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THURSDAY, MARCH 28, 1872

THE IRON AND STEEL INSTITUTE

THE Third Annual Meeting of the Iron and Steel Institute was last week held in London, under the presidency of Mr. Henry Bessemer, and has been numerously attended by representatives, not only of the principal iron and steel works in the United Kingdom, but also by those of many of the most important metallurgical establishments on the Continent, which in several instances have sent special delegates to this meeting.

It will perhaps be remembered that the Iron and Steel Institute was founded barely three years ago, and that upon the occasion of the Inaugural Address, delivered by the first president (the Duke of Devonshire), it had then only received the adherence of some two hundred gentlemen connected with the trade; whereas, on this occasion, notwithstanding that the rules of the society only allow the admission of those either practically engaged in the manufacture or application of iron and steel, or connected therewith by their scientific attainments, it has increased so rapidly in this short interval as to number at present about five hundred members, including in this list nearly all the influence and talent associated with the iron and steel industries of Great Britain. It is self-evident, therefore, that its establishment must be regarded as a complete success, such as could not have been expected had it not supplied a tacitly acknowledged previously existing want. That this conclusion is one accepted not only here at home, but also in every part of the world where the manufacture of these metals is carried on, may be considered as demonstrated on the occasion of this last meeting of the Institute, by the attendance of gentlemen connected with the iron and steel trades of France, Belgium, Germany, Sweden, Russia, Spain, and the United States, several of whom, although foreigners, have, we understand, been so impressed with the good service which the Institute is doing to these metallic industries, as to have enrolled themselves on its list of members.

This unexampled success is no doubt in great part due to the fact that the Council of the Institute have conscientiously adhered to the original programme, in not allowing any of what may be termed trade or purely mercantile considerations to interfere with the true objects for which the Institute was from the first established; these objects being, the scientific and practical inquiry into and the open discussion of all subjects bearing directly or indirectly upon the production and working of iron and steel, to provide the members with a means of intercommunication of their ideas and practical experiences, and to supply them with as accurate information as possible as to what is being done in the same direction in foreign countries as well as at home. How far these aims have been attained in practice, may best be judged of by the rapid increase in members, and by referring to the volumes of the Journal already published by the Institute, which, both abroad as well as at home, have been universally admitted to sustain the high standard aspired to from the first by this young but vigorous institution, and to stand alone in their line, whether regarded from a purely scientific or a practical point of view.

The two annual (London and country) meetings of the Institute may be likened to those of a permanent technical tribunal, before which everything new in connection with iron and steel has to be brought forward, and judged upon as to its merits, after having first passed through the ordeal of cross-examination by the scientific and practical members of the Institute, with the object, as the president tersely expressed it, of sifting out the grain from the chaff; and short as the existence of the Institute has as yet been it has still been long enough to prove how much the iron trade in general, and inventors in particular, may gain by the constitution of such a tribunal.

The most interesting and important feature of the present meeting has been the reports of the committee on machine puddling. The operation of puddling in the conversion of cast into wrought iron is one of so arduous and trying a nature to the workmen that it is daily becoming, in great part owing to the spread of education and the growing desire of men to better their position in society, more difficult to find hands willing to engage in such heavy work; and as it requires long training to make a good puddler, it has now become altogether impossible to obtain a supply of such workmen sufficient to keep pace with the increasing demand for the product; for which reason we find the manufacturer of wrought-iron completely at the mercy of these men, who, besides not ranking very high in the scale of humanity, keep the ironmasters in a perpetual state of terror by their frequent strikes, which, as a rule, do not benefit either party, yet always result in damaging the general iron trade of the kingdom, by driving it abroad and otherwise. This state of things has, as might naturally be expected, given rise to numerous attempts to supersede manual labour in puddling, by machinery, although it may be said, as yet, unsuccessfully; since, notwithstanding that attempts have been made in all directions, and on the most opposite systems, no one of them, when carefully examined into by the Puddling Committee of the Institute, has been considered to fulfil all the conditions requisite to insure its general adoption. When, therefore, at the meeting of the Institute last autumn, in Dudley, Mr. Danks (an American, although born in Staffordshire) declared that he had successfully solved this problem, his announcement was received with considerable incredulity, and he was requested to explain his system before the Institute. To the surprise, yet it may also be added gratification, of all, his explanations, after having been submitted to a severe cross-examination, were considered so far feasible that the members of the Institute unanimously decided upon taking up the matter, and at once sending out a commission (at an expense of some two thousand pounds) to test the system there, with the furnaces and machinery already erected by Mr. Danks, at the Cincinnati Ironworks, but taking with them sufficient pig-iron and other materials from England and Wales to enable them to thoroughly test the system on the large scale, and thereby insure that the process is adaptable to the products we have to treat in this country. After a most patient and painstaking investigation, the three gentlemen who composed this committee — Messrs.

Snelus, Jones, and Lester—reported the system as a complete success, and well suited for the treatment of the iron of this country, an announcement which was received with the greatest interest; and steps were immediately taken to erect similar appliances in England, so that already in the month of February, one of Mr. Danks's furnaces was at work with results which fully corroborated the report of the commissioners, and left no doubt but that the invention must entirely revolutionise this branch of the iron manufacture, doing away with the severe, and it might almost be called degrading, labour of manual puddling altogether, and in other respects producing wrought-iron of a more certain and superior quality to the product obtained from the same pig-iron by the old system.

It is almost impossible to over-estimate the direct and indirect benefits which must accrue to that greatest of all metallic industries, the iron manufacture; and as it might have been years before this invention had asserted itself had it not been taken up so energetically by the Iron and Steel Institute, this may be mentioned as a striking instance of the important results which may be expected from the labours of such a society.

NICHOLSON ON THE GRAPTOLITES

Monograph of the British Graptolitidæ. By H. A. Nicholson, M.D., &c. (Edinburgh: Blackwood and Sons.)

It is with no small degree of satisfaction that we welcome the appearance of the first part of Dr. H. A. Nicholson's Monograph of the British Graptolites, the first English essay attempting a clear digest or history of this very difficult and perplexing group of fossils. Dr. Nicholson has, however, for years lived in those regions whose rock masses, life contents, and structure were long since elucidated and rendered classical and famous by the researches of Sedgwick in 1848; and where these organisms are most abundantly distributed. Patient investigation of the great stores of entombed materials at his command, combined with requisite knowledge of zoology, has favoured the author in the preparation of this valuable contribution to our hitherto limited knowledge of these extinct forms of life.

Much has been written upon the Graptolitidæ, but in a disjointed manner, by numerous writers since 1727; but Linnæus, in his "Skanska Resa" in 1768, first applied the name "graptolithus" to some or certain allied forms occurring in the Scandinavian rocks. Much controversy has been carried on about this original scalariform type of graptolite; some writers believing it to have been a monoprionidian, others a diprionidian genus. It signifies little now save as matter of history. Since then eighteen genera and ninety species have been established and recognised in Britain alone, and these have been mostly obtained from rocks of Lower Silurian age. Seven species out of the ninety are only known in the Upper Silurian rocks, and four of these are peculiar to that horizon, or do not range lower. The authenticity then of the character of the one and disputed Linnæan form, will do little more after all than add to the literature of the group. This original figure is sufficient to show us that it was a graptolite in our acceptation of the genus, and doubtless the form looked upon and drawn by the illustrious Swede was *one of millions* contained in the black and slaty rocks over which he travelled; a form, with many others since discovered, and now known to all students of those Silurian rocks which belt the earth from Canada to Britain, Scandinavia, Saxony, and Bohemia, and on to Australia. The historical notice of the Graptolitidæ occupies seventeen pages, and forms a compilation of the bibliography of the group, for which all students will gladly thank the author, from 1821-2, when Wahlenberg and Schlotheim advocated their alliance to the Cephalopoda, to Hopkinson's last paper in 1871 (*describing the reproductive capsules*). We have, in fact, a well-digested chronological history, enumerating about eighty notices, and embracing the labour of thirty-five authors.

To study and examine the graptolites *in situ*, or as they occur in the black paper like flaggy shales of the Arenig, Llandeilo, and Caradoc beds, to which they are chiefly confined in Wales, Westmoreland, Scotland, and Ireland, is no small pleasure; but after their stratigraphical position or succession in time is definitely settled in any area to the satisfaction of the physical geologist or stratigraphist, the question of their zoological affinities, or the position they hold in the animal kingdom with relation to modern and existing types becomes one of high importance and value, yet one even now not satisfactorily determined or established. Were they free swimming or floating bodies, in the old Silurian seas, or were they attached like the hydroid Sertularidæ of modern shores and time? These questions are dealt with by the author under two heads: first, *their mode of existence*, and secondly, their *systematic position and affinities.* To our mind the modes of existence of the Graptolitidæ have little weight in classification; a knowledge of their intimate structure alone must be the basis of their zoological position in the animal kingdom.

It was natural that the older writers should have referred this extinct group to many divisions which themselves were not then really understood; and they have been placed in no less than six divisions of the animal kingdom.

Modern systematists, however, have referred them to three groups—the Hydrozoa, Polyzoa, and Actinozoa. In 1839 Sir R. Murchison, in his Silurian System, placed them with the Actinozoa, assigning their position to the Pennatulidæ, and related to the Virgularia of the northern seas. No real analogy however exists between the tubular chitonous fibre of the graptolites, and the calcareous or sclerobasic rod of Virgularia, whose cænosarc secretes no external envelope, and where the polypes are not contained in, or protected by, special chitonous thecæ. All research also tends to show that the graptolites were free bodies and perhaps oceanic; the structure and condition of the radicle or initial point is conclusive on this point. With respect to their development we as yet know little; but the fact that, as in other Hydrozoa, the reproductive organs were outwardly developed processes of the body wall, strongly allies them to the Hydrozoa. Hopkinson has of late added much to our knowledge of the external reproductive sacs or gonothecæ of Diplograpsus.

To Colonel Pollock is undoubtedly due the suggestion of their sertularian affinities through Sertularia and Plumularia, but they certainly are not their fossil representatives.

The author wisely "regards them as a special group of Hydrozoa" unrepresented by any living forms, and forms them into a distinct sub-class.

Chapter II. is devoted to the form and mode of reproduction. This, we think, would have been better placed after the chapter on their special morphology, or prior to Chapter VIII., which is devoted to their geological distribution. We are prepared to admit, however, that much error has arisen from our want of clearly understanding their true history and the mode of their preservation in rocks of such varied physical texture and chemical condition.

Chapters III. and IV. are devoted to the general and special morphology of the graptolites; typical forms being selected in Chapter III., in which the main anatomical features and aspects are recognisable. For this purpose the author has selected the well-known forms of *G. sagittarius*, *G. colonus*, and *Climacograpsus teretiusculus*, and devotes fifteen figures to the elucidation of the monoprionidian and diprionidian type of structure.

Chapter IV. embraces thirteen pages and thirty-five figures devoted to the special morphology of the graptolites. We regard this chapter as a condensed history or digest of the labours of European, American, and British graptolithologists. The views and labours of Hall in Canada, Geinitz, Nilsson, and Barrande in Europe, Salter, Carruthers, M'Coy, Hopkinson, Harkness, &c., and the author in Britain, are embodied under the *nature of the solid axis, common canal, cœnosarc, cellules, and ornamentation of the polypary.*

Space forbids us to do more than notice that in Chapter V. twelve pages and twenty-two figures are occupied by the consideration of chief and special portions of the graptolites, viz. the "radicle or initial point of Hall," and the basal process, the funicle, or non-celluliferous connecting process, largely developed in the Dichograpsi, and the central disc of the Tetragrapsi. Whether these corneous bodies find their analogue in the float of certain oceanic Hydrozoa has yet to be determined.

The chapter upon reproduction and development contains much important matter. The evidence of reproductive organs, however, amongst a group so obscurely preserved as the graptolites must be studied with much care, and deductions received with much caution, but since Hall, in 1858, first drew attention to what he believed were ovarian capsules, Mr. Hopkinson in 1871 confirmed the discovery and description of pyriform gonothecæ or ovarian capsules in *Diplograpsus pristis.*

Nicholson had, in 1866, noticed bodies which he believed to be, and referred to, reproductive bodies, and named them *grapto-gonophores.* He, however, had doubts as to their analogy. Mr. Carruthers differed from the deductions of Nicholson, maintaining that these bodies were accidental, or did not belong to the graptolites, although associated or in juxtaposition with them.

Mr. Carruthers first drew attention to and noticed the existence of young forms of graptolites; but Prof. Hall appears to have been the first to make accurate observations upon their development (Grap. of Quebec group, Pl. B, p. 12—19). We, however, as yet know little about this obscure question or point in their history.

The chapter upon the systematic or zoological position of the graptolites is a valuable one, the author taking and adopting what we believe to be the right view, *placing them in the Hydrozoa.* This is the first and invariable question of the systematist; the naturalist shirks the question and waits.

It is quite impossible within the limits at our command to discuss the interesting problem of the geological distribution of the graptolites. Although strictly Silurian as regards age, and only occurring in rocks of that period, yet their assignment to the special area which gave birth to them, and from whence they became distributed in space, is a problem yet to be worked out. We believe this has been elsewhere attempted by the author. That the Quebec genera and many species agree in the main with the so-called Arenig or Skiddaw slate forms in Britain is certain, and this is a fact of much interest as a question of distribution. At present we know of no species in the Tremadoc beds, omitting Dictyonema of doubtful affinity; and the statement that the lower Llandeilo flags of Wales are the precise equivalents of the Skiddaw slate of Westmoreland needs confirmation; neither should we hastily accept the generalisation that the Potsdam group in America is upon the horizon of the Skiddaw series, but rather perhaps refer the Quebec and Chazy series to the Arenig or Skiddaw beds of the lake country, where, or in the Llandeilo area in Wales, the graptolites perhaps came first into existence, unless to Canada we refer their birth-place. Homotaxically, however, we require more data. Nine out of fifteen genera are common to Britain and Canada; and this though the Skiddaw slates of Westmoreland, indeed the Skiddaw and Llandeilo rocks and their equivalents, are the graptolitic beds throughout Europe if not the world. The old generalisation as to the diprionidian species occurring in the Upper Silurian is confirmed and borne out by the researches of Nicholson: the unsatisfactory genus Retiolipes alone being found. The sea which deposited the Caradoc rocks saw the last of the compound species, and the physical nonconformity was also a zoological one, especially in hydrozöoid life. Indeed only 140 species of all groups of 1,450 known Silurian species, or 10 per cent., are common to rocks of Lower Silurian and Upper Silurian time.

Chapter IX. deals with the generic characters of the radiculate group, omitting those of doubtful affinity; the author follows the sectional grouping of Barrande, adopting monoprionidian and diprionidian, &c., as modified by Hopkinson.

We look forward with much interest to the part containing full and detailed descriptions of the species. The splendid volume by Prof. Hall and Sir William Logan upon the Canadian species (Report of Progress of the Geological Survey of Canada, 1857, and figured descriptions of Canadian organic remains Decade 2, Grap. of Quebec group) we hope to see equalled if not surpassed by the author of the present valuable memoir. R. E.

OUR BOOK SHELF

Observations upon the Climate of Uckfield. A Meteorological Record for the district from 1843 to 1870, &c. By C. Leeson Prince, M.R.C.S., F.R.A.S. (London: Churchill, 1871.)

WE opened this work expecting to find in it a mere record of the barometric and thermometric observations taken by an assiduous observer for twenty-seven years. It is this, however, and much more; and Mr. Prince must be congratulated upon having written a very interesting and readable book upon what we fear would, in the hands of most men, be a very dry subject. The observations he has collected show what valuable information might be stored up by many country surgeons, clergymen, and farmers, at little cost of time or money, by adopting a regular system. The parish of Uckfield, Mr. Prince tells us, lies upon an undulatory tract of country situated about midway between the South Downs and the highest point of Ashdown Forest. The upper portion of the town is 200 feet, and the lower 66 feet, above the level of the sea. It is situated on the Horsted beds of the Hastings Sands. The instruments were read every morning at nine o'clock. The annual mean height of the barometer at Uckfield, as deduced from observations extending over seventeen years, was 29·982 in. Mr. Prince gives the mean temperature of winter at Uckfield from all his observations at 38°·96 Fahr.; of spring at 47°·66; of summer at 61°·34, and of autumn at 50°·45. The coldest winter was that of 1845; the warmest that of 1869; the difference being 10°·99. The coldest spring was that of 1845; the warmest that of 1848; the difference, 5°·84. The coldest summer was that of 1860; the warmest that of 1859; the difference being 6°·74. The coldest autumn was that of 1867; the warmest that of 1857; the difference being 6°·22.

Mr. Prince points out that "the mean annual temperature varies 5°·3, viz.: from 51°·93 in 1857 to 46°·62 in 1845, and although at first sight this difference may not appear considerable, yet it is sufficient to exert an enormous influence upon the general character of the seasons, the produce of the soil, and the health of the population. The Registrar-General's interesting returns have fully established the important fact that there is a very intimate connection between temperature and mortality. Whenever the mean temperature falls to 45°, or thereabouts, the number of deaths from diseases of the respiratory organs increases, and should it fall below 40°, death-rate from such diseases is still higher. When a period of intense cold prevails, so that the temperature scarcely rises above the freezing point for two or three weeks, the number of deaths will be found to exceed what takes place during an epidemic of cholera or scarlet fever. But when the mean temperature rises to 55°, there will be an increase in the number of deaths from diseases of the abdominal viscera, and this number will fluctuate as the temperature fluctuates between 55° and 65°. Hence we are informed that the mortality from all causes is least when the temperature is about 50°, which is very little above our mean annual temperature." In this way Mr. Prince deduces important conclusions from statistics, and renders his book much lighter reading than might have been anticipated. He devotes a chapter to the general characters of the months, and then inserts a series of monthly remarks respecting atmospheric phenomena from the year 1843 to 1870, both inclusive. His fifth chapter treats of prognostics of atmospheric changes, and includes a translation of the poet Aratus' "Diosemeia." He remarks very sensibly that with reference to prognostics of seasons, there are very few upon which any reliance can be placed. But the following, of which we can only quote a few, need not, he thinks, be altogether discarded.

From whatever quarter the wind blows at the quarter days, there is a probability of its being the prevalent wind during the ensuing quarter. Whenever the latter part of February and beginning of March are dry, there will be a deficiency of rain up to Midsummer-day. When the foliage of the ash appears before that of the oak, we shall probably have much rain the first half of the summer; but there will be a good harvest-time. When during the spring more swifts than swallows arrive, expect a hot and dry summer. Many other prognostics of change of weather are given, drawn from the habits of mammals, birds, insects, and plants, some of which are very curious.

The last chapter gives some vital statistics in regard to the population of the country; from which it appears that Sussex is one of the most salubrious counties in England, its death-rate being 1·82 per cent., in which it is surpassed only by the extra-Metropolitan portion of Surrey, the mortality of which is only 1·78; whilst that of Lancashire is 2·78 per cent. Upon the whole we warmly recommend Mr. Prince's book to our readers, and trust that some of them may be induced to commence a similar series of observations. A flora of the district, with the times of flowering of the plants, would, we think, be an interesting addition to Mr. Prince's work. H. P.

LETTERS TO THE EDITOR

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

Circumpolar Land

IN a previous letter* I have endeavoured to show that the land surrounding the North Pole is rising in a continuous and definite area. I find that what I there said about the land north of America is very scanty and unsatisfactory, and before proceeding to the next part of my subject, I wish to strengthen it somewhat. Speaking of the eastern part of Melville Island, Captain Parry says one of the *Hecla's* men brought to the boat a narwhal horn, which he found on a hill more than a mile from the sea. Sergeant Martin and Captain Sabine's servant brought down to the beach several pieces of fir tree, which they found nearly buried in the sand, at the distance of 300 or 400 yards from the present high-water mark, and not less than thirty feet above the sea level (Parry's Voyage, 1819, 1820, p. 68). Again, "in the north of Melville Island, two pieces of drift wood were found, ten or twenty feet above the present sea level, and both partly buried in the sand" (p. 193). Again, speaking of west of the same island, "The land gains upon the sea, as it is called, in process of time, as it has certainly done here, from the situation in which we found the drift wood and the skeletons of whales" (p. 235).

In Franklin's voyage in 1819, 20, and 21, he mentions having found much drift wood in the estuary of the Copper Mine River. He also picked up "some decayed wood far out of reach of the water" (see his narrative, p. 357). In his second voyage along the Arctic Sea, he describes the coast from the Mackenzie River to the Rocky Mountains as very shallow, and full of shoals and reefs. Inside some of the latter was brackish water, as was also the water in pools at some distance inland; piles of wood were also thrown up far from the coast (see p. 134). While Franklin surveyed the coast westward, Dr. Richardson did the same to the east. He says, "On the coast from Cape Lyon to Point Keats, there is a line of large drift timber, evidently thrown up by the waves, about twelve feet in perpendicular height above the ordinary spring tides." He shortly afterwards mentions that in the Polar Sea, when cumbered with ice, such waves are impossible, and as his journey was in the hottest season, and the sea was then crowded with hummocks, the inference that the drift wood was thrown up by the waves is inadmissible; and the line of drift wood twelve feet above the sea level is only a parallel to the numerous cases we have mentioned. The vast sheet of shallow and brackish water, 140 miles long and 150 broad, which is separated from the Polar Sea by low banks and spits of sand, and is called by Dr. Richardson Esquimaux Lake, formed, there can be little doubt, very recently, as that traveller suggested, a bay of the Polar Sea, and is an example of the formation of huge brackish lakes by a sea which is constantly contracting, such as are so familiar in the eastern borders of the Caspian.

It would be impossible, in the short space at my command, to collect the many instances of the same kind that are found in the later Arctic voyages; but I would especially commend the pages of Captain Maclure's and of Sir Edward Belcher's narratives, as containing very striking ones.

The orthodox school of physical geographers generally speak

* See NATURE, vol. v., p. 163.

of Behring's Straits, and the shallow sea about the islands, as an area of depression, but without any authority, so far as I know.

Those barren and desolate islands, so well described by the Russians, bear all the traces of having recently been under water, and the American Birkbeck has proved, beyond much doubt, that the eastern coasts of Asia, including China and Japan, are being upheaved. I find I was forestalled by Pennant in the conjecture of the very recent junction of the White Sea and the Baltic, and I am very glad to quote him as an authority. He says the lakes Sig, Ondar, and Wigo, form successive links from the Lake Onega to the White Sea. The Lake Saima almost cuts Finland through from north to south; its northern end is not remote from Lake Onda, and the southern extends very near to the Gulf of Finland, a space of nearly 40 Swedish or 260 English miles. These, probably, were part of the bed of the ancient Streights (*sic*) which joined the White and Baltic Seas (Appendix to Arctic Zoology, 23).

In regard to the rise of Spitzbergen, it is curious to find the following passage so early as 1646:—"These mountains (twenty-two mountains of Spitzbergen) increase in bulk every year, so as to be plainly discovered by those that pass that way. Leonin was not a little surprised to discover upon one of these hills about a league from the sea-side, a small mast or a ship, with one of its pullies still fastened to it; this made him ask the seamen how that mast came there, who told him they were not able to tell, but were sure they had seen it as long as they had used that coast. Perhaps, formerly, the sea might either cover or come near their mountain, where some ship or other being stranded, this mast is some remnant of that wreck." (Account of Greenland by M. La Peyrere in Churchill's Voyages, vol. ii.) Parry, in his account of his journey towards the Pole, 126, also refers to the vast quantities of drift wood stranded on the Spitzbergen coasts above high-water mark.

Having strengthened my former paper by instances of upheaval in other points, and I hope satisfied your readers of the justice of the generalisation about the rise of circumpolar land, it is natural to ask if this remarkable fact is paralleled in any way at the southern pole,—whether we can show that both in the Arctic and Antarctic seas there is a bulging out of the land, and a displacement of the sea at present in progress. Our knowledge of the lands immediately about the southern pole is very scanty; but fortunately we have unmistakeable evidence at the various points of those better known austral lands which approach the antarctic seas, from which we may be justified in drawing a sound conclusion, South America, New Zealand, Australia, Tasmania, and Southern Africa.

To begin with South America, I cannot quote a better authority than Mr. Darwin:—

"Everything in this southern continent has been effected on a grand scale: the land from the Rio Plata to Terra del Fuego, a distance of 1,200 miles, has been raised in mass (and in Patagonia to a height of between 300 and 400 feet) within the period of the now-existing sea shells. The old and weathered shells left on the surface of the upraised plain still partially retain their colours. . . . . I have said that within the period of existing sea shells, Patagonia has been raised 300 to 400 feet; I may add that within the period when icebergs transported boulders over the upper plain of Santa Cruz the elevation has been at least 1,500 feet" (Naturalists' Voyage p. 171). Again, "M. d'Orbigny found on the banks of the Parana, at the height of 100 feet, great beds of an estuary shell now living 100 miles lower down nearer the sea, and I found similar shells at a less height on the banks of the Uruguay; this shows that just before the Pampas was slowly elevated into dry land the water covering it was brackish. Below Buenos Ayres there are upraised beds of sea-shells of existing species, which also proves that the period of elevation of the Pampas was within the recent period" (p. 130). So much for the East Coast. Now for the West. Speaking of the Hacienda of Quintero, in Central Chili, he says:—"The proofs of the elevation of this whole line of coast are unequivocal. At the height of a few hundred feet old-looking shells are very numerous." Again, speaking of Northern Chili, he says:—"I have convincing proofs that this part of the continent of South America has been elevated near the coast at least from 400 to 500 feet, and in some parts from 1,000 to 1,300 feet, since the epoch of existing shells, and further inland the rise may have been greater." In Peru, about Callao, he also found evidences of rising land; but here we come to one of the horizons where rising and sinking land meet. If it be necessary to supplement the account of Mr. Darwin, I have the authority of Mr. Baxendall for stating that he found numerous skeletons of whales and seals stranded above high-water mark on the coast near Africa, where a tide (as is well known to be the case in all the Eastern Pacific) is almost unknown.

Having satisfied ourselves of the rise of the southern portion of South America, we must now shortly state the reasons for making it very recent. Speaking of the earthquake of 1822, which caused a general upheaval of the land, Mr. Darwin says, "The most remarkable effect of this earthquake was the permanent elevation of the land; the land round the Bay of Concepcion was upraised two or three feet, at the island of Santa Maria (about thirty miles distant) the elevation was greater. On one part Captain FitzRoy found beds of putrid mussel-shells still adhering to the rocks 10 feet above high water-mark; the inhabitants had formerly dived at low-water spring tides for these shells" (p. 310). Again, two years and three-quarters afterwards Valdivia and Chiloe were again shaken, and an island in the Chonos Archipelago was permanently elevated more than 8 feet. At Valparaiso within the last 220 years the rise has been somewhat less than 19 feet, while at Lima a sea beach has certainly been upheaved from 80 to 90 feet within the Indo-human period (*id. passim*). Eighty-five feet above the sea level in an island in the Bay of Callao he found on a sea beach some Indian corn and pieces of Indian thread, similar to those found in Peruvian tombs, a parallel find to that made by Sir Charles Lyell in Scandinavia, which I previously referred to.

Having examined the evidence for South America, we will now turn to the other great southern continent, Africa. I will quote a few passages. "There cannot be the slightest doubt that the upheaval of the country is still going on; for along the whole coast of South Africa from the Cape to Durham Bluff, and still farther north, even as far as Zanzibar, modern raised beaches, coral reefs, and oyster banks may everywhere be seen. At the Izinhluzabalungu Caves is such a point, where the rising of the coast is plainly visible, recent oyster-shells are now 12 feet and more above high-water mark. The same can be observed on the whole line of the Natal Coast. Van der Decken has observed the same thing at Zanzibar, and is of the same opinion as myself, viz., that the Eastern Coast is rising early in the present year (*i.e.*, 1870). I had the opportunity of observing at the Bazanito Islands about ninety miles north of Inhambane, on the east coast of Africa, a series of raised coral reefs round the island of Marsha containing many living shells and quite recent oyster-banks." (Griesbach, Geology of Natal, Quart. Journ. Geol. Soc. xxvii. part ii. p. 69.) Mr. Griesbach also mentions that he saw implements of early man, which were obtained by Richard Thornton and others in old raised beaches of Natal, near Inanda, and at the mouth of the Zambesi River.

Mr. Griesbach is confirmed by Mr. Stow in his papers on the Geology of South Africa in the same Journal (see vol. xxvii. p. 526 *et seq.*), where bones and teeth are found mixed with shells, quite in a recent state, about Port Elizabeth, &c.

In regard to Tasmania, I quote the following from Mr. Wintle's paper on the Geology of Hobart Town (*Mine Journal*, vol. xxvii. p. 469):—"Until a very recent period in the geological annals of this island, a great portion of what now constitutes the site of this city was under water. This is proved by the extensive deposits of comminuted shells, all of recent species, which are met with for miles along the banks of the Derwent. Some of these deposits are at an elevation of upwards of 100 feet above high-water mark, and from 50 to 100 yards from the water's edge, plainly showing thereby that a very recent elevation of the land has taken place."

In New Zealand the evidence is the same. M. Reclus says the port of Lyttelton has risen 3 feet since it was occupied by the settlers. Mr. Forbes says that proofs of upheaving of the land are even now obvious to any intelligent traveller. Some of these changes have been witnessed by the present generation. Again, in the Middle Island upheaval of the land is observable in a marked manner through the entire length of the western coast from Cape Farewell to Dusky Bay. Some of the most extraordinary changes in these regions have taken place within the last few years.

This has been confirmed by Dr. Haast, who, however, found some signs of depression at the north-western extremity of the lands. In Australia our evidence is ample:—The north-east, if not the whole of the east coast of Australia, is slowly rising, as proved by the gradual shoaling of the Channel between Hinchinbrook Island and the mainland, due to all appearance neither to silting up nor growth of coral water-worn caves, now well above high-water mark in the sandstone cliffs of Albany Island, and those of the mainland opposite, and in the existence along many parts of the coast, especially towards the north of the peninsula, of extensive tracts of level country now covered with sand dunes, bearing a scanty vegetation, stretching inland 10, 15, and 20 miles off, but which once bordered the sea" (Rattray, Geology of Cape York Peninsula, Australia, *Mine Journal*, vol. xxv. p. 297).

"An immense portion of the continent of Australia is known to be uprising. . . . The whole coast round to a distance of several miles inland is covered with recent shells; the drainage of the country is apparently altering. Lakes known to have been formerly filled with salt water are now filling up with fresh or becoming dry. The lagoons near the coast are filled with salt and brackish water, and their banks are filled with marine shells with their colours in many cases preserved. Reefs of rocks are constantly appearing in places where there were none formerly. At Rivoli Bay the soundings have altered so much as to make a new survey requisite. A reef has lately almost closed this harbour. Other reefs have appeared at Cape Jaffa, &c. It would appear that a vast movement is taking place in the whole of the south of Australia. In Melbourne the observations of surveyors and engineers have all tended to confirm this remarkable fact. In Western Australia the same thing is observed at King George's Sound, the same," &c., &c., and so on, for many pages. (See Wood's Geological Observations in South Australia, 135-207, and *passim.*)

The facts I have enumerated, which might be almost indefinitely multiplied, are sufficient to prove the position that every large mass of land near the South Pole which we can examine shows signs of upheaval, and justifies the conclusion that the circumpolar land is rising at both poles, and that there is a general thrusting out of the earth's periphery in the direction of its shorter axis.

I must modify the opinion expressed in a previous paper that the 57th parallel is the southern limit of upheaval in the northern hemisphere. The limit of upheaval is an irregular line. I believe that the district intervening between the two projecting poles, with its focus along the equator, is an area of subsidence. This conclusion I believe to be of crucial importance in solving both geological and meteorological problems.

H. H. HOWORTH

New Zealand Trees

I HAVE been greatly astonished by the perusal of a paragraph on New Zealand timber trees, which appears on p. 14 of the current volume of NATURE (No. 105, Nov. 2, 1871). Almost all that is said, either directly or inferentially in that paragraph is so grossly inaccurate that I cannot understand how such statements found their way into a periodical like yours. In the first place, the Rimu (*Dacrydium cupressinum*), the Matai (*Podocarpus spicata*), and the Totara (*P. totara*), are spoken of as if peculiar to the North Island, whilst the truth is that they are common to all parts of New Zealand. These trees are never "cut down wholesale" for firewood, except perhaps now and then when bush land is being cleared so far from other settlements that transport of the timber to any market is a physical impossibility. The woods enumerated are, Kauri (*Dammaris australis*), and the white pine (*Podocarpus dacrydioides*), the principal building timbers of the colony. The Rimu is not "valuable for furniture and all ornamental work," although some choice sections of it look well when carefully polished. Totara and Kauri look better when polished, but their brittleness spoils their usefulness for ordinary furniture work. When I deny that these timbers are "valuable" for cabinet work, I mean that they have not, and never will have, the value which attaches to mahogany, rosewood, walnut, and similar woods. That the Rimu, Matai, and Totara "are none of them Coniferæ," is news to botanists on this side the world. All these trees are to be found in horticultural collections in England and Scotland, and it is to be regretted that the writer of this paragraph did not acquaint himself with them before he undertook to instruct others as to their botanical characteristics. But the most amazing of all the statements in this paragraph is that about the Rata (*Metrosideros lucida*). This appears to have been quoted from somewhere. I should very much like to know who is responsible for such a monstrous fiction. I can only conceive that its author has confused the Akakura (*Metrosideros scandens*) with the Rata in his memory—he could never have confused the objects themselves when before his eyes. The whole story of the manner of growth of the Rata is utterly without foundation.

I may take this opportunity of mentioning that the description of *M. lucida* in Hooker's "Handbook of the New Zealand Flora" is inaccurate. The tree is there described as a small one, whereas it grows in the South Island to the dimensions of a large forest tree. Probably Dr. Hooker had to depend on information derived from North Island sources only. W.

Dunedin, N. Z., January 13

Earthquakes in the Philippine Islands

IN the middle of December, 1871, the volcano Albay in the S.E. of Luzon began to play, and threw out smoke, stones, and lava for several weeks.

The following phenomena have also to be recorded :—

1871.—October 8 and 9, at Pollok on Mindanao, sulphurous springs arose in the neighbourhood.

December 8 to 14, at Kottabato on Mindanao, very heavy earthquakes, which destroyed all the houses.

1872.—January 29, at 7 P.M., at Manila, three slight shocks from E. to W., which I witnessed.

Manila, Feb. 5 A. B. MEYER

Height of Auroras

ALLOW me to suggest the following rules, to be attended to by those who incline to make observations on the heights of auroras :—

1. Observations to be made at the exact hours and half hours, Greenwich mean time.

2. If there is an arch, the position of the apex of its central line should be noted with reference to the stars ; or else its altitude should be ascertained carefully, and its azimuth approximately. If the lower or the upper edge of the arch is well defined, give similar particulars respecting it. State the width of the arch ; state whether it is regular or not. If it is somewhat irregular, instead of its actual position, give that of an imaginary arch having its average position.

3. If there is any other very conspicuous feature, its position among the stars may be observed ; care being taken to describe it sufficiently for it to be recognised in any account from another place. But the position of the corona, or point to which the rays converge, is of no value for determining the height of the aurora, for it is merely an apparent phenomenon.

Observers must not consider themselves tied down to observe on every occasion ; *any* observations, if made in accordance with these rules, may be useful. If they are sent to me, I will endeavour to calculate the aurora's height from them, unless some one else volunteers to take them in hand.

T. W. BACKHOUSE

West Hendon House, Sunderland, March 20

Eccentricity of the Earth's Orbit

I SHALL feel obliged if some of your correspondents would inform me if, with the exception of Grant's Physical Astronomy, there is any treatise or encyclopædic article on Astronomy, published in this country before 1864, where the superior limit of the eccentricity of the earth's orbit, as determined by Lagrange or by Leverrier, is given ; or even any reference made to the researches of these geometricians on the subject.

Edinburgh, March 11 JAMES ELLIS

Barometric Depression

IN Mr. Monck's article on barometric variations in NATURE of 21st inst. there is a serious mistake about the theory of trade-winds. He says the trade-winds would probably extend to the poles were it not that the parallels of latitude become so narrow before reaching them. The trade-winds are east winds ; and if, as is certainly the case, the only motive power acting on the earth's atmosphere is the sun's heat, it follows from the law of the conservation of rotation that the total force of the east and west winds must exactly balance each other. This must be the case even were the earth of some other form than a sphere.

JOSEPH JOHN MURPHY

Old Forge, Dunmurry, March 25

*FURTHER INVESTIGATIONS ON PLANETARY INFLUENCE UPON SOLAR ACTIVITY**

1. IN a previous communication by us to this Society, an abstract of which was published in the Proceedings, vol. xiv. p. 59,† we showed some grounds for believing that the behaviour of sun-spots with regard to increase and diminution, as they pass across the sun's visible disc, is not altogether of an arbitrary nature. From the information which we then had, we were led to think that during a period of several months sun-spots will, on the whole, attain their minimum of size at the centre of the disc. They will then alter their behaviour so as, on the whole, to diminish during the whole time of their passage across the disc; thirdly, their behaviour will be such that they reach a maximum at the centre; and, lastly, they will be found to increase in size during their whole passage across the disc. These various types of behaviour appear to us always to follow one another in the above order; and in a paper printed for private circulation in 1866, we discussed the matter at considerable length, after having carefully measured the area of each of the groups observed by Carrington, in order to increase the accuracy of our results. In this paper we obtained nineteen or twenty months as the approximate value of the period of recurrence of the same behaviour.

2. A recurrence of this kind is rather a deduction from observations more or less probable than an hypothesis; nevertheless, it appeared to us to connect itself at once with an hypothesis regarding sun-spot activity. "The average size of a spot" (we remarked) "would appear to attain its maximum on that side of the sun which is turned away from Venus, and to have its minimum in the neighbourhood of this planet." In venturing a remark of this nature, we were aware it might be said, "How can a comparatively small body like one of the planets so far away from the sun cause such enormous disturbances on the sun's surface as we know sun-spots to be?" It ought, however, we think, to be borne in mind that in sun-spots we have, *as a matter of fact*, a set of phenomena curiously restricted to certain solar latitudes, within which, however, they vary according to some complicated periodical law, and presenting also periodical variations in their frequency of a strangely complicated nature. Now these phenomena must either be caused by something within the sun's surface, or by something without it. But if we cannot easily imagine bodies so distant as the planets to produce such large effects, we have equal difficulty in imagining anything beneath the sun's surface that could give rise to phenomena of such a complicated periodicity. Nevertheless, as we have remarked, sun-spots do exist, and obey complicated laws, whether they be caused by something within or something without the sun. Under these circumstances, it does not appear to us unphilosophical to see whether as a matter of fact the behaviour of sun-spots has any reference to planetary positions. There likewise appears to be this advantage in establishing a connection of any kind between the behaviour of sun-spots and the positions of some one prominent planet, that we at once expect a similar result in the case of another planet of nearly equal prominence, and are thus led to use our idea as a working hypothesis.

3. We have now a larger number of observations at our disposal than we had in 1866. We had then only the groups observed by Carrington, the positions and areas of all of which we had accurately measured. We have now in addition five years of the Kew observations, for each group of which the positions and areas have been recorded by us in our previous communications to this society. We have thus altogether observations extending from the beginning of 1854 to the end of 1860, forming the series of Carrington; and observations extending from the beginning of 1866, forming the Kew series, as far as this is yet reduced. We have, in fact, altogether a nearly continuous series, beginning a year or two before one minimum, and extending to the next, and thus embracing rather more than a whole period.

We propose in the following pages to discuss the behaviour with regard to size of the various groups of these two series, as each group passes from left to right across the sun's visible disc. Unfortunately for this purpose, a large number of groups has to be rejected; for, on account of bad weather, we have frequent blank days, during which the sun cannot be seen, and on this account we cannot tell with sufficient accuracy the behaviour of many groups as they pass across the disc. In our catalogue of sun-spot behaviour, we have only retained those groups for which, making the times abscissæ, and the areas ordinates, we had sufficiently frequent observations to enable us to construct a reasonably accurate curve exhibiting the area of the group for each point of its passage across the disc. From these curves a table was then formed denoting the probable area of each non-rejected group at the following heliographic longitudes (that of the visible centre of the disc being reckoned as zero):—

$$-63^\circ - 49^\circ - 35^\circ - 21^\circ - 7^\circ + 7^\circ + 21^\circ + 35^\circ + 49^\circ + 63^\circ;$$

in fact, giving the area of the group for the ten central days of its progress, and rejecting those observations that were too near the sun's border on either side, on account of the uncertainty of measurement of such observations. We have succeeded in tabulating in this manner 421 groups of Carrington's series, and 373 groups of the Kew series up to the end of 1866, in all 794 groups. In this catalogue the area is that of the whole spot, including umbra and penumbra; and in measuring these areas a correction for foreshortening has always been made, as described in a paper which we presented to this society, and which constitutes the first series of our researches. These areas are expressed in millionths of the sun's visible hemisphere.

4. When we began this present investigation into the behaviour of spots, we soon found reason to conclude that in the case of sun-spots the usual formula for foreshortening is not strictly correct. Perhaps if a sun-spot were strictly a surface-phenomenon, the usual formula might be correct, though even that is doubtful; for the earth as a planet may not impossibly affect the behaviour of all spots as they cross the disc, so as to render the formula somewhat inexact. However this may be, a spot is probably always surrounded more or less by faculous matter, forming in many cases a sort of cylindrical wall round the spot. Now the effect of such a wall would be to allow the whole spot to be seen when at or near the centre of the disc, but to hide part of the spot as it approached the border on either side. A spot thus affected would therefore appear to be more diminished by foreshortening than the usual formula would indicate; and we should therefore expect, if this were the case, that, on the whole, after making the usual allowance for foreshortening, spots would nevertheless be found deficient in area near the borders as compared with their area at the centre of the disc. As a matter of fact we have something of this kind, as will be seen from the following table, in which we have used the whole body of spots forming the catalogue to which we have made allusion.

In this table the first column denotes the heliocentric longitude from the centre of the disc reckoned as zero; the second denotes the united areas at the various longitudes of all those groups from both series, the behaviour

* By Warren De La Rue, D.C.L., F.R.S., Balfour Stewart, LL.D., F.R.S., and Benjamin Loewy, F.R.A.S. Read before the Royal Society, March 14, 1872.

† See NATURE, vol. v., p. 192.

of which we have been able to obtain with accuracy; while the third column exhibits the residual factor for foreshortening, which will bring the areas of the second column into equality with each other.

TABLE I.

Longitude observed.	United areas of all groups at longitude of column 1.	Residual factor for foreshortening necessary to equalise the areas of column 2.
—63°	147,508	1·229
—49	156,758	1·156
—35	168,697	1·075
—21	176,417	1·028
— 7	178,990	1·013
+ 7	181,336	1·000
+21	178,638	1·015
+35	175,747	1·032
+49	171,140	1·059
+63	162,541	1·115

5. From the above table it appears that the average behaviour of spots, as far as can be judged from the information at present attainable, is not quite symmetrical as regards the centre of the disc. Without attempting at present to enter into an explanation of this remarkable phenomenon, we may point to it as a confirmation of our view previously stated, that most spots are accompanied by a wall-shaped surrounding of facula. Observations show that on the whole the life-history of the facula begins and ends earlier than that of the spot which it surrounds, and that throughout a gradual subsidence of this elevated mural appendage seems to be taking place. But such a diminution of the wall discloses more of the spot itself, and hence the spot-areas, measured on the eastern half of the hemisphere, might be expected, *cæteris paribus*, to be smaller than those observed in the western half, a fact strikingly demonstrated by the above table.

Our present object, however, is not to account for the average behaviour of spots, but rather to investigate the causes or concomitants of a departure from this average behaviour. We have, therefore, in all cases made use of the factors given in the above table as those which, judging by the average behaviour, tend to equalise the areas that pass the various longitudes. We have called this *earth-correction*, and have limited our discussion to any well-marked behaviour that remains after the earth-correction has been applied.

Let us now divide the whole mass of observations into four portions, depending upon the position of the planet Venus with reference to the earth or point of view. First, let us take each occasion on which the planet is in the same heliographic longitude as the earth, that is to say, when the earth and Venus are nearly in a line on the same side of the sun.

Let us use five months' observations for each such occasion, extending equally on both sides of it; thus, for instance, if the planet Venus and the earth had the same heliocentric longitude on September 30, 1855, we should make use of sun-spots from the middle of July to the middle of December of that year as likely to represent any behaviour that might be due to this particular position of Venus. Let us do the same for all similar occasions, and finally add all the spots thus selected together. We have thus obtained a mass of observations which may be supposed to represent any behaviour due to this position of the planet Venus with reference to the earth or point of view.

Secondly, let us now take each occasion on which Venus is at the same longitude as the extreme right of the visible disc, that is to say, 90° before the earth, and do the same as we did in the previous instance, using five months' observations for each occasion We shall thus, as before, obtain a mass of observations which may be supposed to represent the behaviour due to a position of Venus 90° before the earth. Thirdly, let us obtain in a similar manner a mass of observations representing the behaviour of sun-spots for a position of Venus 180° before the earth, Venus and the earth being now at exactly opposite sides of the sun; and fourthly, let us finally obtain, in a similar manner, those observations representing the behaviour of sun-spots when Venus is 270° before the earth, being now of the same heliocentric longitude as the extreme left of the visible disc.

These four series of five months each will in fact split up the whole body of observations into four equal parts, the synodical revolution of Venus being nearly twenty months. The following table exhibits these series after the earth-correction has been applied to each. It also represents each series reduced so as to exhibit its characteristic behaviour for an average size of spot = 1000.

TABLE II.

Longitude.	Sum of areas corrected for earth-effect.							
	(A) Venus=Earth+0°.		(B) Venus=Earth+90°.		(C) Venus=Earth+180°.		(D) Venus=Earth+270°.	
		1000		1000		1000		1000
—63°	48905	+54	60573	+56	44031	—16	27776	—152
—49	48385	+42	59869	+43	44075	—15	28881	—118
—35	47508	+23	60210	+49	43606	—25	30023	— 84
—21	46203	— 4	59847	+43	43974	—17	31331	— 44
— 7	45026	—30	58493	+20	45084	+ 7	32711	— 1
+ 7	43603	—61	56496	—15	47446	+61	33791	+ 31
+21	44134	—49	54867	—44	47768	+68	34547	+ 55
+35	45306	—25	54184	—55	46821	+47	35068	+ 71
+49	46476	+ 1	54782	—46	43693	—23	36285	+107
+63	48742	+49	54473	—51	40875	—87	37143	+135
	464288	10000	573794	10000	447373	10000	327556	10000

7. We may do the same for the planet Mercury as we have done for Venus, that is to say, we may split up the whole body of observations into four parts, representing the behaviour of sun-spots when Mercury is in the same four positions with respect to the earth as those which are given for Venus in the above table. Only in this case we must bear in mind that, owing to the eccentricity of Mercury's orbit, this planet will sometimes take a longer,

and sometimes a shorter time to go from one configuration to another. Thus, for instance, we have

Mercury = earth + 0° on March 24, 1854 ;
Mercury = earth + 90° on May 6, 1854 ;
and Mercury = earth +180° on May 29, 1854.

We should therefore take the observations between April 15, 1854, and May 18, 1854, as representing the behaviour of sun-spots due to a position of Mercury 90° before the earth, and so on for other cases. The following table has been constructed on this principle, and it may be regarded as exhibiting for Mercury precisely what the second table exhibited for Venus.

TABLE III.

Longitude.	Sum of areas corrected for earth-effect.							
	(A) Mercury=Earth+0°		(B) Mercury=Earth+90°.		(C) Mercury=Earth+180°.		(D) Mercury=Earth+270°.	
°		1000		1000		1000		1000
—63	45298	+22	45555	+85	39034	—84	50409	+ 0
—49	45492	+26	44183	+52	40288	—54	49868	—10
—35	45978	+36	41723	— 7	42303	— 8	48996	—28
—21	43870	—11	41398	—14	44554	+46	48453	—39
— 7	42568	—40	41386	—15	45266	+62	48817	—31
+ 7	42384	—44	41096	—21	45502	+68	49844	—11
+21	42885	—33	41460	—13	44817	+52	51341	+18
+35	44270	— 2	40649	—31	42740	+ 3	53000	+51
+49	45780	+32	40337	—39	41478	—27	51772	+27
+63	44922	+14	42157	+ 3	40122	—58	51562	+23
	443447	10000	419944	10000	426104	10000	504062	10000

8. The following is a table constructed on a precisely similar principle with reference to the planet Jupiter :—

TABLE IV.

Longitude.	Sum of areas corrected for earth-effect.							
	(A) Jupiter=Earth+0°.		(B) Jupiter=Earth+90°.		(C) Jupiter=Earth+180°.		(D) Jupiter=Earth+270°.	
°		1000		1000		1000		1000
—63	29348	— 34	35369	—20	48871	—25	42794	+39
—49	28665	— 57	35256	—24	50118	— 1	43163	+48
—35	28836	— 51	35176	—25	51432	+26	40747	—11
—21	28623	— 57	34962	—32	51029	+18	41318	+ 3
— 7	28779	— 53	35739	— 9	51116	+20	40500	—17
+ 7	30321	— 1	36494	+11	50360	+ 9	40599	—15
+21	31309	+ 31	37264	+32	50266	+ 3	40979	— 5
+35	31488	+ 36	36935	+24	50489	+ 7	41579	+ 9
+49	32400	+ 67	36584	+13	49558	—11	40876	— 7
+63	34017	+119	37147	+30	47792	—46	39373	—44
	303786	10000	360926	10000	501231	10000	411928	10000

9. If we now examine the two tables for the planets Venus and Mercury, we shall find in them indications of a behaviour of sun-spots appearing to have reference to the positions of these planets, and which seems to be of the same nature for both. This behaviour may be characterised as follows :—the average size of a spot would appear to attain its maximum on that side of the sun which is turned away from Venus or from Mercury, and to have its minimum in the neighbourhood of Venus or of Mercury.

10. The apparent behaviour is so decided with regard to Venus, that the whole body of observations will bear to be split up into two parts, namely, Carrington's series and the Kew series, in each of which it is distinctly manifest. The following treatment will serve to render this effect more visible to the eye.

In Table II., column (A) (Venus = earth + 0°), we have ten final numbers denoting the behaviour of a spot of average area = 1,000 at ten central longitudes as follows:

+ 54 + 42 + 23 — 4 — 30 — 61 — 49 — 25 + 1 + 49.

Let us take the mean of the first and second of these, the mean of the second and third, and so on, and we get the following nine numbers :—

+ 48 + 32 + 10 — 17 — 45 — 55 — 37 — 12 + 25.

Performing the same operation once more, we obtain the following eight numbers, corresponding to the eight central longitudes :—

+ 40 + 21 — 3 — 31 — 50 — 46 — 25 + 7.

In Table V. we have exhibited the results obtained by this process.

11. If we now refer to the table of Jupiter, we find that we cannot detect the same kind of behaviour that we did in the case of Venus and Mercury. We cannot say that such a behaviour does not exist with reference to this planet ; but, if it does, it is to such an extent that the observations at our disposal have not enabled us to detect it.

12. The following evidence from a different point of view goes to confirm the results we have now obtained.

We might expect, if there really is a behaviour of sun-spots depending upon the position of Venus, and of the nature herein stated, that the average area of a spot as it passes the central longitude of the disc ought to be greatest when Venus is 180° from the earth, and least when Venus and the earth are together, and the same ought to hold for Mercury and for Jupiter, if these planets have any influence. Taking the mean of the four central

TABLE V.

Longitude.	Venus (whole series).				Venus (Carrington's series).				Venus (Kew series).				Mercury (whole series).			
°	(A)	(B)	(C)	(D)	(A)	(B)	(C)	(D)	(A)	(B)	(C)	(D)	(A)	(B)	(C)	(D)
—49	+40	+48	—18	—118	+8	+30	—10	—160	+117	+58	—27	—46	+28	+45	—50	—12
—35	+21	+46	—20	—82	+9	+24	—5	—95	+47	+58	—39	—59	+21	+6	—6	—26
—21	—3	+39	—13	—43	+1	+24	+10	—37	—16	+45	—38	—52	—6	—12	+36	—34
—7	—31	+17	+15	—3	—12	+16	+36	+16	—74	+13	—9	—36	—33	—16	+60	—28
+7	—50	—14	+49	+29	—23	+2	+53	+58	—113	—29	+45	—20	—40	—18	+63	—9
+21	—46	—40	+60	+53	—15	—20	+46	+82	—119	—57	+77	+4	—28	—20	+43	+19
+35	—25	—50	+34	+76	+4	—45	+13	+100	—91	—56	+59	+36	—1	—28	+7	+36
+49	+7	—50	—22	+105	+14	—50	—40	+118	—9	—44	+1	+82	+19	—27	—27	+32

areas as giving the best value of the araea of a spot its passes the centre, we have for Venus the following results :—

Mean of 4 central areas,

(A)	(B)	(C)	(D)
44741	57426	46068	33095

and the number of groups for these are as follows :—

229	265	150	181

hence the mean area of one group will be,—

195	217	307	183

from which we get (A) = 195 ; mean of (B) and (D) = 200 ; (C) = 307 ; that is to say, A is least, and C is greatest.

Doing the same in the case of Mercury, we get

(A) = 204 ; mean of (B) and (D) = 217 ; (C) = 246 ;

and finally, doing the same in the case of Jupiter, we get

(A) = 185 ; mean of (B) and (D) = 207 ; (C) = 282 ;

it thus appears that in all these cases the same order is preserved.

13. We leave it to others to remark upon the nature and strength of the evidence now deduced as to a connection of some sort between the behaviour of sun-spots and the positions of the planets Venus and Mercury. We think, however, it must be allowed, that the investigation is one of interest and importance, and we trust that arrangements may be made for the systematic continuance of solar observations in such localities as will ensure to us a daily picture of the sun's disc.

The influence of blank days in diminishing the value of a series of sun-observations is very manifest. We have been able to record the behaviour across the sun's disc of 421 groups of Carrington's series for a total number of 885 groups, and we have been able to record the same behaviour for 373 out of 544 groups observed at Kew. Thus, out of a total of 1,429 groups, we have only been able to record the behaviour of 794. Nor are the records which we have obtained so perfect as we could wish, on account of blank days, which make interpolations necessary. It is therefore of much importance for the future of such researches as the present that there should be several observing-stations so placed that we may reckon on having at least a daily picture of the sun's disc.

It will be easily seen that such observations are very different from experiments which may be multiplied *ad libitum* ; for in this case Nature gives us in a year or in ten years a certain amount of information, and no more ; while it depends upon ourselves to make a good use of the information which she affords.

It is already universally acknowledged that we ought to make the best possible use of the few precious moments of a total eclipse ; but such observations must necessarily be incomplete unless they are followed up by the equally important if more laborious task of recording the sun's surface from day to day.

RHINOCEROSES

THE few species of Rhinoceros which now exist on the world's surface are divisible into two distinct groups, one of which inhabits Africa, the other certain portions of Asia. The Asiatic rhinoceroses are readily distinguishable from their Æthiopian brethren by the presence of incisor teeth throughout life, and by the remarkable folds of the skin. In the African rhinoceroses the incisor teeth are absent, or rather never cut the gums, and the skin is smooth, or, at all events presents scarcely any appearance of the peculiar folds which distinguish the Asiatic species.

Commencing with the Asiatic group, the great Indian rhinoceros (*Rhinoceros unicornis*) is the largest, oldest, and best known species. Of this animal the Zoological Society's Collection contains two adult specimens—a female, purchased in 1850, and a male, presented by Mr. Grote in 1864. But long before the arrival of these animals the large Indian rhinoceros was represented in the Society's Collection by a specimen which died in 1849, and which formed one of the subjects of Prof. Owen's elaborate memoir upon the anatomy of this animal, published in the Society's "Transactions," vol. iv., p. 31.

The habitat of the large Indian rhinoceros is the wooded district called the Terai, which lies along the foot of the Himalayas from Nepaul to Bhotan, and thence extends into Assam.

The Sondaic rhinoceros (*Rhinoceros sondaicus*) appears to be very like its larger brother in general conformation, having but one horn on its nose, and the same complicated folds of the skin. It is, however, much smaller in size, and, according to the best authorities, presents certain well-marked cranial characters, which render it easily distinguishable. This rhinoceros was, until recently, supposed to be confined to Java, Sumatra, and Borneo, in which latter island, however, its existence in the present epoch is somewhat problematical.*

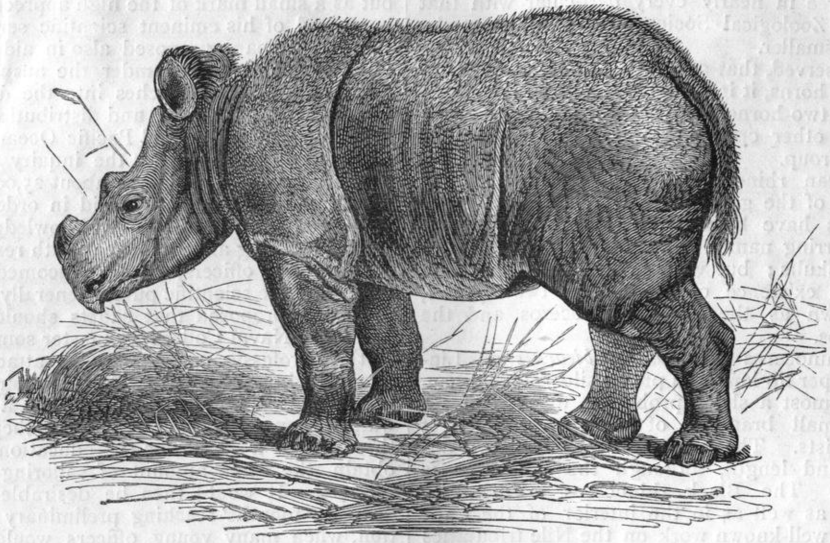
Mr. Blyth, however, has recently shown that the one-horned rhinoceros of the Malay peninsula is in all probability referable to this species, and that the rhinoceros which occurs in the Sunderbunds of Bengal is most likely the same animal.

Of the Sondaic rhinoceros, the Zoological Society has

* See Busk in Proc. Zool. Soc. 1869, p. 409, and Fraser, *ibid.*, p. 29.

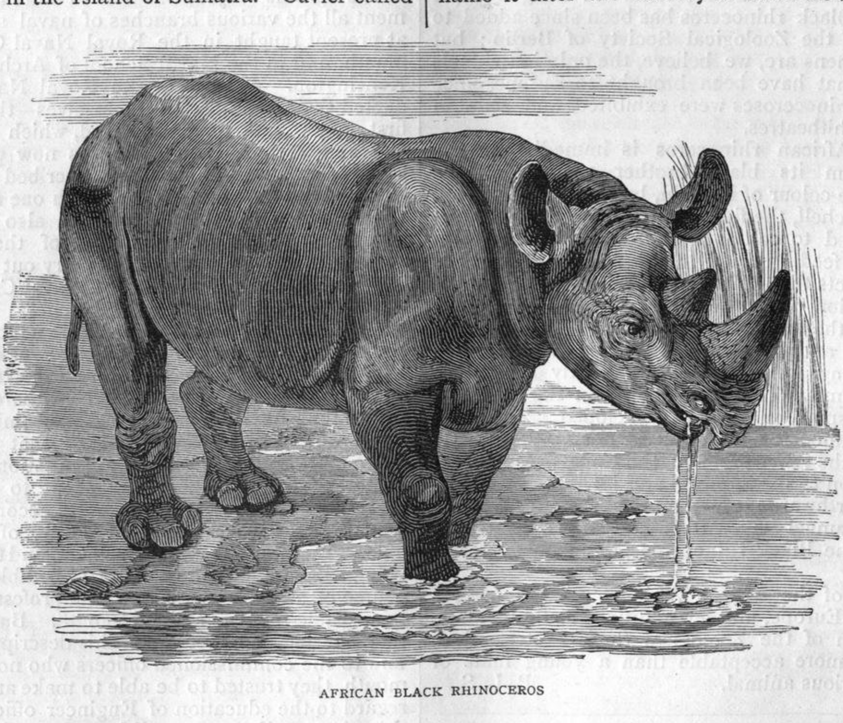
not yet succeeded in obtaining a specimen, and I am not aware that the animal has ever been brought alive to Europe. It would be of great interest to place a living example of this species by the side of its larger ally in the Regent's Park.

The third Asiatic species of rhinoceros is a very different looking animal from the two previously mentioned, having two horns on its forehead, the smaller of which is situated just above the eye, and the other still farther forward. Its body is, moreover, covered with bristly



SUMATRAN RHINOCEROS

hairs, and there is only one strong, well-marked cutaneous fold of skin on the back, which renders it very unlike its mailed brethren. This animal was until lately supposed to be only found in the Island of Sumatra. Cuvier called it *Rhinoceros sumatrensis* from this circumstance; and our countryman, Sir Stamford Raffles, who obtained it in that island about the same period, likewise proposed to name it after the country to which he believed it to be



AFRICAN BLACK RHINOCEROS

confined. It has, however, been recently discovered that the Sumatran rhinoceros extends northwards along the whole range of the Malay peninsula, at least as far as Chittagong. The fine female specimen of this rhinoceros now in the Gardens of the Zoological Society of London was captured a little way south of Chittagong about four years ago. At the time of its capture, it is said to have been quite young, perhaps two years old. Now, however, it is about four and a half feet high, and has probably nearly attained its adult stature; this species being the smallest of existing rhinoceroses. Singularly enough, at the time this animal was on its way to England, a second specimen of the same species was received by the Zoological Society of Hamburg, and is now living in their gardens in that city. The Hamburg animal is likewise a female, and is said by those who have examined both individuals, to agree in nearly every particular with that belonging to the Zoological Society of London, but to be about one-third smaller.

It must be observed, that although the Sumatran rhinoceros has two horns, it is by no means nearly related to the African two-horned rhinoceros, but has the incisor teeth and other cranial characters of the Indian division of the group.

Of the African rhinoceroses, which constitute the second division of the genus as explained above, many nominal species have been made by naturalists who delight in conferring names upon fragments of horns, and imperfect skulls; but we have not as yet certain evidence of the existence of more than two species, commonly known as the Black rhinoceros and the White rhinoceros.

The Black rhinoceros (*Rhinoceros bicornis* of Linnæus) has its upper lip long and prehensile. This organ, in fact, forms almost a short proboscis, well fitted for grasping the small branches of trees, upon which it principally subsists. The two horns are not very different in size and length, although the front one is usually longest. The Black rhinoceros is found in Eastern Africa, as well as in the interior of the Cape Colony. In his well-known work on the Nile tributaries of Abyssinia, Sir Samuel Baker describes it as being not unfrequently met with in Upper Nubia. The young male example of this animal obtained by the Zoological Society in September 1868, was captured in this district by the Hamram Arabs, of whose prowess Sir Samuel Baker tells us such wonderful stories. A living example of the African Black rhinoceros has been since added to the collection of the Zoological Society of Berlin; but these two specimens are, we believe, the only individuals of this species that have been brought to Europe, since the days when rhinoceroses were exhibited and slain in the Roman amphitheatres.

The White African rhinoceros is immediately distinguishable from its black brother, apart from the difference in the colour of its skin, by its short upper lip, whence Dr. Burchell, the first scientific traveller who met with it, proposed to call it *Rhinoceros simus*. It is a grazing animal, feeding chiefly upon grass, and inhabits more open districts than *R. bicornis*. But the most noticeable distinction of the White rhinoceros is the enormous length of the front horn, which in old individuals reaches to three and a half, or even four feet in length, and, after sloping forwards, curves gently backwards towards the summit. The hinder horn, on the contrary, always remains small, and slightly developed. The range of the White rhinoceros in Africa is not very perfectly known. From the inner parts of the Cape Colony it extends probably on to the Zambesi and its affluents. How much farther northwards it may go is uncertain; but, according to Sir Samuel Baker, it is not known in Upper Nubia, where the Black rhinoceros is the only species met with.

No specimen of the African White rhinoceros has yet been brought to Europe, and few additions could be made to the collection of the Zoological Society of London, which would be more acceptable than a young male of this rare and curious animal. P. L. S.

SCIENCE IN THE NAVY

It is with great satisfaction that we learn, from a speech made by Mr. Goschen in the House of Commons last week, that the Government proposes a vote of 2,000*l.* to Mr. Archibald Smith, Q.C., for great services rendered by him to the Admiralty, not in his professional capacity, but as a man of science whose researches into matters connected with magnetism had been of great service to the Navy and the country. This grant was not proposed as a compensation for Mr. Smith's very laborious services, but as a small mark of the high appreciation the Government had of his eminent scientific services. There was another increase proposed also in aid of the expedition about to be organised under the auspices of the Royal Society to make researches into the depth, temperature, composition, circulation, and distribution of animal life in the Atlantic, Indian, and Pacific Oceans. The total cost to the country, supposing the inquiry to extend over two and a half years, would be about 25,000*l.*, a sum which would not be grudgingly paid in order to secure a vast amount of important scientific knowledge.

The following announcement, with respect to the education of naval officers, will be welcomed with great satisfaction by the scientific public generally:—

"It was proposed that cadets should first go for two years to a Naval College, to master some of the rudiments of their profession, cruisers being attached, so that they might begin to go to sea. At the expiration of or within twelve months they would go out in a seagoing man-of-war, with naval instructors, when they would have for three years a much better education than they now obtain, the same amount of sailoring experience being retained. It would then be desirable that they should have six months' teaching preliminary to their examination, when many young officers would ascertain which way their bent lay, and whether they should apply themselves to higher courses of study, for which arrangements could be made, but which would not be entered upon till they had passed the lieutenant's examination. . . The question that the Government had before them in reference to this subject was how to unite in one establishment all the various branches of naval study which were at present taught in the Royal Naval College at Portsmouth, and in the Naval School of Architecture at South Kensington. At present the Royal Naval College conducted their examinations themselves—that is to say, they first taught and then examined, which was not at all a desirable state of things. It was now proposed to combine the scheme which he had described as regarded the education of the young officers with one for the education of the commissioned officer, and also to make better arrangements for the education of the Engineer and Marine officers. In order to carry out these objects it was proposed to found a Royal Naval College at Greenwich, where all branches of a general naval education would be taught, and to do so upon a scale which would be calculated greatly to raise the tone of our naval officers. In the first place there would be received in the College sub-lieutenants, who would be kept there for six months before their passing their general examination, and also naval officers. It was proposed that after the sub-lieutenants had passed their examinations and had been a short time at sea, those who chose to avail themselves of it should have an opportunity accorded to them of pursuing a higher course of study, of which half-pay officers might also avail themselves, and the establishment being so near London they should be able to offer a better course of study, under more able professors, than would be possible to give at Portsmouth. But, in addition to thus offering an education of this description to the young and to the commissioned officers who now went to Portsmouth, they trusted to be able to make arrangements with regard to the education of Engineer officers. At present these latter officers were all brought up in our own yards, which they entered at about fifteen or sixteen years of age, and in which they remained for four or six years as Engineering apprentices, and at the end of the fourth year three were selected to go to the School of Naval

Architecture at South Kensington. In the same way, from a certain number of shipwrights' apprentices three or four were also selected every year to go up and study at the latter school. As regarded the Engineers, it was proposed that not merely three or four out of the thirty should be sent every year to South Kensington, but that all of them, after having been four years in the yards, should have the advantage of going through a course of one year's education at Greenwich, which should include all the higher branches of engineering education, such as metallurgy and chemistry. It was further proposed to take a similar course with reference to the shipwright's apprentices, but only as regarded a limited number, who would have an opportunity of studying naval architecture at Greenwich. The South Kensington School would be removed to Greenwich. . . With regard to the cadets, it was not proposed that they should go to Greenwich. No definite arrangements had as yet been proposed with reference to them, but that there was no great hurry in the matter, because in future they would not be taken under fifteen years of age, and it would be as well to wait until those who had entered at thirteen had attained the latter age before new arrangements were entered into with regard to them."

We heartily congratulate the Government on this commencement of a higher scientific instruction of officers of the Navy, and trust that the course thus commenced will be persisted in.

NOTES

THE Royal Commission on Scientific Instruction and the Advancement of Science have, we are informed, concluded their inquiry into the scientific instruction afforded in training colleges and elementary schools, and in the science classes of the Science and Art Department.

THERE will be an election to a Natural Science Fellowship in Exeter College, Oxford, on Wednesday, June 19. The examination will be in Biology. The Fellow elected will be required to reside and take part in the instruction of the College. The election will take place under the conditions of the special ordinance of the College with regard to residence. The Fellow elected under the ordinance will be subject in all other respects to the Statutes of the College. The examination will probably begin on Tuesday, June 11, and no person can be admitted as a candidate who has not passed all the examinations necessary for the degree of Bachelor of Arts in the University of Oxford, or been incorporated as a graduate in the University. Candidates are requested to make application by letter to the rector on or before June 1.

THE examinations for Scholarships in Natural Science, which have recently been held at Clare and at Emmanuel College, Cambridge, have both terminated without an election being made. The reason of this is that at neither of the colleges did candidates present themselves, whose attainments, in the opinion of the examiners, entitled them to receive the distinction. The number of competitors was but small in each case, in one three only.

THE Vice-Chancellor of the University of Cambridge has promulgated the text of a memorial addressed to the University upon the subject of higher education, and adopted at a public meeting at Birmingham. It is similar to the memorials addressed upon the same subject from Rochdale, Leeds, Crewe, and the North of England Council for the Education of Women, and the prayer of the memorial is that a Syndicate be appointed to investigate the subject, and to inaugurate such means as would produce—firstly, a standard of excellence in the departments of literature, science, and art, fixed by some universally recognised authority, and attainable by students of this class, which would secure for their studies the definiteness and thoroughness that are so much needed; secondly, an opportunity, offered to all who might be inclined to take advantage of it, of bringing their acquirements to the test of an examination; thirdly, the command of teaching power of a high order for the benefit of those who might wish to place themselves under instruction.

PROF. HUXLEY is, we learn from the *Times*, the favourite candidate for the rectorship of St. Andrew's University.

THE following are the probable arrangements for the Friday evening meetings at the Royal Institution after Easter:—April 12, Mr. John Morley, "On Rousseau's Influence on European Thought;" April 19, Mr. Vernon Harcourt, F.R.S., "On the Sulphurous Impurity in Coal Gas and the means of removing it;" April 26, Prof. Blackie, "On the Genius and Character of the Modern Greek Language." May 3, Wm. Spottiswoode, Treas. R.S.; May 10, N. Story-Maskelyne, F.R.S., "On Meteoric Stones;" May 17, Prof. Abel, F.R.S.; May 24, Prof. Clifford, "On Babbage's Calculating Machines;" May 31, Mr. E. J. Poynter, A.R.A. June 7, Prof. Odling, F.R.S. And the following lecture arrangements are announced:—Dr. Wm. A. Guy, F.R.S., three lectures, "On Statistics, Social Science, and Political Economy," on Tuesdays, April 9, 16, and 23; Mr. Edward B. Tylor, F.R.S., six lectures, "On the Development of Belief and Custom amongst the Lower Races of Mankind," on Tuesdays, April 30 to June 4;" Prof. Tyndall, F.R.S., nine lectures, "On Heat and Light," on Thursdays, April 11 to June 6; Mr. R. A. Proctor, five lectures, "On the Star Depths," on Saturdays, April 13 to May 11; Prof. Roscoe, F.R.S., four lectures, "On the Chemical Action of Light," on Saturdays, May 18 to June 8.

PROF. THISELTON DYER is about to deliver a course of lectures on flowers and fruits to the Royal Horticultural Society, with the following titles:—Thursday, April 11, "Flowers: their common plan of construction." April 25, Flowers: the variety in their forms, and how brought about." May 9, "Flowers: their colours and odours." May 23, "Fruits: their structure." June 6, "How seeds are sown in Nature." June 20, "Flowers and Fruits under cultivation." The lectures will commence at 3 P.M.

M. SCHIMPER, the celebrated botanist and palæontologist, is the only one of the old professors in the French University of Strasburg who has consented to continue to hold his post under the German rule. M. Schimper is a Frenchman by birth and descent, and had been offered a superior position elsewhere by the French Government.

M. PRILLIEUX, the French botanist, having declined to continue an honorary Associate of the Leipsic Leopold Academy of Natural Science, some German professors call upon their countrymen to return the "brevets" they have received from French scientific bodies. But it is satisfactory to see Dr. Virchow coming forward to warn his colleagues against imitating such a bad example.

AN ingenious patent is now being worked, by which leather for the sides of boots and shoes is rendered impervious to wet and damp by exhausting the air from the pores of the leather, and filling them up with a substance which unites with and adheres to the fibre, thereby strengthening without impairing the elasticity of the material. It is stated that the patent, known as "Fanshawe's Waterproof Leather," is not only likely to be largely employed for the purpose to which we have referred, but that when asphalte pavement becomes more general, it will be possible to shoe horses with a material as hard as the asphalte itself, and which will prevent them slipping.

A NOVEL and most interesting experiment in the field of elementary instruction has just been resolved upon in Saxony. Hitherto, as everywhere else, so in that small but highly-developed kingdom, the youth of the lower orders, upon being apprenticed to a trade, have been left at liberty to forget the little they learnt at school. Attendance at Sunday schools and evening instruction provided by the State and charitable societies were perfectly optional. By a law just passed this liberty is abridged, and compulsory attendance at evening schools exacted for a period of three years. This is, we believe, the first time in the annals of the world that an attempt has been made by a State to extend the education of the humbler classes beyond the merest rudiments, and after they have entered upon the business of life. Saxony, already the best taught portion of Germany, will by the new law be more than ever in advance of her sister States.

It has been necessary to remove the Parliamentary copies of the Imperial standards, in consequence of the wall of the Palace at Westminster, in which they were immured, having been pulled down in order to form an entrance to the refreshment rooms. On the 7th of March, 1872, in the presence of the President of the Board of Trade and five other public functionaries, the standards were deposited in their new resting place in the wall on the right-hand side of the second landing of the public staircase, leading from the lower waiting-hall up to the Commons' Committee Room. One alteration has been made. When the standards were originally immured, a brass plate was fixed upon the wall bearing the following inscription in old English letters:—"Within this wall are deposited standards of the British yard and the British pound weight, 1853." The word "measure" has now been inserted after "yard."

In another column will be found an article on the recent meeting of the Iron and Steel Institute, referring, among other matters of interest, to the new puddling machine. We learn that an agreement has been entered into between Mr. Danks, the inventor, and a combination of iron manufacturers representing the different districts, whereby the latter undertake to have 200 furnaces on his plan put up within six months, and in consideration of his permission to do so, to pay him 50,000*l*. at that time, whether the furnaces are in operation or not. This step, which adds something like 450 furnaces to our producing power, will effect such a revolution as has never before occurred in the history of this branch of industry, and it is the more to be wondered at when it is remembered that, till July last, it was thought that hand-puddling must for ever continue, every machine to do away with it having, before that, entirely failed.

The *Swiss Times* says that the late Professor Pictet-de-la-Rive has left the whole of his remarkable palæontological collection to the Museum of Natural History, and the greater part of his valuable scientific library to be divided between the Academic Museum and the Library of the city of Geneva.

We learn with regret of the death, at his plantation, not far from Vera Cruz, of Dr. Charles Sartorius, a gentleman well known in the United States and Europe as a naturalist and meteorologist. Few students of the zoology and botany of Mexico have failed to become acquainted with the labours of the doctor, as shown by the numerous specimens sent to the museum of the Smithsonian Institution and to the American Entomological Society, &c.

The French Minister of Agriculture and Commerce has ordered the institution at the Central School of Arts and Manufactures at Paris of a new course of lectures to be devoted to the higher teaching of agriculture.

The Annual Meeting of French *savants*, held at Paris under the auspices of the Ministry of Public Instruction, will commence on Monday, April 1, at the Sorbonne, and continue on the three following days.

We regret to learn that the proposed Dredging Expedition of the *Norna* is postponed, one of the party being seriously ill, and her owner somewhat unexpectedly having to join his regiment in May instead of autumn. He is anxious to employ a vessel large enough to carry a good stock of fuel for a donkey engine, to save time and labour, and the *Norna* being small for this, and for carrying a steam launch, as is also to be desired, Mr. Marshall-Hall will, in all probability, part with her. If he is successful in organising the more extensive undertaking now proposed, he fully expects to contribute very interesting observations to marine science, and to investigate several chemical questions, besides the zoological work.

Prof. Pepper, who has done good service in working some of the more popular and easily-illustrated departments of science at the Polytechnic, is about to leave that Institution, and to start an exhibition on his own account at the Egyptian Hall, Piccadilly, in conjunction with Mr. T. W. Tobin.

Prof. Luther has discovered a new planet (No. 118) of the 11th magnitude. The discoverer suggests the name "Peitho."

At the meeting of the Royal Geographical Society, held on Monday evening last, Mr. W. Giffard Palgrave read a paper, detailing a journey made by him during his late residence as Consul in Asia Minor. He began by giving a rough account of the general divisions of that region, confining himself more particularly, however, to that tract of country consisting of tableland, formerly known as Armenian, and where, moreover, the Tigris, Euphrates, and other important rivers take their rise. Many observations made of phenomena in the neighbourhood of the range of mountains known as the Kolat Tagh all tended to show beyond doubt that at some period or other glaciers must have formed and existed in large quantities in the immense tracts of mountains, though at the present time the climate is too genial to allow the snow to remain even on the ridges and peak throughout the year. A short insight was afforded into the volcanic features of the place, and also into the mineralogical formation of the soil. From this it appeared that mines, if only persons were found enterprising enough to work them, might be opened which would yield a surprising amount of lead and a considerable quantity of silver, and would most likely prove very lucrative.

The educational importance of our large schools, not only to their actual pupils but to the inhabitants of the surrounding neighbourhood, is being happily illustrated at Taunton. An able lecture on "The Theory of Musical Tone," was delivered last week to a large audience in the College School Dining-hall by Mr. E. B. Tylor, F.R.S. It was largely illustrated by experiments, and the valuable apparatus was left behind him by the lecturer as a present to the School. It is hoped that other lectures on Science, Art, and Literature, will succeed; and that gentlemen of eminence will be found to aid, by their presence and teaching, so praiseworthy an attempt. For some time past the Botanical Lectures at the School have been attended not only by the pupils, but by a considerable number of strangers; and a class of forty students will present themselves for the approaching South Kensington Examination in Botany. There is already a small Botanical Garden, well furnished and laid out, which will be largely increased when the funds of the School permit. *O, si sic omnes!*

Mr. Fairgrieve, successor to Mr. George Wombwell, is about to sell by auction his well-known menagerie. The catalogue comprises 186 lots, and includes a large number of monkeys, ten lions and lionesses of various ages, a tiger and tigress, a male and female elephant, three boa constrictors, and a large number of other animals, and appurtenances. The sale will take place at Edinburgh, and will commence on April 9, unless the whole menagerie is previously disposed of by private contract.

Gentlemen interested in the improvement of Geometrical Teaching may obtain a copy of the Association's Second Annual

Report (referred to in last week's NATURE) on application to the Hon. Secretaries, King Edward's School, Birmingham, or to the London Local Secretaries, Mr. C. W. Merrifield, F.R.S., South Kensington, and Mr. R. Tucker, University College School.

MR. I. LOWTHIAN BELL read a paper at the Institution of Civil Engineers on Tuesday evening, March 18, "On the conditions which favour and those which limit the Economy of Fuel in the Blast Furnace for Smelting Iron." A discussion on the paper was taken at the following meeting on Tuesday evening last.

MR. ALFRED SMEE, F.R.S., has in the press a volume entitled *My Garden*, in which he gives a complete description of his experimental garden at Beddington, in Surrey, and details the results of his experience in the culture of flowers and fruit: of these nearly 700 species and genera are described. The volume also treats generally of the natural history, geology, and antiquities of the neighbourhood. It is illustrated with about 1,000 wood engravings, executed expressly for the work. The volume will be published by Messrs. Bell and Daldy.

ANNUAL ADDRESS TO THE GEOLOGICAL SOCIETY OF LONDON, FEB. 16, 1872

BY J. PRESTWICH, F.R.S., PRESIDENT

IN looking at the labours of the Society during the past year, it is satisfactory to notice the same activity, the same wide range of subjects as ever, and the same independence of research for truth's sake which there ever should be. But, though good work has been done in special branches and the technical details of Geology, not so much progress has been made in its higher problems. I would, however, direct your attention to the steps made in grouping our volcanic rocks, and in the determination of the fauna of our Cambrian strata, which proves to be so much larger and richer than was anticipated a few years back. Both these subjects are in able hands, and cannot fail to yield important results, the latter especially in aiding to settle that interesting question—the true line of division between the Silurian and the Cambrian formations. On the subject of denudation and river-action, we have also had several excellent papers, and look forward with interest to the further development of the many original views which they have put before us.

The great question of the history of our globe during the Quaternary period seems also to be advancing towards more completeness. Many able observers, both in and out of our own Society, are engaged upon the subject, and various scientific periodicals and publications of our local societies are rich in contributions bearing upon this interesting subject. There is no more wonderful chapter in the earth's history than that which embraces the phenomena connected with the prevalence of great and exceptional cold immediately preceding our time,—the first dim appearance of man—his association with a race of great extinct Mammalia belonging to a cold climate—the persistent zoological characters of the one, so far as we have yet gone, in opposition to the variable types presented in geological time by the others—the search for connecting links, and the measure of man's antiquity,—all of which constitute theoretical problems of the highest interest, and are now occupying the attention of geologists of all countries. Allied also to this subject are the great questions relating to the form of our present continents—the elevation of the land—the origin of valleys and plains—and of all that which prepared this globe for the advent of man.

But while treating of these abstract and philosophical questions, geology deals also with the requirements of civilised man, showing him the best mode of providing for many of his wants, and guiding him in the search of much that is necessary for his welfare. The questions of water-supply, of building materials, of metalliferous veins, of iron and coal-supply, and of surface-soils, all come under this head, and constitute a scarcely less important, although a more special branch of our science than the palæontological questions connected with the life of past periods, or than the great theoretical problems relating to physical and cosmical phenomena. Looking at this triple division of geology, and seeing that the first, or applied geology, is, as it were, only incidental to our general studies, and therefore not often the topic of our discussions, notwithstanding its practical importance, I propose on this occasion to say a few words in connection with the two momentous subjects which, during the last few years, have been made the objects of investigation by two Royal Commissions,* on both of which the geological questions have received much and careful consideration. I shall here restrict myself to the more special geological bearings of the subject, extending them, however, in some directions beyond the scope of the original inquiries, and refer you to the Reports and Minutes of Evidence themselves for the many valuable economical questions and practical details which are there discussed.

Our Springs and Water-supply.

The site of a spring or the presence of a stream determined probably the first settlements of savage man; and his civilised descendants have continued, until the last few years, equally dependent upon like conditions—conditions connected first with the rainfall, and, secondly, with the distribution of the permeable and impermeable strata forming the surface of the country. Under ordinary circumstances, few large towns have arisen except where there has been an easily accessible localised water-supply, and where the catchment-basin on which depends the volume of the rivers has been large, and permeable strata prevail. Take, for example, London. Few sites could be more favourable in every respect. Beneath it are strata rich in springs, while at a distance there is that large development of those massive permeable strata so necessary to maintain a sufficient and permanent flow in our rivers. As the conditions exhibited in the London basin afford all the illustrations we need for our subject, I will confine myself in this address to that area alone.

London north of the Thames stands on a bed of gravel, varying in thickness from ten to twenty feet in round numbers, and overlying strata of tenacious clay from 100 to 200 feet. The former being easily permeable, the rain falling on its surface filters through it, until stopped by the impermeable London clay, where it accumulates and forms a never-failing source of supply to the innumerable shallow wells that have been sunk all over London from time immemorial, and which for centuries constituted its sole water-supply. Not only does it form an easily accessible underground reservoir, although of limited dimensions; but where the small intersecting valleys cut down through the bed of gravel into the London clay, a portion of the water in this reservoir escapes at the junction of the two strata, and gives rise to several springs formerly in much repute, such as those of Bagnigge Well, Holywell, Clerken-well, St. Chad's Well, and others.

The early growth of London followed unerringly the direction of this bed of gravel, eastward towards Whitechapel, Bow, and Stepney; north-eastward towards Hackney, Clapton, and Newington; and westward towards Chelsea and Kensington; while northward it came for many years to a sudden termination at Clerkenwell, Bloomsbury, Marylebone, Paddington, and Bayswater; for north of a line drawn from Bayswater by the Great Western station, Clarence Gate, Park Square, and along the north side of the New Road to Euston Square, Burton Crescent, and Mecklenburg Square, this bed of gravel terminates abruptly, and the London clay comes to the surface, and occupies all the ground to the north. A map of London, so recent as 1817, shows how well-defined was the extension of houses arising from this cause. Here and there only beyond the main body of the gravel there were a few outliers, such as those at Islington and Highbury; and there habitations followed. In the same way, south of the Thames, villages and buildings were gradually extended over the valley-gravels to Peckham, Camberwell, Brixton, and Clapham; while, beyond, houses and villages rose on the gravel-capped hills of Streatham, Denmark Hill, and Norwood. It was not until the facilities were afforded for an independent water-supply by the rapid extension of the works of the great water companies, that it became practicable to establish a town population in the clay districts of Holloway, Camden Town, Regent's Park, St. John's Wood, Westbourne, and Notting Hill.

On the outskirts of London a succession of villages grew up for miles on the great beds of gravel ranging on the east to Barking, Ilford, and Romford—on the north, following the valley of the Lea to Edmonton and Hoddesdon; and on the West, up the Thames-valley to Ealing, Hounslow, Slough, Hammersmith,

* Royal Commission on Water Supply, appointed April 1867. Report of the Commissioners and Minutes of Evidence and Appendix, June 1869. Royal Commission on Coal Supply, appointed June 1866. Reports of the Commissioners, Minutes of Evidence, Appendix, July 1871.

and beyond; whereas, with the exception of Kilburn, hardly a house was to be met with a few years since between Paddington and Edgeware, or between Marylebone and Hendon; and not many even between the New Road and Highgate and Hampstead. As a marked case of the excluding effects of a large tract of impermeable strata close to a great city, I may mention the denuded London-clay district extending from a mile north of Acton, Ealing, and Hanwell, to Stanmore, Pinner and Ickenham, near Uxbridge. With the exception of Harrow (which stands on an outlier of the Bagshot Sands), and Perivale, and Greenford (on outliers of gravel), there are only the small villages of Northholt and Greenford Green. In the earlier edition of the Ordnance Maps, there was a tract of ten square miles north and westward of Harrow within which there were only four houses. Yet the ground is all cultivated and productive. But immediately eastward of this area, and ranging thence to the valley of the Lea, the ground rises higher, and most of the London-clay hills a-e capped by gravel of an older age than that of the London valley, and belonging to the boulder-clay series. On these we have the old settlements of Hendon, Stanmore, Finchley, Barnet, Totteridge, Whetstone, Southgate, and others.

There is yet another very common source of well-water supply from beds of gravel directing population to low sites in valleys, which is this. Everywhere on the banks of the Thames and its tributaries there is a lower-lying bed of valley-gravel or of rubble on, and often passing beneath, the level of the river. This bed is supplied with water both by rain falling on it, by springs thrown out from the adjacent hills or by the drainage from those hills and in places by infiltration from the river, when, from any cause, the line of water in the gravel falls below that of the adjacent river; while, on the other hand, the surplus land-supplies find their way direct and unseen, from the bed of gravel to the river. A great part of London south of the Thames, Westminster, Battersea, and a number of towns up the Thames, as Hammersmith, Brentford, Eton, Maidenhead, and others, together with Newbury and several villages on the Kennet, also the towns of Ware and Hertford on the Lea, have this shallow well-supply. A great many towns and numberless villages along most of our river-valleys all through England, and on whatever formation situated, are dependent on this superficial source of supply, a supply much more permanent than the other shallow well-supplies, in consequence of the outside aid from springs and rivers. It is, however, only in case of exceedingly dry seasons or of excessive pumping, that the supply requires to be supplemented by the river-waters. As, in ground of this description, the land-water is generally dammed back by the stream, the level of the water in the wells, which are always shallow, varies with the level of the water in the streams, rising and falling more or less with them.

A few of the higher London-clay hills in the neighbourhood of London are also capped by outliers of the Bagshot Sands, as, for example, Harrow, Hampstead, and Highgate, all of which are sites of old habitations. The sands at these places attain a thickness of from 30 to 80 feet, are very permeable, and afford a sufficient water-supply by means of wells to a limited population. A number of well-known small springs are thrown out at the contact of the sands and the clay on the slopes just below and around the summit both of Highgate and Hampstead Hills. In some instances, owing to the presence of iron in the sands, they are slightly chalybeate. When the Baghshot Sands, further westward of London, attain their fuller development of from 300 to 400 feet, the depth to the water-level at their base becomes so great that the upper porous beds are left high and dry, and form uncultivated wastes, such as Bagshot Heath, Frimley Heath, and others; but on the outside of this area, where the sands become thinner, and the water-level more within reach, we find a number of villages, such as Englefield Green, Sunninghill, Brackwell, Wokingham, Alderstone, Esher, Weybridge, Woking, &c. There are also some thin subordinate beds of clay in the middle of the series which hold up a sufficient quantity of water for small local supplies, and give rise to small streams in the valleys of the Blackwater and of Chobham. The running nature of portions of these sands, and the presence of beds of ferruginous and green sands, often interfere much with the construction of deep wells, and the quantity of the well-water; and, externally, the mixed clay-and-sand character of the upper beds of the London clay fails to give any good retaining-line for the water, which therefore rarely issues as springs, but oozes out from the general surface of the intermediate spongy mass.

The 70 to 100 feet of sands and pebble-beds belonging to the lower tertiary strata under the London clay, and overlying the chalk, are also very permeable, and being intercalated with some beds of retentive clay, they give rise to one or two levels of water, affording wherever these strata form the surface, as at Blackheath, Bexley, Chiselhurst, and Bromley, a moderate water-supply to shallow wells. Where these sands dip under the London clay, and only present a narrow belt on the surface, a small valley is commonly formed into which the London-clay hills drain on the one side, and on the other the chalk dammed back by the Tertiary strata throws out its springs, and the sands are thus kept charged with water up to a short depth from the surface. As instances of the many places whose sites have been determined by these favourable circumstances, I may name Croydon, Beddington, Carshalton, Sutton, Cheam, Ewell, the villages between Epsom, Ashstead, and Leatherhead, to Guildford, and again between Old Basing and Kingsclere.

But besides furnishing a supply by ordinary wells to a number of villages on their line of outcrop, the Lower Tertiary sands have of late years contributed to the metropolitan supply, as well as to the supply of those adjacent districts where the surface is formed of tenacious clay, and water is scarce, by means of artesian wells. For along the line of country just named, and along a more irregular belt on the north of London, these sands pass beneath the London clay, so that the water they receive from rain and springs on the surface, passes underground, where it is prevented from rising by the impermeable superincumbent clay; consequently, as there is no outlet for the water below ground, these sand-beds are filled with water along their whole underground range, between their outcrop in Surrey and that in Hertfordshire.

I need not dwell here upon the constructions of Artesian wells, which have been explained by Hericart de Thury, Arago, Degousée and Laurent, Burnell, Hughes, myself, and others, beyond offering a few explanatory remarks on this particular case, which we shall also have to bring to bear upon the origin of springs.

The surface of the ground at the outcrop, just referred to, of the Lower Tertiary sands is about 100 ft. above the level of the Thames, whilst under London the sands are at a depth of from 100 ft. to 220 ft. below that level, thus forming the shell of a basin from 200 ft. to 300 ft. deep, the centre of which is filled with a depressed mass of impermeable clay, There is, however, a notch in the lip of the basin, where it is traversed by the Thames, at Deptford and Greenwich, which is at a lower level of 100 ft. than the rest of the rim. Below this level, as there is no escape for the water, the strata are naturally perpetually water-logged; and if any water is withdrawn from one part, it is, owing to the permeability of the strata, at once replaced from adjacent parts of the same strata. Early in the present century, bore-holes were made through the overlying London clay to the sands at depths of from 80 ft. to 140 ft., and the water from these deep-seated springs rose at once to a height of several feet above the level of the Thames, where it tended to maintain itself, and thus form, in the lower-lying districts, permanent natural fountains. But the ease and facility with which this abundant supply was obtained, led to the construction of so great a number of such wells that a time soon came when the annual rain outfall no longer sufficed to meet the demand, or, rather, it could not be transmitted fast enough to the central area of abstraction to replace the out-draught. The consequence was that, after some years, the water ceased to overflow, and the line of water-level has gradually sunk at London, until it now stands some 70 ft. or 80 ft. beneath the surface level. This, however, is not the case at a distance from London; and in many parts of Middlesex, and more especially in Essex, where Artesian wells are common, they have been found of very great service.

In order to supply the deficiency thus caused in the Lower Tertiary sand, most of the Artesian wells in London have of late years been carried down into the underlying chalk, which also extends beneath London at depths of from 150 ft. to 280 ft. Both formations are permeable, but in different ways. On both the rainfall is at once absorbed, but the transmission of it is effected in different ways. Through the sands it filters at once; but not so with the chalk. A cubic foot of the latter will hold two gallons of water by mere capillary attraction; but it parts with this with difficulty. Still in time it finds its way through the body of the chalk, aided by the innumerable joints, fissures, and lines of flints by which this formation is traversed; and, when once under the line of saturation, the water in these fissures circulates freely. This line of saturation is governed in this as well as in all other permeable formations, by the level of the lowest natural point of escape, which is either the coast-line if near, or the nearest river-valley. Below these levels permeable strata are always charged with water; consequently under London the chalk is everywhere water-bearing; but as the Lower Chalk is more compact than the Upper, and is less fissured, especially when covered by other strata, and as the more compact water-logged chalk delivers its charge with extreme slowness, it is not until a fissure is met with that a free supply of water is obtained. Further, as there is no law regulating the position of the fissures, the depth to which the chalk has to be traversed before meeting with a free supply of water is quite uncertain. It is a question of probability depending upon meeting with a fissure sooner or later—10 to 15 feet have sufficed in some of the deep London wells, whereas in others it has been necessary to sink to a depth of from 100 to 200 feet or more before hitting on the necessary fissures. Large as this supply is, the same causes which have operated in the case of the sands have told also on the chalk supplies (and, no doubt, there is some community between tbe two), and the great demands on it have occasioned a similar lowering of the water-line. At the same time this line also remains unaltered at a distance from London, and as with Tertiary Sands the mass of the chalk beneath intersecting the level of the river valleys remains constantly charged with water. Ordinary wells, therefore, sunk below this line of saturation into the chalk where it comes to or near the surface, are capable of yielding very large quantities of water. More than seven million gallons daily are in fact now so obtained from the chalk on the south-east of London.

Numerous and useful as the London Artesian wells are, they sink into insignificance when compared with the application of the same system in Paris. Our deepest wells range from about 400 to 500 feet, and the water comes from the chalk hills at a nearest distance of from 15 to 25 miles from London; whereas in Paris the well of Grenelle is 1,798 feet deep, and derives its supplies from the rain-water falling in the Lower Greensands of Champagne, and travelling above 100 miles underground before reaching Paris. The well of Passy, sunk also through the Chalk into the Lower Greensands at a depth of 1,923 feet, derives its supplies from the same source. The level of the ground above the sea at the outcrop of the Lower Greensands in Champagne averages about 350 feet, and the water at Grenelle well rises 120 above the surface, which is nearly the level of the Seine, there 89 feet above the sea-level. The water-delivery is large and well maintained. These results were considered so encouraging, that in 1865 the Municipality of Paris decided on sinking two Artesian wells of unexampled magnitude. Hitherto the bore-holes of such wells have been measured by inches, varying from 14 to 4 inches, that of Passy alone having been 4 feet at the surface and 2 feet 4 inches at bottom. But it was resolved to exceed even the larger dimensions of this well.

One of these experimental wells is in the north of Paris, at La Chapelle, St. Denis, 157 feet above the sea-level. A shaft, with a diameter of of 6½ feet, was first sunk through Tertiary strata to a depth of 113 feet. At this point the boring was commenced with a diameter of 5½ feet, and carried through difficult Tertiary strata to a depth of 450 feet, when the Chalk was reached. A fresh bore-hole was here commenced in August 1867, which in September 1870 had reached the depth of 1,954 feet. The works were stopped on account of the war until June 1871, when they were resumed, and the bore-hole has now reached the great depth of 2,034 feet, with a diameter still of 4 feet 4½ inches. It is now in the Grey Chalk, and it is calculated that the Lower Greensands will be reached at a depth of about 2,300 feet.

The other Artesian well is at the Buttes-aux-Cailles, on the south-east of Paris, at an elevation of 203 ft. above the sea. The Tertiary strata are there only 205 ft. thick. This well is not quite on so large a scale as the other, and is still, at the depth of 1,640 ft., in the White Chalk.

The discharge from these great wells will probably be equal to that of a small river. At Passy, notwithstanding some defective tubage, and the circumstance that the surface of the ground is there 86 ft. above the Seine, the discharge at the surface is equal to 3½ millons of gallons daily; and it has been above 5 millions, or enough for the supply of a town of 150,000 inhabitants.

The question may arise, and has arisen, why, with a like geological structure, should not like results be obtained at London as at Paris; and, to a certain extent, it has been answered. At Kentish Town an Artesian well was, in 1855, carried through 324 feet of Tertiary strata, 645 ft. of Chalk, 14 ft. of Upper Greensand, and 130ft. of Gault. Instead of then meeting with the water-bearing Lower Greensands which crop out from beneath the Chalk, both on the north and south of London, unexpected geological conditions were found to prevail, to which we shall have occasion to refer presently; and not only were these Greensands found to be absent, but likewise all the Oolitic and Liassic series. The bore-hole passed at once from the Gault into a series of red and grey sandstones, probably of Palæozoic age, and not water-bearing. The Chalk has more recently been traversed at Crossness, near Plumstead, where its base was reached at a depth of 785 ft., and the bore-hole carried 159 ft. deeper into, but not through, the Gault, when, owing to difficulties caused by the small size of the bore-hole, the work had to be abandoned. Although we were mistaken in our anticipations as to the results of the first of these works, still it is evident—as the Lower Greensands, with a thickness of 450 ft., pass beneath the Chalk and the Gault in a line from Farnham, Reigate, to and beyond Sevenoaks—and they again occupy the same position north of London, on a line from Leighton Buzzard to Potton—that it is only a question of how far they may be prolonged underground towards London. They have as yet been followed only 4 miles from their outcrop under the Gault in Buckinghamshire, and 1 mile in Kent; and no attempt has been made to follow them under the Chalk. It is therefore quite possible that they may extend to under Croydon, or even to Sydenham, or still nearer London; but this depends upon the width of the underground ridge of Palæozoic rocks, which has not been determined. It is a matter for trial. As the sands are from 200 to 500 ft. thick, and show no sign of an immediate approach to the old shore-line, there is every probability that in Kent and Surrey they extend at all events some miles northward, and in Bucks some miles southward, before they thin off against the underground ridge of old rocks, so that they might still be found available, as a supplementary source, for the water-supply of London.

Such is the geological structure of the ground on which this large city is dependent for its first and immediate water-supply by means of wells. The highest seam of water, that in the drift-gravel, extends almost everywhere under the streets and houses of London, at depths of from 12ft. to 25ft., forming what is called ground-springs. The Lower Tertiary sands, with their greater thickness, and their larger and distant area of outcrop, contain the second and larger underground body of water beneath London. The third underground reservoir is the Chalk, which, from its large dimensions—500ft. to 1,000ft. thick—and extensive superficial area, forms a still larger reservoir, and source of water-supply.

With the increase of population, however, the need for larger quantities necessitated the recourse to river-supply; and this supply, equally with the other, is regulated by geological conditions, only that in this case the question concerns those conditions which affect the strata throughout the catchment-basin of the river itself above the town which needs its supply.

(*To be continued.*)

PROF. SCHIAPARELLI'S RESEARCHES

THE following address was delivered by the president of the Royal Astronomical Society, Mr. William Lassell, February 9, 1872, on presenting the Gold Medal of the Society to Signor Schiaparelli :—

You will have learned from the Report just read, that your Council have awarded the Gold Medal this year to Signor Schiaparelli; and I regret to have to inform you that we shall be deprived of the pleasure of presenting it to him in person; as by a letter received from him a few days ago, I learn that his duties of Professor and Director of the Observatory at Milan will prevent his being able to undertake so long a journey.

The first notice I find of Signor Schiaparelli's labours is his discovery of the minor planet *Hesperia*, at the Observatory of Milan, on April 29, 1861, an indication that, besides his mathematical attainments in Theoretical Astronomy, he possesses industry and practical skill as an observer.

In the *Astronomische Nachrichten* of August 13, 1864 (No. 1487), is a purely mathematical paper by him, entitled "Théorèmes sur le mouvement de plusiers corps qui s'attirent mutuellement dans l'espace." Of this paper, not bearing immediately upon those labours of Signor Schiaparelli which have more especially called forth the award, I will only express the opinion of a friend of high mathematical attainments, who characterises it "as an elegant and probably original contribution to the theory of the orbits of bodies moving freely in space, and acted on only by their mutual attractions."

I come now to give some account of Signor Schiaparelli's principal discovery of the law of identity of meteors and comets, and of the observations and reflections which led him to that result, as contained in a series of letters to Father Secchi in the year 1866.

It appears from these that Signor Schiaparelli's study of this subject received a great impulse from his own observation of the meteors which fell on the nights of the 9th, 10th and 11th of August, 1866. He states that he was then confirmed in the opinion expressed three years before, that, of the meteors which usually fall on those nights, a great number are distinguished by their starting nearly all from one point. And, from the spasmodic fall of these meteors—more sometimes falling in one minute than in the next quarter of an hour—he inferred that their distribution in space must be very unequal. He also observed that those stars proceeding from one point were all of a fine yellow colour, and left behind them a fugitive but very sensible track; whilst the other meteors, proceeding from various points, offered every variety of colour and form. Hence he concludes that the meteors form a number of rings, and become visible when the earth traverses their orbit, as if shooting forth from one point in the sky. And he remarks that the observations of M. Coulvier-Gravier, and Professor Heis, and of our own countrymen, Professor Herschel and Mr. Greg, have shown that these radial points occur in every quarter of the heavens; therefore these rings or orbits must possess every possible degree of inclination to the ecliptic.

He then proceeds to inquire how such a mass of cosmical matter could become accumulated in the Solar System. This system seems to consist of two classes—the planets, characterised by but little eccentricity of orbit, slight variation of the plane of the orbit, exclusion of retrograde motion, and a tendency to take the form of a sphere (deviating from it only so much as is necessary to preserve the equilibrium of the body)—these characteristics applying also to the secondary systems, with the exception of the satellites of *Uranus*. The second class consists of cometary bodies, which are under no law as to the planes of their orbits, or the direction of their motions. The point most remarkable about them is the extreme elongation of their orbits, most of which are described in stellar space; which seems to show that they did not form part of our system when that was first constituted, but are wandering nebulæ picked up by our sun.

Signor Schiaparelli further observes that the velocity of the solar system through space has been shown by Otto Struve and Airy to be somewhat similar to that of the planets round the sun. Now if a nebulous body or comet in motion were to come within the action of the sun, it would go round the sun at such an immense distance from us, that it would remain invisible. Two circumstances might bring it within our range of vision—first, if the comet met the sun in almost a direct line; and secondly, if it were travelling in a direction parallel to the sun's motion.

If we suppose a cloud of cosmical matter formed of particles so minute and so widely separated as to possess scarcely any mutual attraction, to be brought within the power of the sun's influence, each particle would pursue an elliptic orbit of its own. Those particles which differed most in the *planes* of their orbits would however possess *nodes in common*, and, in consequence, the particles as they approached the sun would necessarily approach each other, and when separating again, after passing the node, would at their perihelion passage be still very much nearer than they were when brought first within the sun's attraction. Those particles which, lying in the same plane, presented a wide angle with respect to the sun, would form *ellipses*, the planes of which would be identical; though the positions of the major axes would diverge, and, as a result, the particles at their perihelion would pass in nearly the same orbit, but at different velocities, the originally foremost particle being overtaken by those behind it. Again, those particles which, being in the same *plane*, were also in the same *line with regard to the sun*—their separation consisting in the variation of their distance from the sun—would form *ellipses in the same plane*, and having a major axis in the same direction, but of different lengths,—the orbit of the particle *nearest* the sun being described *within* that of the farthest particle, the result of which would be a difference of speed, and an ever-widening distribution of the particles along the whole of the orbit. This reasoning is illustrated, in the second letter to Father Secchi, by a series of diagrams and figures; and then Signor Schiaparelli proceeds to give a recapitulation or summary of his principal propositions thus:—Celestial matter may be divided into the following classes, 1st, fixed stars; 2nd, agglomerations of small stars (resolvable nebulæ); 3rd, smaller bodies invisible except when approaching the sun (comets); 4th, small particles composing a cosmical cloud. This last class probably occupies a large portion of the celestial spaces, and the motion of these dust-clouds may be similar to that of the fixed stars. When attracted by the sun they are not visible unless they receive an orbit which is an elongated conic section.

Whatever may have been the original form of the cloud, it cannot penetrate far into our system without assuming the form of an elongated cylinder passing gradually into a stream of particles. The number of such streams seems to be very great. The particles are so scattered that their orbits may cross each other without interruption, and may possibly be always changing like the beds of rivers. The stream, after passing its perihelion, will be more diffuse than before; and, when passing a planet, may be so violently affected as to separate or break up, and even some particles may assume quite a new orbit and become independent meteors.

Thus meteors and other celestial phenomena of like nature, which a century ago were regarded as atmospheric phenomena —which La Place and Olbers ventured to think came from the moon, and which were afterwards raised to the dignity of being members of the planetary system—are now proved to belong to the *stellar regions*, and to be, *in truth, falling stars*. They have the same relation to comets as the asteroids have to the planets; in both cases their small size is made up by their greater number.

Lastly, we may presume that it is certain that falling stars, meteors, and aerolites, differ in size only and not in composition; therefore we may presume that they are an example of what the universe is composed of. As in them we find no elements foreign to those of the earth, we may infer the similarity of composition of all the universe—a fact already suggested by the revelations of the spectroscope.

Signor Schiaparelli further pursues the subject in another and later paper, published in No. 1629 of the *Astronomische Nachrichten*, entitled "Sur la Relation qui existe entre les comètes et les étoiles filantes." In this communication he refers to the letters to Father Secchi above referred to, in which he had endeavoured to bring together all the arguments in favour of the opinion of an analogy between the mysterious bodies known as shooting stars and comets.

Signor Schiaparelli, in this paper, proceeds to state that he is prepared to afford to this analogy a large amount of probability, since there is no doubt that certain comets, if not all, furnish the numerous meteors which traverse the celestial spaces. In proof of this Signor Schiaparelli quotes from a paper of Prof. Erman, in which he has pointed out the method of obtaining a complete knowledge of the orbit described by a system of shooting stars, when the apparent position of the point of radiation and the velocity through space of the meteors is known.

Assuming from the necessity of the case that the orbit of the August meteors must be an elongated conic section, Signor Schiaparelli employs the method of Erman to calculate the parabolic orbit of those bodies; taking right ascension 44° and north declination 56° for the position of the point of divergence, according to the observations made in 1863 by Prof. A. S. Herschel. And he proceeds to give the following elements, assuming the maximum of the display of 1866 to be August 10, 18 hours. Comparing these elements of the orbit of the August meteors with those of the orbit of Comet II. 1862, calculated by Dr. Oppolzer, he exhibits the following remarkable coincidence in each element:—

	Elements of the Orbit of the Aug. Meteors.	Elements of the Orbit of Comet II, 1862
Perihelion Passage	23 July, 1862	22·9 Aug., 1862
	° ′	° ′
Longitude of Perihelion	343 28	344 41
Ascending Node	138 16	137 27
Inclination	64 3	66 25
Perihelion Distance	0·9643	0·9626
Revolution Period	105? years	153·4 years
Motion	Retrograde	Retrograde

Although the time of revolution of the August meteors is still doubtful, Signor Schiaparelli, on reference to the catalogues of Biot and Quetelet, deduces a hypothetic period of 105 years, which introduces but small changes in the elements—very inferior to the uncertainty of some of the data on which this determination is built.

In the letters above referred to, Signor Schiaparelli had given an orbit for the meteors of November, assuming the point of radiation as determined in America to be γ *Leonis*. But later observations made with much care in England have shown that this position is erroneous by several degrees, so that that orbit can only be termed a very rough approximation. Assuming, then, that the point of radiation is longitude 143° 12′ and latitude 10° 16′ north—that the maximum of the shower was November 13, 11h. G.M.T.—and that the period of revolution is 33¼ years, according to Prof. Newton—Signor Schiaparelli compared the following elements of the meteoric orbit, which he compared with those of the orbit of Comet I., 1866, calculated by Dr. Oppolzer.

	Elements of the Orbit of Nov. Meteors.	Element of the Orbit of Comet I, 1866.
Perihelion Passage	Nov. 10·092, 1866.	Jan. 11·160, 1866.
Longitude of Perihelion	56° 25′·9	60° 28′
Ascending Node	231 28·2	231 26·1
Inclination	17 44·5	17 18·1
Perihelion Distance	0·9873	0·9765
Eccentricity	0·9046	0·9054
Semi-axis Major	10·340	10·324
Revolution Period	33·250 years	33·176 years
Motion	Retrograde	Retrograde.

The assumed position of the point of radiation of the meteors is the mean of 15 determinations obtained by Prof. A. S. Herschel, and given in the *Monthly Notices* of our Society, vol. xxvii. p. 19. If this point be advanced 2° in longitude, and 145° be taken in lieu of 143°, the difference of 4° in the place of the longitude of perihelion in the above elements will disappear.

Signor Schiaparelli then concludes his memoir in these remarkable words :—"These approximations need no comment—must we regard these falling stars as swarms of small comets, or rather as the product of the dissolution of so many great comets? I dare make no reply to such a question."

In venturing to offer a word or two of comment on this very imperfect *résumé* of the labours of Signor Schiaparelli, it appears to me that we can scarcely speak of them too highly, or overrate their importance. Granting that his hypotheses are correct,—of which indeed there seems to be a very high probability, some of the most difficult questions in the contemplation of the constitution of the universe seem at once, and as it were *per saltum*, to be solved. To have placed before our view so clear a history of those mysterious bodies—nebulæ, comets, and aerolites, and their several and intimate relations pointed out—is an advancement of Astronomical Science I at least individually had not ventured to anticipate. And a collateral advantage resulting from this splendid discovery, is the encouragement given to the careful and diligent observation of phenomena, even when the prospect of a fruitful result is by no means apparent. Had it not been for the patient, systematic, and intelligent observations of Prof. Heis, M. Coulvier-Gravier, Mr. Greg, and Prof. Herschel, Signor Schiaparelli would have wanted many valuable data required in his investigations.

I may finally remark that an important confirmation of Signor Schiaparelli's conclusions appears in a valuable paper of Prof. Adams, in our *Monthly Notices*, vol. xxvii. p. 247, in which from somewhat different data, including some observations of his own, he calculates elliptic elements of the November meteors generally very accordant with those above given.

SOCIETIES AND ACADEMIES

London

Geological Society, March 6.—Prof. Duncan, F.R.S., vice-president, in the chair.—(1.) "*Prognathodus Güntheri* (Egerton), a new genus of fossil Fish from the Lias of Lyme Regis." By Sir P. de M. Grey-Egerton, Bart, M.P., F.R.S. In this paper the author described a new form of fossil fish, having a broad premaxillary plate somewhat resembling the incisor tooth of a gigantic Rodent, a single auxiliary plate like that of *Callorhynchus*, and a mandibular dental apparatus closely resembling that of *Cochliodus*. For this form he proposed the establishment of the new genus *Prognathodus*, and named the species *P. Güntheri*. *Ischyodus Johnsoni*, Agassiz, also probably belongs to this genus, as it agrees with *P. Güntheri* in the characters of the premaxillary teeth. The author was doubtful as to the exact position of this genus, which had a head extended in a horizontal instead of a vertical plane, suggesting a resemblance to *Zygæna*, but covered with hard plates like the head of a sturgeon, and exhibited in the dental apparatus the curious combination indicated above.—Dr. Günther pointed out the interest attaching to the dentition of this fossil fish as proving the connection between the Ganoid and Chimæroid forms. The existence of three teeth instead of one on each side of the jaw, as in *Ceratodus* and others, presented in it a generic character; but the type was still the same. Mr. Etheridge made some observations as to the horizon in the Lias in which these fossil fishes occurred. He believed that nine out of ten of the Lower Lias Species came out of the upper part of the *Bucklandi* limestone series. Sir P. Egerton corroborated Mr. Etheridge's views as to the localisation of species of fish, and agreed with him as to the importance of recording the exact position of all such fossils.—(2.) "On two specimens of *Ischyodus*, from the Lias of Lyme Regis." By Sir P. de M. Grey-Egerton, Bart., M.P., F.R.S. In this paper the author noticed a new example of the greatly developed rostrum of a male Chimeroid, an inch shorter, more slender, and more attenuated at the apex, than that of *Ischyodus orthorhinus* Egerton, having a projecting median rib along the upper surface, and the tubercles of the lower part smaller and fewer than in *I. orthorhinus*. For this form the author proposed the name of *I. leptorhinus*. Also a dorsal fin-spine, with the cartilages to which it was articulated, showing the mechanism of its attachment very clearly. This spine differs from that of *I. orthorhinus* in being straighter and smoother, and having fewer and smaller tubercles. The author regarded it as probably belonging to *I. leptorhinus*.—(3.) "How the Parallel Roads of Glen Roy were formed." By Prof. James Nicol, F.G.S. In this paper the author endeavoured to explain, in accordance with the marine theory of the origin of the Parallel Roads of Glen Roy, the coincidence of the level of these terraces with that of the different cols, and also how the same sea could have produced terraces at different levels in different valleys. He assumed that during the gradual elevation of the land, the gradual closing of the straits between its separate masses by the elevation of the cols above the surface would, by checking the eastward flow of the tidal current, cause the sea-level in the western bays to remain stationary relatively to the rising land; and during this period the marine erosion would take place along a line corresponding in level to the col. Hence, in Glen Gloy, which has only one col, the highest in the system, the highest road only was formed; and Glen Gloy remained unaffected by the stoppage of those cols which produced three roads at lower levels in Glen Roy, the lowest of them also extending round Glen Spean. Professor Ramsay entered into the history of the theories for accounting for the terraces, the first of which, that of Professor Agassiz (in 1840), accounted for them by a great glacier damming up the valley, and from time to time declining in height. The glacial theory, on which this view rested, had to some extent been doubted, but eventually had been almost universally accepted even by its first opponents. He next cited the works of the late Mr. Robert Chambers as to the existence of old sea-margins, pointing to a gradual sinking of the sea or a rising of the land. There could be little doubt that a great part of Scotland and of the northern part of England, had been at one time covered with glaciers, as had also been the case in other parts of Europe. Unless the whole country had been submerged, and then came up again by a succession of jerks, it seemed impossible that such terraces could have been formed by the sea and still have remained in existence. If, however, there had been great oscillations in temperature, it seemed possible that during the decline of some transverse glacier the varying levels of the lake might have left terraces, traces of which might still be preserved. Mr. Gwyn Jeffreys renewed his protest against regarding these beds as marine unless marine remains were found in them. In Prof. Nicol's former paper, mention, however, had been made of rolled boulders. These occurred at Glasgow, and elsewhere, covered with *Balani*. As, however, no marine remains had been found in Glen Roy, he adopted the freshwater theory. Mr. Evans regretted that no one else was present who would in any degree advocate the author's views. He pointed out that if the surface of the rocks below the detritus in Glen Roy was glaciated, the probability was in favour of the superficial drift being of marine rather than of subaërial origin. He much doubted whether Ben Nevis, or any of the mountains of the district, offered a sufficient gathering-ground for any such glacier as that supposed in the freshwater theory, assuming the climate to have been such as would have admitted of a large lake in Glen Roy. He suggested the possibility of the openings through which the sea would gain access to the district having at the time of the last submergence been to some extent choked with ice, which thus checked the tidal action inland from the present coast; and thought that possibly both glaciers and the sea had together contributed towards the formation of the terraces. These, he observed, were by no means confined to Glen Roy itself, but were to be seen on a large scale, and at a lower level in the valley of the Speam, if not elsewhere.

PARIS

Academy of Sciences, March 11.—The following mathematical papers were read:—On flattened curves, by Mr. A. Cayley, communicated by M. Chasles; on the determination of the characteristics of the elementary system of cubics, by M. H. G. Zeuthen, also presented by M. Chasles; and on a change of variables, which renders certain equations with partial derivations of the second order integrable, by M. J. Boussinesq, presented by M. de Saint-Venant. M. de Saint-Venant also presented the continuation of his memoir on the hydrodynamics of water-courses. — Papers on auroras were communicated by Marshal Vaillant, M. Vinson, M. H. de Parville, and M. H. Tarry. M. Vinson's communication, and two extracts from letters read by Marshal Vaillant, related to a magnificent Aurora Australis observed at the Island of Bourbon (Réunion) on the night of February 4-5.—M. C. Saint-Claire Deville presented a note by M. A. Houzeau on the proportion of ozone contained in the air of the country, and on its origin.—M. W. de Fonvielle presented a note in continuation of that read at the previous meeting on the means of protecting habitations against the perils of lightning strokes induced by gas-pipes, &c. — A report, by M. Coumbary, on the prediction of earthquakes, was read. — M. E. Becquerel presented a note by M. A Cazin on the quantity of magnetism of electro-magnets.—M. Delaunay communicated a paper by M. A. M. Mayer describing some experiments, showing that the translation of a vibrating body gives origin to a wave of different length from that produced by the same vibrating body in a fixed position.—A note by M. H. Resal on the geometrical theory of the movement of the planets was also presented by M. Delaunay.—A paper was read by M. Kolb on the densities of hydrochloric acid; it contained some useful tables.—M. Blanchard presented a note by MM. P. Fischer and L. de Folin on their dredgings in the fosse of Cap Breton during the year 1871. These dredgings were made at depths extending from 24 to 250 fathoms. The authors indicate the principal species of animals obtained by them.—M. de Quatrefages communicated a paper by M. E. Perrier containing a summary of his anatomical investigation upon the earthworm, and M. Coste a note by M. G. Pouchet on changes of colour produced in prawns to accommodate them to the colour of surrounding objects. This change of colour is prevented by removing the eyes of the prawns.—M. A. Leymerie described some geological peculiarities in the lower Pyrenees.

March 18.—M. Serret presented some remarks on the note by Mr. Boussinesq, read at the last meeting of the Academy, and stated that M. Boussinesq was long since anticipated by Lacroix in the transformation proposed by him. — M. Serret also presented some remarks by M. E. Combescure, upon an analytical memoir by Legendre, on the integration of certain equations with partial differences.—M. de Saint-Venant read a continuation of his memoir on the hydrodynamics of water-courses.—M. H. Saint-Claire Deville communicated a note by M. D. Gernez, on the absorption spectra of the vapours of sulphur, selenious acid, and hypochlorous acid. The author finds that coloured vapours in general absorb rays of irregularly variable refrangibility. Vapour of sulphur at first produces a gradual extinction of the spectrum, except the red part a little beyond line C of the of the solar spectrum; with an increase of temperature the rest of the spectrum reappears with very distinct bundles of lines in the violet and blue, and returning into the green. Vapour of selenious acids produces a veiy distinct system of absorption-bands in the violet and blue, and the absorption-spectrum of hypochlorous acid is identical with that of hypochloric and chlorous acids.—M. H. Tarry presented a note on the extraordinary extension of the zodiacal light, and its coincidence with the periodical reappearance of auroras; and the aurora of the 4th of February was the subject of notes by MM. Denza, Mohn, aud Coumbary.—M. Tarry and M. Denza also noticed the sand rains of the South of Europe.—M. C. Sainte-Claire Deville also presented some remarks on a note on the theory of auroras, read at the last meeting by Marshal Vaillant.—The papers on chemical subjects were particularly numerous. M. Chevreul read a memoir on a phenomenon in the crystallisation of a very concentrated saline solution.—A paper on the formation of chloral by MM. A. Wurtz and G. Vogt was read.—The question of the preservation of wine by the application of heat was further discussed by MM. de Vergnete-Lamotte and Pasteur.—M. Wurtz presented a note by MM. C. Friedel and R. D. Silva, on the isomers of trichlorhydrine and the reproduction of glycerine; a note by M. G. Bouchardat on the transformation of acetone into hydride of hexylene (dipropyle); and some facts with regard to diphenylamine by MM. C. Girard and G. de Laire.—M. C. Robin presented some observations by M. E. Ritter, on colourless bile, in which the author stated that in all cases where colourless bile occurred the liver presented more or less fatty degeneration.—A note was read by M. Duclaux on the influence of the cold of winter upon the seeds of plants.—M. Decaisne presented a note by M. E. Bornet, on the gonidia of Lichens, in which the author supports the curious opinion put forward by M. Schwendener, that the lichens are complex organisms, formed by the association of certain low algæ wlth fungi or other plants. He regards the connection as one of parasitism.—A note was read by M. S. Meunier on the discovery of an abundant deposit of *Hemirhynchus Deshayesi* in the Calcaire Grossier of Puteaux.—M. C. Bernard presented a note by M. Ollier, on cutaneous grafts, and a note by M. Guibert on the beneficial results obtained by the combined action of morphine and chloroform in surgery.

BOOKS RECEIVED

ENGLISH.—Space and Vision: W. H. S. Monck (Dublin, McGee).—Practical Physiology: E. Lankester; 5th edition (Hardwicke).—Moth and Rust: by M. L. (W. Tegg).

FOREIGN.—Corso di Geologia, Vol. i.: A. Stoppani (Milan, Bernardoni).

DIARY

SATURDAY, MARCH 30.

CHEMICAL SOCIETY, at 8.—Anniversary Meeting.

MONDAY, APRIL 1.

ENTOMOLOGICAL SOCIETY, at 7.
ROYAL INSTITUTION, at 2.—General Monthly Meeting.
VICTORIA INSTITUTE, at 8.—On Force: Dr. M'Cann.

TUESDAY, APRIL 2.

SOCIETY OF BIBLICAL ARCHÆOLOGY, at 8.30.—Notice of a Curious Myth respecting the Birth of Sargina, from the Assyrian Tablets containing an Account of his Life: H. F. Talbot, F.R.S.L.—The Assyrian verbs "Basu," to be, "Qabah," to say, and "Isu," to have, identified as variant forms of verbs having the same significations in the Hebrew language: R. Cull, F.S.A.—On the Origin of Semitic Civilisation, chiefly upon Philological Evidence: Rev. A. H. Sayce, M.A.

WEDNESDAY, APRIL 3.

SOCIETY OF ARTS, at 8.
MICROSCOPICAL SOCIETY, at 8.
PHARMACEUTICAL SOCIETY, at 8.

THURSDAY, APRIL 4.

LINNEAN SOCIETY, at 8. —On the Geographical Distribution of Compositæ: G. Bentham, President (concluded).
CHEMICAL SOCIETY, at 8.

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