Lodge, B.Sc., then described some investigations on which he has recently been engaged in reference to the flow of electricity in plane bounded surfaces, in continuation of a paper read before the Society in the early part of last year, by Prof. G. C. Foster and himself. After some introductory considerations, he pointed out that all the conditions of the flow of electricity are known for any number of poles in an unlimited sheet. The problem then consists in reducing cases of poles in bounded plates to corresponding cases in the unlimited plane, such that the flow conditions on the bounding line may be the same in both cases. The determination of these data, however, for limited planes of certain forms presents considerable difficulty. In studying questions of this nature there are two kinds of lines which must be considered. These are "equipotential lines," *along* which no electricity passes, and "lines of flow," *across* which no electricity passes. The boundary of any conducting surface will of course always be a line of flow, and, in a bad conductor, we can form an equipotential line by laying a band of copper in the required direction. If, therefore, in studying a surface of limited extent in contact with an electrode, we can find a point or points outside the surface such that, if they be made electrodes, the boundary line of the surface becomes a line of flow, we are at liberty to treat the surface as part of an infinite plane, and all the circumstances are therefore known. To take the simplest case, a straight line in an infinite surface will be a line of flow if equal sources be placed in pairs on opposite sides of the line so that one is the virtual image of the other; but, if the components of each pair are of opposite sign, it becomes an equipotential line. To make a circle of radius (r) an equipotential circle, we require a source A, within, and a sink B, without, such that $CA.CB = r^2$. To make it a line of flow we require two sources, such that $CA^1.CA = r^2$ and an equal sink at C, the centre of the circle. The cases of an infinitely long straight strip and of a surface bounded by two straight lines inclined at an angle θ were then referred to, and Mr. Lodge showed that the first requires an infinite number of external sources arranged on a straight line, and the second an infinite number on a circle except when θ is a submultiple of π, the number then becoming finite. Diagrams of the images for certain cases of triangles and squares were also shown. The dimensions of the electrodes in contact with conducting surfaces are not matters of indifference. In a plane bounded by straight lines the electrodes within and without the boundary are of equal size, but when the boundary is a circle the areas of electrodes vary as the squares of their distances from the centre. It was then pointed out that not only the poles may be reflected in this way, but also every point in the sheet; and if the lines of flow or of potential are drawn inside a given circle for any arrangement of poles, the lines outside can be immediately obtained from them by inversion with regard to the centre of the circle by means of a Peaucellier cell. The author then described the manner in which the principle of Wheatstone's Bridge can be employed for tracing out lines of equal potential. If A and B be a source and sink on a conducting ring, and P any point on the ring between A and B and Q any point between B and A, then P and Q are of equal potential whenever $\frac{PA}{PB} = \frac{QA}{QB}$. If now the wire under the point P be flattened out into a surface, the above expression holds good for a certain line on that surface, which is therefore an equipotential line. Similarly by flattening out the wire under the point A, the line for which the expression then holds good is a line of flow for a certain distribution of poles. At this point the reading of the paper was adjourned to the next meeting of the Society.—Prof. McLeod exhibited a glass plate covered with a film of silver which had in places been deflagrated by means of Leyden jars, the poles being placed at varying distances apart. The form of the surface acted upon tended towards the Lemniscate of Bernouilli.

Paris

Academy of Sciences, Feb. 21.—Vice-Admiral Paris in the chair.—The death of M. Brongniart was announced.—The following papers were read:—Meridian observations of small planets, made at the Observatory of Greenwich (sent by the Astronomer Royal) and at the Observatory of Paris, during the fourth quarter of 1875, by M. Leverrier.—Theorems relative to the displacement of a plane figure, two points of which glide in two curves of any order and class, by M. Chasles.—Remarks on the laws of storms, by M. Faye. The older meteorology places the origin of great atmospheric movements in the lower layers, the new meteorology traces them to upper currents of the region of cirrhus.—On fire-damp, by M. Faye. Instead of trying to suppress all causes of ignition (which is evidently impracticable, and has for result the allowing of large quantities of gas to accumumulate till an explosion comes), would it not be well to supply the ceilings of the galleries with small open lamps every ten or twenty metres, so as to constantly burn the gas as it was presented? M. Berthelot gave some reasons against this method.—On the rotatory power of styrolène, by M. Berthelot.—On the invariability of great axes of the orbits of planets, by M. Tisserand.—Report on an apparatus of M. Vinot for recognising stars.—On the principles which ought to govern the construction of common lodgments (for men and animals), by M. Tollet. Outline of memoir. Barracks constructed, under the author's directions, for the eighth Army Corps, have realised an economy over the old system, of 300 francs per man, and 50 to 60 francs per horse, or 600,000 to 800,000 francs per regiment.—On the coefficient of dilatation of the air under atmospheric pressure, by MM. Mendéléeff and Kaiander. The most probable number is $\alpha = 0{\cdot}0036843$, or about $\frac{11}{2985}$ instead of $\frac{11}{3000}$, which has been adopted hitherto.—On some remarkable points in magnets, by M. Blondlot. If a very short magnetic needle, supported at its centre of gravity, be carried along near the surface of a magnet, then among its varying directions, those normal to the surface of the magnet are remarkable; the points to which they correspond M. Blondlot terms *orthogonal points*. One property of these points is that if a small magnetic body be placed at one of them, more mechanical work will be required to remove it from there to an infinite distance, than if it had been placed at any other neighbouring point on the surface of the magnet. Another property: the positions of equilibrium of a small magnetic body in relation to a magnet are precisely the orthogonal points.—Composition of the dark matter that is obtained in calcining ferrocyanide of potassium, by M. Terreil. It is a mixture containing, in minute division, cast-iron, magnetic oxide of iron, free carbons, and a small quantity of cyanide of potassium.—On the formation of anhydrous acids of the fatty and the aromatic series, by the action of phosphoric acid on their hydrates, by MM. Gal and Etard.—On the products of the action of chloride of lime on amines, by M. Tscherniak.—Reply to the reclamation of M. Plateau, on the subject of digestion of insects, by M. Jousset. M. Jousset disputes M. Plateau's statement that in insects in the normal state, the digestive juices are all alkaline or neutral, never acid; also that the liquid secreted by the gastric cœcums acts on starch but not on albuminoid substances.—M. Husson gave details of a process for testing, by means of sulphate of soda, the resistance of stones to frost.—M. Beyris described a convenient syphon, which consists of a caoutchouc tube; one end has a valve opening inwards, the other a stop-cock. The tube, stretched straight, is filled with liquid and the cock closed; you then put the valve end in the liquid, curve the tube, and open the cock.

Feb. 28.—Vice-Admiral Paris in the chair.—The following papers were read:—On the explosion of powder, by M. Berthelot. The chemical transformation is expressible, in every case, by a simultaneous system of very simple equations.—Researches on a sulphate which seems to contain a new oxide of manganese, by M. Fremy.—On the influence of mould on the nitrification of azotised substances of organic origin, employed as manures, by M. Boussingault. In sand and chalk there was little nitrification; it was in mould already nitrifiable, that all the azotised organic matters developed most nitric acid and least ammonia.—On fire-damp, by M. Faye. The ascent of the light protocarburetted hydrogen to the upper parts, takes place immediately, and it would there be burnt without danger. M. Berthelot replied.—On the methods of meteorology, by M. Sainte-Claire Deville.—Proposal made by Bouguer, in 1726, for obtaining from the log-books of all ships, by professors of hydrography, information useful to navigation, by M. de la Gournerie.—M. Dupuy de Lome, in presenting a work by M. Ledieu, "Les Nouvelles Machines Marines," recommended it for the application made of the mechanical theory of heat, to comparative examination of new engines.—Report on the memoir published by Messrs. Noble and Abel, "Researches on explosives, fired gunpowder."—Report on a memoir of M. Alb. LePlay, on a system of irrigation of meadows by means of rain-water in the mountainous and impermeable strata of Limousin.—Note on the meridian circle of the imperial observatory of Rio de Janeiro, by M. Liais.—The heart experiences at each phase of its revolution changes of temperature which modify its excitability. Note by M. Marey. The cooling corresponds to the phase of less excitability.—On the oil of Elæococca, and on its solid modification produced by the action of light, by M. Cloëz.—Means of preventing explosions of fire-damp, by the employment, *a tergo*, of compressed air, by M. Buisson. He would convey pure compressed air in pipes to the bottom of the mine, and drive the vitiated air outwards.—Note on the tracing of gearings by arcs of a circle; improvement on the method of Willis, by M. Léauté.—On some combinations of titanium (second note), by MM. Friedel and Guérin. This treats of the oxychloride and the sesquioxide.—On sulpho-phenylurea, by M. de Clermont.—On the antiseptic properties of borax, by M. Schnetzler. The body of a horse which had lain four months in a layer of borax earth in California, was quite fresh and odourless, the pupil clear and bright, the hair supple and well attached.—Reply to M. Glénard's last note on the *rôle* of carbonic acid in the phenomenon of spontaneous coagulation of the blood, by MM. Mathieu and Urbain.—On the reducing sugar of raw sugars, by M. Müntz.—Note on a new genus of fossil Entomostraca from the carboniferous system of Saint Etienne (*Palæocypris Edwardsii*), by M. Ch. Brongniart.—On the half November oscillation in America, by M. Hinrichs. This is as well marked, from Iowa up to Newfoundland as in Europe and Algeria. Curves are given.—On the manufacture of superphosphates destined for agriculture, by M. Millot. The retrogradation of these, after their ordinary preparation, is due to the presence, in the natural phosphates, of sesquioxides, and especially of sesquioxide of iron.—On movement in the hairs and foliar laciniations of *Drosera rotundifolia* and in the leaves of *Pinguicula vulgaris*, by M. Heckel. This refers to the action of chloroform and sulphuric ether placed near the plant under a bell jar. The effect was at first irritant, but, where the dose was not too strong (*e.g.*, three drops of chloroform) the organs soon returned to a state of repose. The jar having been removed, it took eighteen minutes, in this case in open air, for the irritability to be removed.—Meteoric combustions, by M. De Fonvielle. He suggests a method of ascertaining aërostatically the amount of dust in a given layer of air. At the end of a pole is placed a surface of some square decimetres, held horizontal, one of the sides covered with very pure glycerine. Let H be the vertical height traversed by the aërostat, S the sticky surface in square decimetres, and p the weight of dust received. The amount in a cubic metre will be $\frac{p \times 100}{HS}$.—Reclamation of priority concerning the mechanism of an electric lamp, presented by M. Girouard.

CONTENTS