THURSDAY, AUGUST 9, 1883

TWO "EMINENT SCOTSMEN"

James Nasmyth, Engineer. An Autobiography. Edited by Samuel Smiles, LL.D. (London: Murray, 1883.)

The Life of John Duncan, Scotch Weaver and Botanist, with Sketches of his Friends and Notices of his Times. By William Jolly. (London: Kegan Paul and Co., 1883.)

WE do not know in what particular direction Dr. Smiles has exercised his editorial functions in the charming autobiography of Mr. Nasmyth. The "pruning-knife" which the latter advised him to use freely was surely not needed; the inventor of the steam-hammer gossips so delightfully about himself that we should have been glad had he gone on to a much greater length. On the other hand it is a pity that Mr. Jolly had not obtained the services of some judicious editorial pruner. He himself has evidently not had the leisure to write briefly, and his book is therefore a somewhat heterogeneous collection of materials much in want of rearrangement and cutting down.

Mr. Nasmyth's autobiography, we venture to think, is likely to become a classic in the section of literature to which it belongs. The genial simplicity, the unconscious and perfectly just self-appreciation with which the great engineer and student of science talks of his career and his work, enlists from the first the reader's sympathy and interest. His father, Alexander Nasmyth, a painter of high rank and the founder of the Scottish landscape school, was himself a genius in mechanics; and an atmosphere of mechanical invention pervaded his happy home in Edinburgh. He was one of the select party on board Symington's steamer on Dalswinton Loch in 1788; and among his fellow-passengers was Robert Burns, a fact new to us. Mr. Nasmyth gives us a delightful sketch of his father and his happy family and the simple Edinburgh life of the time. He himself was born in 1808, and educated at the High School of Edinburgh. From his earliest years he delighted in mechanical invention, and was great at making "peeries" and toy cannon. He naturally, as his father's son, learned the use of the pencil, and insists strongly on the great value of drawing to a mechanical engineer. He himself, throughout life, has made almost daily use of his skill in this art, and by the facility with which he could record his ideas and incipient inventions in this form, saved himself much writing, and preserved much that would otherwise have been lost. He left the High School in 1820, when only twelve years of age, though afterwards he attended classes at Edinburgh University. At this early period he says of himself:—

"I was constantly busy; mind, hands, and body were kept in a state of delightful and instructive activity. When not drawing, I occupied myself in my father's workshop at the lathe, the furnace, or the bench. I gradually became initiated into every variety of mechanical and chemical manipulation. I made my own tools and constructed my chemical apparatus, as far as lay in my power. With respect to the latter, I constructed a very handy and effective blowpipe apparatus, consisting of a small air force-pump, connected with a cylindrical vessel of tin plate. By means of an occasional use of the handy pump, it yielded such a fine steady blowpipe blast, as enabled me to bend glass tubes and blow bulbs for thermometers, to analyse metals or mineral substances, or to do any other work for which intense heat was necessary. My natural aptitude for manipulation, whether in mechanical or chemical operations, proved very serviceable to myself as well as to others; and (as will be shown hereafter) it gained for me the friendship of many distinguished scientific men."

He had moreover taken part in really practical work in some Edinburgh workshops, and at the age of seventeen he was constructing small steam-engines and models for illustrative purposes, and two years later he invented a very efficient road steam-engine. The great event in Nasmyth's early life, however, was his engagement in the great engineering works of Henry Maudsley, of London, in 1829. Maudsley was, indeed, so impressed with what he saw of the young Scotchman's intelligence, knowledge, and skill, that he at once took Nasmyth into his confidence as his personal assistant. In London, as in Edinburgh, Mr. Nasmyth made many friends among those whose friendship was best worth having; through Brougham, for instance, he became acquainted with Faraday, whose friendship he retained to the end of the latter's life.

In order that he might be able to live upon his rather scanty wages, Nasmyth invented an ingenious cooking-stove, a sketch of which he gives, and by means of which he was able to cook a "capital dinner" at 4½*d.* Long before this his attention had been given to the contrivance of accurate cutting-tools, and one of the first things he did for Maudsley was to construct a nut-cutting machine. A visit to the north of England, in 1830, one of the objects of which was to see Stephenson's "Rocket," gave him the first idea of settling ultimately in business for himself in the neighbourhood of Manchester. And so indeed he did in 1832, in a very small way, for his means at the time were limited. Business rapidly increased, and he had shortly to remove to new premises at Patricroft, where in 1836 the great Bridgewater Foundry was in complete and efficient action. For twenty years after this Mr. Nasmyth continued at the head of his constantly growing establishment, adding to his inventions, and extending his operations at home and abroad. The result was that at the early age of forty-eight years he felt himself in the happy position to be able to retire entirely from business and devote his life to those scientific and artistic pursuits which had been to him a constant source of pleasure. Indeed it was his full and accurate knowledge of the science of his art, combined with his native insight and common sense, that enabled him to achieve so many mechanical triumphs.

Mr. Nasmyth naturally enters in considerable detail into the history of the steam-hammer, with which his name is so intimately associated. The conception and completion of the invention seems to have been the work of a very brief time. He was incited to it, so early as 1839, by the difficulty which Mr. Humphries, the engineer who had charge of the construction of the *Great Britain* steamship, found in finding forges powerful enough to weld the paddle-shaft of that vessel. Mr. Humphries wrote to Mr. Nasmyth on the subject, and, says the latter:—

"This letter immediately set me a-thinking. How was it that the existing hammers were incapable of forging a wrought-iron shaft of thirty inches diameter? Simply because of their want of compass, of range and fall, as well as of their want of power of blow. A few moments' rapid thought satisfied me that it was by our rigidly adhering to the old traditional form of a smith's hand hammer—of which the forge and tilt hammer, although driven by water or steam power, were mere enlarged modifications—that the difficulty had arisen; as, whenever the largest forge hammer was tilted up to its full height, its range was so small that when a piece of work of considerable size was placed on the anvil, the hammer became 'gagged'; so that, when the forging required the most powerful blow, it received next to no blow at all, as the clear space for the fall of the hammer was almost entirely occupied by the work on the anvil.

"The obvious remedy was to contrive some method by which a ponderous block of iron should be lifted to a sufficient height above the object on which it was desired to strike a blow, and then to let the block full down upon the forging, guiding it in its descent by such simple means as should give the required precision in the percussive action of the falling mass. Following up this idea, I got out my 'Scheme Book,' on the pages of which I generally *thought out*, with the aid of pen and pencil, such mechanical adaptations as I had conceived in my mind, and was thereby enabled to render them visible. I then rapidly sketched out my Steam Hammer, having it all clearly before me in my mind's eye. In little more than half an hour after receiving Mr. Humphries' letter narrating its unlooked-for difficulty, I had the whole contrivance, in all its executant details, before me in a page of my Scheme Book, a reduced photographed copy of which I append to this description. The date of this first drawing was the 24th November, 1839."

The paddle-wheel of the *Great Britain* was, however, never forged, as about that time the substitution of the screw for the paddle-wheel as a means of propulsion was attracting much attention. Indeed, Mr. Nasmyth could get no English firm to take up his invention, and was naturally surprised to find, on a visit he made to France in 1842, that his steam-hammer was in full operation at Creuzot, M. Schneider having copied the design from Mr. Nasmyth's drawing when on a visit to Patricroft. Very naturally Mr. Nasmyth on his return to England lost no time in protecting his invention by patent; its career since is well known.

As we said, Mr. Nasmyth retired from business in 1856, twenty-eight years ago, bought a "Cottage" in Kent, a picturesque place near Penshurst, to which he gave the characteristic name of Hammerfield. Long before this he had learned to take an interest in science, especially in geology and astronomy. His investigations into the structure of the moon are well known, and these, as well as his examinations of the sun's surface, have been conducted with telescopes of his own construction. His elaborate work on the moon, with its magnificent series of views of its surface, has long been classical, and his contributions to the subject of the sun's heat are well known. His imagination, when not engaged in devising mechanical contrivances and contributing to scientific theory, has often blossomed into fancy which has found expression in exquisite pictures of fairy-land and other regions of the unseen. Altogether Mr. Nasmyth's long life has been one of almost unchequered success; from the first he has clearly seen what he wished to accomplish, and with scientific precision has devised the most effective means of realising his aims. Not the least delightful and instructive of his many works is the one before us, which we commend to the study of all young engineers, as well as to all who wish to read the story of a successful life simply and pleasantly told.

John Duncan's career, as told by Mr. Jolly, is a complete contrast to that of Mr. Nasmyth. He never rose above the humble station in which he was born, nor apparently ever wished to do so. He had all along to struggle for a bare living, and was essentially unpractical. What little education he had was self-acquired, and it was never much so far as book-learning goes. His love of flowers was a passion. He amid many discouragements managed to acquire a mastery of systematic botany, and his collection of Scottish plants, now in the possession of Aberdeen University, is of real value. Every moment he could spare was devoted to adding to his collection, and partly as weaver and partly as harvester he traversed most of his native land. In other respects he was a man of superior mind, though in no sense a genius, and by no means to be compared with Robert Dick or even Thomas Edward. Mr. Jolly has narrated in our own columns the main facts of Duncan's career. Had he been more happily situated he would certainly have done real service to science. It is some consolation to think that his merits were recognised before he died, and that his last days were surrounded with comforts and attentions to which throughout his previous life he had been a stranger. As we have said, Mr. Jolly has made too big a book of the materials he has collected, and although it abounds in interest, it would have been more creditable to his literary skill had he taken the trouble to rid it of redundancies.

THE HEAVENLY BODIES

The Heavenly Bodies; their Nature and Habitability. By W. Miller, S.S.C. Edinburgh, Author of "Wintering in the Riviera." Pp. 347. (London: Hodder and Stoughton, 1883.)

FEW subjects could be mentioned more remote from the common interests and pursuits of life than what has been usually called the "plurality of worlds," an expression now so long restricted to one well-ascertained meaning as to have lost any ambiguity that might have been charged upon it. The question is one of mere curiosity, and leads to no direct result; but it has always carried with it an attraction irrespective of its unpractical nature, and has exercised the ingenuity of so many minds that its literature is of no inconsiderable extent. To this the book now in our hands is the most recent contribution. It is not the work of an astronomer, as the author himself has informed us; but as his profession leads him to the examination of evidence this need not be considered a material disadvantage. His position, however, in this respect would have been improved by a little more care in the collection of his data, which in some instances, such as Mädler's "central sun," the satellites of Uranus and Neptune, the polar flattening of Mars, and the observations of Schiaparelli, are somewhat in arrear; and it may be the case that those more intimately conversant with the subject would estimate the comparative value of the evidence somewhat differently. He has taken a very commendable degree of pains in collecting the opinions of former writers; though we have met with no notice of worthy old Derham, or the quick-eyed but fanciful Gruithuisen; but the natural result is the revival of a good deal of antiquated matter that can hardly claim a hearing before a modern tribunal; such as the assumptions of the Cosmotheoros (which by the way he invariably cites as "Cosmothereos") or the affected *niaiseries* of Fontenelle. In fact, excepting for those who would find interest or amusement in specimens of almost all that has been said upon the subject, however absurdly nonsensical, or needlessly pugnacious, the book would gain by a process of winnowing and compression and "weighting," if we may be permitted to use a technical expression. And there can be no question as to the advantage of a more careful revision of the press.

As regards the author's own share, there is much deserving of attention. He writes in an excellent spirit; in espousing the negative side of the question, there is no unfairness towards his opponents; and though some of his arguments carry little weight—for instance that drawn from what seems to him the "dismal," "horrible," "terrifying" aspect of the moon—others are well considered and expressed; and some collateral questions are handled in a way which demands attention, and will well repay it. With regard to the point in hand, if the present volume may not be thought to have done much to decide the controversy, it may be doubtful whether any future successor may do much more. The matter is in reality out of reach. The data are insufficient; and we venture to doubt whether any future generation may be able to attain more satisfactory ones. Long-continued and patient investigation may be fairly expected to throw some light upon the supposed final quiescence of the lunar surface; and possibly on the existence, under certain circumstances, of slight obscurations which might indicate the existence of a very attenuated atmospheric envelope; but this would still leave us at an immense and hopeless distance from any certain proof of habitation. As to the other heavenly bodies our position is worse still. The observations of Schiaparelli, supported to some extent by those of others, and at any rate deserving of respectful attention, tend to divest Mars of some of his supposed similarity to our own globe; and the conclusions hitherto attempted to be drawn as to the condition of the other planetary surfaces are, we venture to think, still less satisfactory. Opinion at present can be little better than conjecture; and it is uncertain at the best whether it will ever be permitted to us to make a further advance. The most ingenious analogical reasoning is not demonstration, and the decision of the finest telescopes would be invoked in vain. An interesting inquiry might be entered upon as to the prospects of opticians and observers; the conclusion possibly might be that their future is somewhat cloudy and obscure. At least we might venture to predict, from past experience, that the accomplished solution of any one of the mysteries which now confront us would only prove a prelude to problems still more insoluble, and proof still more convincing of the comparatively bounded character of all human knowledge.

OUR BOOK SHELF

United States Commission of Fish and Fisheries. Part vii. Report of the Commissioner for 1879.

THE contents of the present volume, embracing details of the work done by the United States Fishery Commissioner for the year 1879, are quite as varied and even of greater interest, if that be possible, than the preceding reports. The specific objects of the methodical inquiry which has now been going on for over twelve years, has for its object to report progress in regard to the propagation of food-fishes in the waters of the United States, as also to afford information as to the decrease in the stock of food-fishes. As has been already stated in the columns of NATURE, in which previous reports have been reviewed, the inquiry which has been so long in progress is being conducted in a thorough and searching way; it embraces the consideration of every topic calculated to throw light on the economy of the American fisheries. Nothing that can be deemed illustrative is neglected—the literature devoted to the natural history of food-fishes, or to descriptions of the fisheries of other countries, especially those of Europe, has been largely utilised in preparing the reports, with the result of making the volumes which have been issued a perfect encyclopædia of fishery information. The contents of the present report embrace a full account of the work overtaken in 1879 and the early part of 1880. The fishes which have been more particularly dealt with in the period noted are the Californian Salmon (*Salmo Quinnat*), the Atlantic Salmon (*S. Salar*), the Mountain or "Rainbow" Trout of California (*S. Irideus*), as also the Schoodic Salmon (*S. Salar*, var. *Sebago*). Various details are also given of what has been done in carp culture, as also of experiments made with the Striped Bass (*Roccus lineatus*), and the Shad (*Alosa sapidissima*). This fish is dealt with quite in wholesale fashion, the figures quoted being really marvellous, as many as 16,062,000 of young shad being distributed, a complete record being kept of the places to which they were forwarded; in the previous year the distribution of this fish reached the figure of fifteen and a half millions. Among the distinctive articles contributed to the present volume are some of rare importance; we may refer to that by Prof. Barlow on "The Marine Algæ of New England," which is both interesting and exhaustive; it extends to 210 pages of the volume now before us, and is illustrated by a series of well-executed drawings. Another paper of importance, full of curious information, is that of Mr. A. E. Verrill, "On the Cephalopods of the North-east Coast of America"; it is also profusely illustrated with fine drawings. "The Propagation of the Eel" is a contribution which is sure to attract attention; the article is by Dr. Otto Hermes, and was read before the German Fishery Association; although brief it contains many features of interest in connection with the natural history of the curious animal of which it treats, and describes most distinctly the differences of the two sexes. The author of this paper announces that the old eels, both males and females, die soon after the spawning season; "the extraordinarily rapid development of their organs of generation exhausts them to such a degree that they die soon after having spawned." This is the reason why they are never seen to return to the rivers. Among the miscellaneous contents of the present report will be found instructive essays on the food of marine animals, by Prof. E. Möbius. In the appendix will be found a very readable account of the herring fisheries of Iceland, as also a short treatise on the fisheries of the west coast of South America. One of the most scientific papers which is given is one containing a reprint of a series of extracts from the investigations of the Commission for the Scientific Examination of the German Seas—it contains much that will prove of interest both to naturalists and economists. It may be safely said alike of the present and the preceding reports, that they contain a mass of information on fish and fisheries of a kind which has never been before brought to a focus, and in issuing such a guide to all interested, the United States Government has set us an example which we ought at once to follow. The volume is published at Washington, and is printed at the Government Printing Office.

LETTERS TO THE EDITOR

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

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

Cyanogen in Small Induction Sparks in Free Air

AMONG the "Notes" in NATURE for July 19 (p. 281), where the products of combustion are given for various illuminants in common or uncommon use, and where coal-gas, oils, and candles have a fearful amount of both water-vapour and carbonic acid charged against them, the return for electric lights both in the arc and incandescent shapes is given as 0·0 for each; a return which is there considered to show "the great supremacy of electric lighting over all the other methods of illumination when considered as a matter of health."

Now this I believe is most happily true of the incandescent electric lights hermetically sealed in their vacuous glass globes; but who, on second thoughts, would presume to say that it is so with the arc lights, consuming their carbons visibly in the open air? The solid carbon gradually disappears from view, every one allows, and if it has not combined in gaseous condition with the oxygen of the atmosphere, like that of wax candles, it must have mainly combined with the nitrogen, and formed the far more deleterious compound gas, cyanogen, the basis of prussic acid: and that such gas or hydrocyanic acid is produced in the electric arc was set forth by Prof. James Dewar in the *Royal Society Proceedings* for June 19, 1879.

Leaving the great arc lights, therefore, to such a master of the subject, chemical, physical, and electrical, as the Jacksonian Professor in the University of Cambridge, I would request to be allowed to mention here a spectroscopic proof, which I have not seen mentioned before, that cyanogen is also formed in every induction electric spark worked under atmospheric pressure.

In plate 1 of M. Lecoq de Boisbaudran's admirable "Spectres Lumineux" he gives beautifully engraved views of the spectrum of the induction electric spark first at the positive pole, then at the negative pole with a "mean length" of spark, which was in his case probably about one inch; its extreme length with his induction coil and bichromate battery, in its best condition, being two inches.

Now the spectrum he gives for the positive pole is neither more nor less than the low temperature spectrum of nitrogen; that is as we see nitrogen in a gas-vacuum tube, with all its numerous and delicately shaded bands as such, though it is bioxide of nitrogen according to M. Thalén.

But the spectrum which M. Lecoq de Boisbaudran gives for the negative pole has in addition to the above, and besides the red hydrogen line, a number of other most distinct lines and bands, including one line in the violet, which he dignifies with the letter α, and which is certainly the grandest thing in the whole spectrum.

In his printed pages I do not find that the celebrated French spectroscopist gives any explanation of the origin of either that line or the other supernumeraries, the hydrogen line excepted. But on turning to my own paper on "Gaseous Spectra" printed in vol. xxx. of the *Transactions of the Royal Society, Edinburgh*, in 1881, I find on pp. 119 and 122, last column, that almost every one of the lines and bands which I had separated there from the impurities or dissociated elements of the tube's contents and had put down as due to the compound gas "cyanogen" is coincident in place and character with some one or other supernumerary in M. Lecoq de Boisbaudran's spectrum of the negative pole. My spectrum places are indeed very rough, owing to the small amount of dispersion then employed, viz. one simple prism of white flint with a refracting angle of 52°; but the testimony of the whole is cumulative, and, considering

Spark at the Negative Pole in the Open Air by M. Lecoq de Boisbaudran, with a rather Wide Slit

Colour Region.	W. N. Place approx. in Brit. inch.	Intensity approx.	Appearance approx.	Description.
Orange	41,300	2		Narrow band.
Citron	44,850	3		Stronger band with hazy line.
Green	48,600 / 49,300	4		Group of bands and hazy lines.
Green	50,100 / 50,800	3		Broad band with stronger edges.
Glaucous	53,800 / 54,700	4		Larger and stronger than the preceding.
Blue	55,200	2		Very thin line.
Violet	**59,400**	**8**		**Most powerful line, the α of the spectrum.**
Violet	59,500	5		A darkening of the nitrogen band.
Violet	59,900 / 60,400	5 / 5		Broad band, with strong terminal bars.

Cyanogen's Concluded Spectral Lines by C. Piazzi Smyth, with a rather Narrow Slit

Colour Region.	W. N. Place approx. in Brit. inch.	Intensity.	Appearance.	Description.	Reference page.
Orange	41,146	2		Cyanogen?	121
	41,552	2		Cyanogen	
Citron	44,878	2		True cyan. group	120 & 121
Green	48,582	4		Sharp line begins a band of lines.	120
	49,350	3		Isolated line.	120 & 122
Green	49,996	2		Cyanogen.	120 and 122
	50,728	3		Do.	
Glaucous.	53,963	3		Not nitrogen nor carbon.	122
	54,570	2		Cyanogen?	
Blue	55,271	2		Cyanogen?	120
Violet	**59,405**	**5**		Grand line, followed by a band, characteristic of cyanogen.	120 & 122
Violet	59,985	2·0		Cyanogen.	120 & 122
	60,356	0·2		Cyanogen?	
Violet	60,541	1·0		Nitrogen?	

the totally independent manner in which my results were arrived at, and the certainty with which they were stated on their own merits, perfectly overwhelming.

Thus—of the line which I now identify with that one which is *facile princeps* in M. Lecoq de Boisbaudran's spectrum of the negative pole, and was therefore termed *α* by him, though to the confounding of his series of Greek letters in the positive pole's spectrum—I wrote of it in 1880 as "grand line peculiar to cyanogen," "the powerful violet line (viz. the above) at 59,405 W.N.B. inch, may become useful as a reference for place to many observers," and "grandly strong violet line, followed by a band; specially characteristic of cyanogen."

But a better view of the testimony of the whole case will be found in the above pair of tables, in the first of which I have collected, in a rude way of my own, all the lines and bands which are supernumerary in M. Lecoq de Boisbaudran's negative, as compared with his positive, pole; and in the second I have entered my former conclusions from gas-vacuum tube observations of what spectral lines and bands are peculiar to the compound gas cyanogen. C. PIAZZI SMYTH

15, Royal Terrace, Edinburgh, July 25

The Earliest Known Plotting Scale

THE Babylonian statues recently acquired for the Louvre by the mission of M. de Sarzec are of great interest in the history of measurement. The earliest datable measuring rods hitherto known are two Egyptian masons' cubits of wood, of the reign of Hor-em-heb in the fifteenth century B.C.; but on these statues we find represented not merely a mason's rod, but a finely-divided plotting scale, and the date of these figures is placed before the fifteenth century B.C. Of course the accurate lengths of cubits can easily be recovered from the dimensions of buildings of the earliest periods; but no measures, or accurate representations of such, are preserved to us from the primitive times.

There are several of these diorite statues of King Goudea in the Louvre, some rather less and some rather more than life size; all finely executed in a style superior to anything of the later times from Mesopotamia, with which we were already familiar. They are wrought by means of tubular drills and graving tools, by which lengthy and delicate inscriptions are cut all over the surfaces; the tools employed seem to have been very similar to those used by the early Egyptians for their statuary in diorite, which I recently described at the Anthropological Institute.

The statues which now concern us are two seated figures of an architect (or perhaps the king, as founder); these each bear on the knees a drawing board, 6·3 × 11·3 and 7·4 × 12·7 inches respectively. One board is plain, the other has an elaborate outline of a fortified town, showing all the buttresses and turns of the wall. By the right hand of each figure lies a drawing stylus, and along the front of each board a plotting scale, subdivided along both outer and inner face.

These scales have a sloping face along each side, like modern scales, but meeting in a ridge at the top, like French plotting scales, without a level space. The breadth is ·90, and height ·33 inch, sloping therefore about 36°; the length is just over 10½ inches, or half a cubit, the terminals being lines, with a small surplus beyond them.

The subdivisions vary on the different sides; but the general arrangement is a uniform series of spaces, which we will call digits; these are each $\frac{1}{16}$ of the half cubit, or ·653 inch. Then along one side of each rod the *alternate* digits are subdivided; thus there can be no confusion between digit lines and subdivisions. The dividing lines run the whole width of the face; they are about $\frac{1}{50}$ inch wide, and scored out nearly as deep into the diorite. The subdivisions are of halves, thirds, fourths, fifths, and sixths of a digit; and two sixths are carried over to the other side of the scale, and there further divided into twelfths and eighteenths of a digit; this last fraction being only $\frac{1}{28}$ of an inch.

By calculating a normal scale from the various digit lines (as described in "Inductive Metrology," p. 31) the average error of division may then be computed. It is about the same for the digits and also the subdivisions, varying on different sides from ·009 to ·013 inch; the mean error of all the digit marks is ·011 inch, or about half the breadth of a cut. But it is not to be expected that mere decorative representations like these would be divided with the same care as actual working scales. The mean value of the cubit deduced from these scales is 20·89±·07 inch, which is apparently a long variant of the old 20·63 cubit, and not the later Assyrian cubit of 21·4 or 21·6.

The actual values of the divisions of the two sides of each scale are as follows, stating the amounts as differences from the normal scale in thousandths of an inch, which enables the variations to be most plainly seen. The points measured were about one-third from the bottom edge toward the top ridge.

Normal scale.		Without the plan.				With the plan.			
Digits.	Subdivisions	Outer.		Inner.		Outer.		Inner.	
		+	−	+	−	+	−	+	−
0		(. . .)		12		(. . .)		(. . .)	
·653			15		2	(. . .)		(. . .)	
1·306		(. . .)			20	(. . .)		(. . .)	
1·959		(. . .)			8	(. . .)		(. . .)	
2·612		(. . .)			26	(. . .)		(. . .)	
	$\frac{1}{2}$ 2·938	28		. . .		(. . .)		(. . .)	
3·265			9	2		12		11	
3·917			3	2		. . .		25	
	$\frac{1}{2}$ 4·244	. . .			9	. . .		18	
4·570		(. . .)		. . .		. . .		7	
5·223		(. . .)			8	. . .			11?
	$\frac{1}{3}$ 5·441	. . .		2		. . .		(. . .)	
	$\frac{1}{3}$ 5·658	. . .		4		. . .			1
5·876		(. . .)		4		. . .			1
6·529		(. . .)			5	. . .		8	
	$\frac{1}{4}$ 6·692	. . .		21		. . .		6	
	$\frac{1}{4}$ 6·855	. . .		25		. . .		3	
	$\frac{1}{4}$ 7·018	. . .		18		. . .			1
7·182		7		58			8		10
7·835		1		4		. . .		(. . .)	
	$\frac{1}{5}$ 7·966	. . .		3		. . .		8 ?	
	$\frac{1}{5}$ 8·096	. . .		2		. . .			7
	$\frac{1}{5}$ 8·227	. . .			3	. . .			13
	$\frac{1}{5}$ 8·357	. . .			5	. . .			22
8·488		11		0		. . .			7
	$\frac{1}{2}$ 8·814	. . .		. . .			25	. . .	
9·141			7		12		6		2
	$\frac{1}{6}$ 9·249	. . .			7	. . .			4
	$\frac{1}{6}$ 9·358	. . .			27	. . .			4
	$\frac{1}{6}$ 9·467		14		11	. . .			8
	$\frac{1}{18}$ 9·503		13	. . .		. . .		. . .	
	$\frac{1}{18}$ 9·539		11	. . .		. . .		. . .	
	$\frac{1}{18}$ 9·576		6	0		. . .			19
	$\frac{1}{6}$ 9·685	4		20		. . .			12
	$\frac{1}{12}$ 9·739	14		. . .		. . .		. . .	
9·793		19		20		(. . .)			21
10·446			5		24	(. . .)		(. . .)	

The plain dots show that there was no mark; the dots in brackets where a mark is defaced, or the whole surface destroyed. The great error of ·058 inch is due to a cut run askew, the line being as accurate as the others on the outer face of the rod.

I am indebted to M. Ledrain for kindly granting me permission to take the measurements from these statues.

Bromley, Kent W. M. FLINDERS PETRIE

A Result of our Testimonial System

A LITTLE incident has come under my notice of such a character that I think it ought to be made known to the readers of NATURE.

A candidate, whom I will call Mr. A. B., for a vacant scientific chair in this country writes to an eminent German professor for a "testimonial," and in his letter there occurs the following remarkable sentence:—

". . . 17 *July*, '83

"DEAR SIR,—I intend applying for the vacant chair of . . . at . . ., and would feel grateful if you could send me a testimonial saying a few favourable things of my contributions to the science of . . .

". . . I hope that you will not think me too bold in asking this request, and as I know your time is too valuable to be trespassed on by a stranger, *I beg that you will accept the inclosed*."

The German professor, whom I will call Prof. C., thereupon writes to a distinguished English professor, who is a personal friend of his, the following letter, which has been placed in my hands with the request that I will add a few comments. The letter, which I give in its original language in order that none of its force may be lost, runs as follows:—

". . . 23 *Juli*, 1883

"Verehrter Herr College,—Ihre freundliche Gesinnung gegen mich, ermuthigt mich, Ihnen folgenden Fall vorzutragen, mit der Bitte möglichst viele Ihrer Herrn Collegen und, wenn Sie es für gut halten, auch die Presse davon in Kenntniss zu setzen.

"Ich hatte schon öfter aus England Briefe erhalten von Candidate für irgendwelche . . . Professur mit der Bitte ein Zeugniss ueber ihre Leistungen anzustellen. Ich habe, da mir diese Art der Bewerbung, wie sie in England leider gebräuchlich ist, im höchsten Grade zuwider, meist derartige Schreiben gar nicht beantwortet. Neulich erhielt ich nun aber einen Brief aus . . . von einem gewissen . . . der an Schamlosigkeit Alles uebersteigt, zum Mittel der Bestechung greift. Es klingt unglaublich, aber Herr . . . ist so schamlos, mir als Preis für ein Empfehlungschreiben *Geld anzubieten*. Damit Sie sich selbst davon ueberzeugen können, sende ich Ihnen das Original mit der ergebensten Bitte mir dasselbe nach gewonnener Einsicht bezw. Abschrift, wieder zurückzusenden. Eingelegt war eine Anweisung auf 1 guinea! Letztere sende ich heute ohne Brief recommandirt an . . . zurück. Ich habe Beider hier meinen Freunden gezeigt und werde auch vor Zeugen die Rücksendung der Anweisung auf 1 Guinea vornehmen.

"Ich glaube, verehrter Herr College, dieser Fall ist dazu angethan, weiteren Kreisen mitgetheilt zu werden, um zu verhindern dass ein solch erbärmlicher Mensch wie . . . etwas die Stelle in . . . erhalte. Ihnen im voraus für Ihre Mühe dankend mit vorzüglichste Hochachtung.

"Ihr Ergebenster, . . ."

I imagine that all Englishmen on reading the above will, like myself, be filled with shame that any one speaking our tongue should have laid himself open to such a rebuke.

At the same time it seems to me quite possible that Prof. C.'s view of the matter is unduly severe and indeed unjust. I do not know Mr. A. B. personally, and am quite ignorant of what character he bears; but I can conceive that he has fallen into this disgrace through a clumsy attempt to carry out to its logical conclusion our English system of testimonials. He can hardly have thought that so distinguished and successful a man as Prof. C. could be *bribed* to say something handsome by a post-office order for *one guinea*; and he cannot be so ignorant as not to be aware of the just pride which all Germans feel in the integrity and honour of their professoriate; it is quite open for us to suppose that he was really offering Prof. C. *a fee for a professional service*. And really when you come to think of it, this is a point of view for which something may be said. Only last week, in talking to a colleague about testimonials, I asked him how many testimonials he wrote on an average a week. He replied that he thought *not more than a dozen or fifteen*. In fact when a man, especially one who has spent some years in teaching, has acquired a certain reputation in science, the tax upon his time and energy for the skilful composition and writing of appropriate testimonials amounts during his lifetime to a something which, converted at the market value of his powers into pounds, shillings, and pence, would appear no mean sum.

Now—and this is the kernel of the matter—no one would grudge time spent in assisting a deserving man to get into a place for which he was fitted; but our testimonial system has nowadays reached such dimensions that only a few of the testimonials written have this end in view. I am writing freely, because this is a very serious matter, and one which I have much at heart; I therefore do not hesitate to say, what indeed is well known, that great skill has been reached by many in the art both of writing and reading testimonials. Many testimonials are framed after that well-known formula for acknowledging the receipt of pamphlets which runs as follows:—"Dear Sir,—I beg to thank you for the valuable pamphlet which you have so kindly sent me, and which I will lose no time in reading." And I heard the other day a testimonial praised because it showed the electors whom not to elect.

Surely the time has come to consider whether this plague of testimonials (for it is hardly less) cannot in some measure be stayed. At all events, cannot in higher places at least some steps be taken to mend matters? When such a post as a professorship is vacant, it is the duty of the electors to make themselves acquainted with the manner of man wanted and to find him; our present plan lays upon all persons connected with the subject of the chair the burden of trying to enlighten the electors as to the claims of this or that candidate. A passage in Prof. C.'s letter shows how degrading the Germans think our method; and it is not agreeable to Englishmen to read such passages. Yet every one who has had to struggle for a post with testimonials must feel that such criticisms are just, and that the process is one distasteful to a right-minded man. And it is also unnecessary. I, for one, would rejoice to see the German system of a "call" introduced into our professorial elections; but if we cannot obtain this, let us at least do away with testimonials. In the recent elections at the University of Cambridge, the following significant phrase occurred in the announcements of the vacancies: "testimonials, *if any*, to be addressed, &c."; and as a matter of fact, in the cases of the four chairs recently filled up on the new system, the man chosen in each case had sent in no testimonials. Why cannot this be done in all elections to professorial chairs? Where, as may sometimes be the case, the candidates are previously not all thoroughly known, the electors, by reference, formal or otherwise, can easily make themselves acquainted with their relative merits; and indeed, as I just now said, it is their duty to make such inquiries, and not simply to collate, interpret, and form their decisions on the curious documents which we call testimonials.

Hence, though I venture to send this communication to NATURE for the purpose of making an example of Mr. A. B.'s post-office order for one guinea, I cannot help thinking that he, though sinning, is also sinned against, and that our system of testimonials is to be blamed as well as he. M. FOSTER

Birds and Cholera

YOU ask in one of your "Notes" (p. 329), what can be the cause of birds leaving a locality before the approach of cholera? The following anecdote may be of interest, but I of course cannot vouch for its having any real connection with the subject. It must have been in the summer of 1848 that I was invited to meet a party at my uncle's house in the Close at Salisbury, on the occasion of the visit of the Antiquarian Society. On arriving I found the cholera raging, and the party put off. There were in the house only the gardener and his wife, whom, having been previously servants to my father, I had known from my childhood. The gardener told me that, just before the outbreak of the disease, the man whose duty it was to oil the vane upon the spire had made his annual ascent (of 404 feet), and had perceived a foul scent, which, it seems, had not been noticed below. The inhabitants connected this with the appearance of the epidemic shortly afterwards. Birds might no doubt be affected by such a circumstance. O. FISHER

THIS has been remarked before. It is recorded of the great outbreak of cholera at Salisbury in 1849—can any of your correspondents say where?—that an officer recently from India, happening to make the ascent of the Cathedral, exclaimed suddenly, "I smell cholera!" Immediately afterwards the outbreak followed, when it was observed that the birds (swallows are especially in my remembrance) had fled the neighbourhood. If these two incidents are to be trusted, it can scarcely be doubtful that there is a connection between them. HENRY CECIL

Bregner, Bournemouth, August 6

YOU will find a very interesting but rather sceptical paper on the supposed connection of birds leaving towns with invasions of cholera (NATURE, vol. xxviii. p. 329), by Pfarrer Häckel of Windsheim, in the monthly journal, *Der zoologische Garten* (Bavaria), September, 1873 (vol. xiv. p. 328), published by the Zool. Gesellschaft of Frankfort-on-Main. D. WN.

Freiburg, Badenia, August 4

Animal Intelligence

SEVERAL remarkable instances of intelligence in animals have been given in recent numbers of NATURE. Possibly the following instance of reasoning power in an elephant may not be without interest:—Some years ago I was ascending the lower part of the Darjeeling Hill Road, in the Himalaya Mountains, from Terai. At a certain part of the road, where we met a string of bullock carts, the outer few feet was encumbered by a long flat-topped heap of small rounded boulders, piled there to be broken up for road metal; from the outer edge there was a steep, almost precipitous, slope. On the inner side of the road was a small drain, and then a few feet of comparatively level ground between the drain and the slope above. The carts just mentioned were of the usual kind, the body (constructed of bamboo) about

12 feet long and 3½ feet broad, with the wheels near the middle, each cart being drawn by a pair of bullocks. The *mahaut* (driver) of the elephant I was riding having halted the animal close up to the heap of boulders, there was just room left between the elephant and the chain for the carts to pass. These carts were the ordinary vehicles of the country, and under ordinary circumstances an elephant would no more think of "shying" at them than a London dray horse would think of shying at a cab. Yet as the carts went by one by one my elephant became more and more uneasy, and finally, in spite of the efforts of the *mahaut* to restrain her, mounted on the heap of boulders, at the risk (which, considering how cautious elephants are in treading on suspicious ground, I believe she must have seen quite as clearly as the *mahaut* or I) of rolling down the slope below the road, if the rounded boulders shifted and gave way beneath her weight. It was some time before I perceived the cause of her fear. Elephants, even in India, are uncommon, and bullocks, as well as other domestic animals, generally feel considerable dread of them from their unusual appearance as well as their size. The bullocks in question were greatly frightened at having to pass so close to the bulky brute, and several of them in passing tried to get away from her by jumping the drain. It required all the efforts of the drivers to prevent their doing it. The elephant evidently saw that the bullocks were frightened and that they were trying to jump the drain, and she further calculated that if they did so *the long tail of the cart would swing sharply round in the opposite direction* and strike her violently across the fore legs. Of the two risks she preferred that of mounting on the heap of boulders. F. R. MALLET

Calcutta, July

AS NATURE frequently contains notices of intelligence in animals, I have ventured to send you the inclosed note from the Reading local paper, as containing a remarkable fact regarding intelligence in a blind horse. The writer, Mr. Gostage, is quite trustworthy, and I have taken pains to verify the truth of his statements. JOSEPH STEVENS

128, Oxford Road, Reading, August 6

NOTE PUBLISHED IN THE *Reading Observer* OF AUGUST 4, 1883

Sagacity of the Horse

SIR,—A circumstance so fully illustrative of the sagacity of the horse was witnessed in the neighbourhood of Mortimer last Saturday, and reported to me through the owner, that I think it worth publicity. I can vouch for its truthfulness, and if any doubt arises I can introduce such doubter to the owner. The hor e under notice, an old blind one, belonging to a small tradesman and farmer, was turned out to graze on the common near the owner's house. For some cause it wound its way through lanes to the blacksmith's, where he had often been before. The entrance to the forge is difficult of access on account of the ditches on either side, but the animal reached it safely, took its stand by the forge, and then neighed. The blacksmith, being at work in his garden, and hearing a horse neigh, looked for it, and not seeing it, returned to his gardening operations. In a short time he heard it again, but could not see a horse anywhere, until he went into his shop, when he found it standing very quietly by the forge as if waiting to be shod. Thinking some one must have brought it there, the blacksmith looked at its feet, and found one with the shoe pressing into the frog, causing great pain. He then put on another shoe, and sent the horse back to its owner.

This instance of sagacity is so clear and telling that I thought it desirable to ask you, Mr. Editor, to publish it.

Yours truly,
S. GOSTAGE

King's Street, Reading, August, 1883

ACCOUNTS are not rare of female cats having adopted the young of other creatures when deprived of their own, or while nursing their own young, but I have never met with a case like the following:—

My tom cat, Smut, whose eighteenth birthday was lately celebrated, has always been kind to kittens; and a long friendship with a tame rabbit was only terminated by the death of the rabbit in consequence of eating too much plum pudding one Christmas. But his benevolence to feathered creatures was first shown in 1881, when, having a solitary chick hatched out of a clutch, I bethought me of making him useful as nurse, and with some fear put the chick into his basket. The experiment answered admirably, except that Smut sometimes licked the feathers the wrong way; and when about a fortnight afterwards the chicken was accidentally killed, it was curious to see its foster-father's search for it during the following three or four days.

Since then Smut has taken charge of as many as fifteen young chickens at a time, but he has never evinced the same affection for them as for his first feathered foster-child.

J. DE B. F. P.

The Orphange, Wandsworth Road, August 7

Different Sources of Illumination

IN your issue of July 19 you give in the "Notes" (p. 281) some interesting data as to the products of combustion and heat produced by different sources of illumination, each being of 100 candle-power and giving off this light for one hour. This is valuable information, and I am sure that others besides myself would be glad if you could give a reference to the authority. I would also suggest that it would be interesting to have a comparative authoritative statement as to the carbonic acid and heat produced in the same time by an average human being. I was told the other day by a mining engineer that he finds that one oil-lamp contaminates the air to the same extent as one miner when at work. It is often stated that one gas-burner in a theatre is as deleterious as six members of the audience. If the true state of the case were published in your columns, it would be interesting to many. GEORGE FORBES

34, Great George Street, Westminster, July 20

[The information is based on an article in *La Lumière Électrique* for June 16.—ED.].

A Remarkable Form of Cloud

AN account, which will I believe be found satisfactory, of the formation of the type of cloud described in NATURE (vol. xxviii. pp. 299, 320), will be found in a paper read by me before the Meteorological Society on June 20 last, and which will be published in the next *Quarterly Journal* of the Society. The paper is on "The Structure of Cirro-filum, or Ice-cloud disposed in Threads." A very valuable contribution to our knowledge on this subject will also be found in an article by Dr. Linn ("Ueber die Entstehung der Wolkenstreifen," *Zeitschrift für Meteorologie*, xviii. 52), to which I would refer those of your readers who are interested in the topic.

The cloud is very common, and regular reports of the direction both of movement and of "filature," elements of very considerable value in the prognosis of weather, have been, for some years past, sent to the Meteorological Office by a limited number of observers. W. CLEMENT LEY

Disease of Potatoes

WHEN I read the note from *Naturen* in NATURE, vol. xxviii. p. 281, it appeared to me that Herr Anda was describing the same effects in the potato stalk as had been described by Berkeley in 1846. In his description of the usual potato disease Berkeley says:—"The stem now rapidly putrefies, the cuticle and its subjacent tissue become pulpy, and separate when touched from the woody parts beneath. The whole soon dries up, and in many instances exhibits in the centre the black, irregular fungoid masses which are known under the name of *Sclerotium varium*, and which are believed to be the mycelium of certain moulds in a high state of condensation."

Now the *Sclerotium varium* grows exactly as described by Herr Anda; but so far as it has appeared here, it does not seem to be truly parasitical, but only begins to be developed on the potato stalks when they are dying down of the common disease. Whether this *Sclerotium* is the same as that referred to by Mr. W. G. Smith (NATURE, vol. xxviii. p. 299) I do not know, but probably it is. He says he did not get his to germinate; while Herr Anda describes the fruit of the *Sclerotia* found at Stavanger.

From "pink eye" potato stalks of last year I threshed out a quarter of a pound of *Sclerotium varium*, and at the present time I have hundreds of specimens germinating in the way Herr Anda describes; one stalk only has yet come to what I regard as the perfect fructification, having developed at the apex a beautiful little cup; but about a score of others of those first laid on wet cloth are beginning to give distinct evidence of the production of cups. The probability at present is that *S. varium* is the Sclerotium of a Peziza, nearly allied to *Peziza tuberosa*.

A. STEPHEN WILSON

North Kinmundy, Aberdeen, July 30

P.S.—Since the above was written I have discovered amongst growing potatoes great numbers of *S. varium* with the completed fungus attached to them. It is a yellowish-brown Peziza of various diameters up to half an inch. I send you a box of specimens.—A. S. W.

"Zoology at the Fisheries Exhibition"

IN NATURE, vol. xxviii. p. 289, is an article upon the zoology of the Fisheries Exhibition, in which the writer states that some of the corals exhibited by Lady Brassey belong to me and are not that lady's property. Will you permit me to emphatically assert that not a single coral in the case belongs or ever did belong to myself, and that every specimen was procured by Lady Brassey during her voyages in the *Sunbeam*.

What is meant by the words "gratuitous inventions" I cannot understand; the new species were carefully compared with those in the British Museum, also with those obtained during the *Challenger* expedition, and with the works of Lamarck, Dana, Milne-Edwards, Moseley, and others.

It is possible that the commissionaire in charge may have, in dusting the collection, shifted some of the labels, but the fact remains that Lady Brassey's collection of corals is the only one in the Exhibition which gives any information either upon the nomenclature or habitat of the specimens exhibited.

204, Regent Street, W., August 4 BRYCE-WRIGHT

"The Student's Mechanics"

I HAVE no wish to quarrel with the review you have printed of my book, "The Student's Mechanics;" and I have to thank the reviewer for drawing attention to one omission, namely, the failure to explain fully the second law of motion, as related to the two methods of measuring force. But I should be glad to be allowed a few words to explain my treatment of Accelerating and Moving force. One of my objects was to clear away, by full explanation, the confusion which no doubt sometimes exists as to those terms; and this I could not have done if I had omitted them altogether. It will be long before a reader of works on mechanics can safely remain ignorant of their meaning; and indeed the discussions of force as causing change of velocity simply (as in kinematics), and as causing change of momentum, are still kept so much apart that terms to indicate the distinction do not seem out of place. Nor do I see any confusion likely to arise between "acceleration" and "accelerating force": the one is the actual change of velocity in a given time, the other is the force which causes that change. The latter is measured by the former, but it is not the same thing. In Art. 422 the word "accelerating" is simply used in opposition to "retarding," in the sense of that which increases velocity instead of diminishing it: I know no other word in use for the same purpose. Lastly, the proof in Art. 359 was given precisely to supply the omission to which your reviewer calls attention, and which does exist in the ordinary proofs that no velocity is lost in passing round a smooth curve. I there show that the sum of such losses, in a given time, is indefinitely small compared with the sum of another set of quantities, which sum is itself finite; hence the first sum may properly be neglected. WALTER R. BROWNE

Sand

AS explained in my note on p. 245, I had not the advantage of perusing Mr. Waller's paper on "Sand." Mr. Gardner, in his notice of it gave the first place to "distinguishing with certainty by the aid of the microscope sand that has been worn by the action of wind from sand that has been for long exposed to surf, and this again from sand brought down from torrents." I assumed this was its primary object. In this I am in error. Mr. Waller says his "paper was to show that chalk flints had scarcely any place in the formation of sand." Had I known this was the purpose of his writing I would not have troubled you with any remarks, as I entirely agree with Mr. Gardner when he says, as in p. 225: "The coast-line occupied by flint shingle is almost limited to portions of Western Europe, and is relatively insignificant."

I am glad to learn that Mr. Waller has a more comprehensive object in view, and that a large series of sands from modern and ancient formations are being examined microscopically, and shall be glad to supply portions of specimens of the soils and subsoils of Australia and New Zealand which contain sand, and were examined under the microscope ten years ago, to compare their form and appearance with similarly situated soils from Europe. JAMES MELVIN

Treble Primary Rainbow

ON Sunday, July 15, as a heavy thunderstorm was passing away from over this place, a brilliant rainbow appeared a little to the south of east about 5.45 p.m. There was a complete primary arch and a nearly perfect secondary one, and on being led to examine the former in consequence of its appearing unusually broad, it appeared to be made up of three bows, one directly below the other. The red of the spectrum being repeated three times was what drew my attention to this point. The two lower bows appeared smaller than the top primary arch. Thinking I must be suffering from some optical illusion, I got my wife, brother, and my little girl of nine, all to look carefully at the rainbow, and found that they all saw three distinct bows in the primary arch, in addition to the secondary arch. Is not this an unusual occurrence? R.

Bexley, Kent, July 21

[This is merely the well-known phenomenon called *spurious bows*, which has not yet found its way into the "popular" class of text-books, though the principles of its explanation were long ago pointed out by Young. The full theory was given by Airy, and found to coincide with the very exact measurements of Hallowes Miller. When the raindrops are all of the same size, each wave-length in the rainbow has one principal maximum with an infinite number of subsidiary maxima of rapidly-decreasing brightness. These lie *inside* the chief maximum in the *primary* rainbow, and outside it in the secondary.—ED.]

FUEGIAN ETHNOLOGY

IN Guido Cora's *Cosmos* for May, 1883, Lieut. Bove, of the Italian Antarctic Expedition, supplies some interesting details on the little known inhabitants of Tierra del Fuego, amongst whom he spent some time in the spring of the present year. He speaks highly of the English missionaries stationed at Ushiwaya, in Beagle Channel, who have succeeded in introducing a few rudimentary notions of human culture amongst several tribes hitherto supposed to be quite irreclaimable. As had long been suspected, the archipelago is found to be occupied not by one but by three distinct races, the Alacalufs in the west, the Onas in the east, and the Yagans in the south. Of these the Yagans, who stretch from the north side of Beagle Channel southwards to Cape Horn, appear to be the true aborigines. They have been driven to the southernmost and most inhospitable islands by the Onas and Alacalufs, both intruding from the mainland. The Onas, who are clearly of Tehuelche origin, penetrated from Patagonia across the eastern arm of Magellan Strait, into the large island of King Charles South Land (Eastern Tierra del Fuego), which they now hold almost exclusively. In the same way the Alacalufs, of Araucanian stock, made their way from the Chilian Andes, across the western arm of Magellan Strait, into the western islands, which they now occupy from Cape Pillar to Stewart Island, at the Pacific entrance of Beagle Channel. They number scarcely more than 2000 altogether, while the Yagans and Alacalufs are estimated by the English missionaries at about 3000 each, giving 8000 for the whole archipelago.

Although now representing the most aboriginal element, the Yagans themselves would appear to belong originally to the same Chilian family as the Alacalufs, the points of difference being easily explained by their longer isolation from the parent stock and by the more unfavourable climatic conditions of their present homes. From numerous measurements taken by Bove, they seem to be much below the middle height, although still nearly as tall as the Araucanians of the mainland. Of these the average stature, according to D'Orbigny, is 5 feet 3 inches, while the Yagans range from 4 feet 10 inches to 5 feet 4 inches, and the women from 4 feet 9 inches to 5 feet. But in other respects they present a more debased appearance than their continental congeners, being distinguished by low brows, prominent zygomatic arches, large pendent lips, flat nose, round face, loose, wrinkly skin ("pelle grinzosa e cadente"), thin extremities, the legs curved outwards. The black hair is of the usual American texture, coarse, lank, and long, but in one district chestnut and wavy, due, no doubt, to mixture with white blood.[1]

They neither tattoo nor paint the body, which is exposed almost naked to the inclemency of an excessively rigorous and stormy climate. In this respect the Fuegians present a striking contrast to the Eskimo at the opposite extremity of the continent, the general cut of whose warm and comfortable attire may, according to Mr. E. B. Tylor, be due to the influence of the old Norse settlements in Greenland. Although Bove gives us two distinct terms, *accar* and *tuma-chi* for *house* and *hut* respectively, the dwellings themselves are all alike described as wretched hovels, made of branches stuck in the ground and loosely bound together in the Botocudo fashion. More skill and care is displayed in the construction of their beechwood canoes, which are generally from fifteen to twenty feet long and about two feet wide. In these frail craft they navigate the intricate channels of their storm-swept waters, and boldly pursue the whale and dolphin often far out on the high seas beyond sight of land ("spesso fuori dalla vista d'ogni terra"). Here, however, it may be well to remember that similar statements were constantly made of the Andaman islanders until Mr. Mann recently showed that in their light outriggers they never venture far from the shore.

Like the Araucanians the Yagans are polygamists, and, like the followers of the Prophet, they have generally four wives. But, while the Araucanians purchase their mates,[2] the Fuegian bride is provided with a dowry consisting usually of a canoe and a few harpoons. Nevertheless all the hard work, such as fishing, hutbuilding, the kindling and preservation of fire, falls to the share of the women, who in return meet with nothing but the most brutal treatment from their helpmates. "How often," writes Bove, "have I seen men seated cosily round a good fire, while the wretched women remained exposed to the snow, wind, water, fishing for their idle and unmannerly husbands!" Notwithstanding their hard lot the women are exceptionally fruitful; but, on the other hand, a small percentage only of the children resist the severity of the climate. They leave the paternal roof at a very early age, and begin to shift for themselves *before* reaching their teens. In fact family ties can scarcely be said to exist, and the only affection of which the Fuegian seems capable is "self love." "How often," again remarks the Italian explorer, "have I seen the father devouring a hunch of meat or bread, while round him stood wives and children, their eyes riveted on the food, with features distorted by hunger, rendered all the more painful at sight of others being sated, timidly gathering the scraps dropping from his lips, and falling rabidly on the remnants of the feast contemptuously thrown to them by the ferocious head of the household!"

Each family circle lives apart in absolute independence, combining only in small tribal groups for the purpose of mutual defence against some common enemy. Thus it is that the first germs of the community are sown by the necessity of self-preservation, just as the fully organised society is still kept together by the same overruling principle. But in the Fuegian community the idea of headship has not yet been evolved. No one claims the right to assume the chieftaincy, or to meddle in the concerns of his neighbour. Hunting or warlike excursions are arranged by common consent, and the spoils of war or the chase are equally distributed amongst the members of the expedition. Certainly the Fuegian social system seems to favour the views of those, rather, who hold that everywhere the commonwealth preceded oligarchy and the monarchy. As the monotheistic conception was arrived at through pantheism and polytheism, so in the social order the autocrat appears as the final outcome of a rude communism and πολυκοιρανία.

The Yagans, however, seem to have scarcely reached the pantheistic, or perhaps it would be more correct to say the pananthropomorphic, state. Religious notions, in the strict sense, cannot be said to exist where no clear distinction has yet been drawn between the natural and supernatural. Even with superstitious ideas they are but little troubled ("sono pochissimo superstiziosi"), while their indifference to the remains of the dead would seem to imply that they have no anticipations of an after life. To the naturalists of the Italian expedition they freely parted with the crania of fathers, friends, and relations, without the least outward symptoms of regret. In one instance, however, a good deal of sentiment was expressed by a young Yagan, who thus somewhat poetically addressed the skull of his father: "Farewell, dear father. You, who when alive never saw aught but our snows and our storms, are now going dead far far away!" This is the language of one, in whom at least dim visions of another existence seem to be dawning.

Considering the extremely low state of their culture, it requires a considerable degree of credulity to accept the statement that their agglutinative language possesses some 30,000 words, besides highly complex and elevated grammatical forms ("ha circa 30,000 vocaboli, e forme grammaticali molto complesse e elevate"). This is naturally regarded as a sure proof that the Yagans have had a much higher origin than might appear from their present debased condition. But it will be safer to await further proof before accepting the statement at all. Reserve is the more needed that we are told somewhat mysteriously that this linguistic phenomenon *was very little studied* by the explorers ("femoneno notato, quantunque pochissimo studiato, dei nostri esploratori.") It is also curious that, with such a copious vocabulary, of which a few specimens are given, the same word *yash* should have to do duty both for *hand* and *finger*, as well as for *head*, this last, however, doubtless as a homophone, or else through one of those mistakes which cannot always be avoided even by *careful* students of barbarous languages. The numerals do not seem to get beyond *five* (cu-pash-pa, an obvious compound), which is again somewhat inconsistent with a vocabulary of 30,000 words! But we may soon expect further light to be thrown upon this point by the English missionaries, who are doing such excellent work among the Yagans of Beagle Channel, and whose labours will doubtless soon be extended to the whole of the Fuegian Archipelago. A. H. KEANE

[1] With this description may be compared that of the fourteen Araucanians now encamped in the Jardin des Plantes, Paris, and figured in the *Illustration* of July 28, 1883. The low brow, high cheek-bone, flat nose, lank hair, and general flat features give to both races a common Mongoloid expression, such as is distinctly seen in the Guarani, Tupi, Botocudos, and so many other South American peoples. This expression seems in fact almost more pronounced in the southern than in the northern races of the New World, and it is certainly remarkable that the physical appearance of the Araucanians and Fuegians should be even more suggestive of an Asiatic origin than is that of the Eskimo and Athabascan groups.

[2] "L'Araucanien peut prendre autant de femmes qu'il en peut nourrir et payer aux parents, car les femmes s'achètent."—*L'Illustration*, July 28, 1883.

THE ISCHIAN EARTHQUAKE

THE report from the Central Observatory, by Prof. de Rossi of Rome, shows that signs of the coming catastrophe were not wanting at the different meteorological stations. What follows is, according to the *Daily News* correspondent, the most interesting part of Prof. de Rossi's report.

"Several days before the 25th and 28th July the microcosmical instruments at Rocca di Papa and connected microphones in Rome showed a great increase in subterranean activity. The earthquake which took place at Cosenza and Catanzaro on July 25 seemed to be the one predicted by those movements; but their continuance and increasing force showed clearly the approach of a new dynamic effort. Science, however, cannot yet determine the topographical point menaced by such effort, because we have not a sufficient number of observatories, and they are especially wanting in the places where the manifestations of the subterranean forces are most to be feared. Thus we could only suspect the direction of the movement, and gather from the daily observations made here and there in Italy that the seismic activity has concentrated in the southern part of the peninsula. The earthquake of Saturday, July 28, was registered by the seismographs in Rome, Velletri, and Ceccano at 9.30 p.m., with slow waves from north to south and east to west. The other instruments, which register quick and abrupt movements of the ground, remained quiet. As far as can be gathered from the observations till now made, this earthquake was an exact but more extensive repetition of that of March 4, 1881, and those just preceding, confirming the previsions and data collected at that time. It is deplorable that my advice respecting the institution of regular observations in those parts was not followed, as such observations would certainly have given warning of the imminent catastrophe. I gave that advice not only immediately after the catastrophe of March 4, but also on my visit to Naples at the Meteorological Congress. In consequence of that visit I wrote in the name of the Observatory to the director of one of the chief baths in Ischia, begging him at least to undertake daily note of the temperature of the thermal waters and the state of the fumarole (natural apertures from which issue smoke and steam). Alteration in the temperature of thermal-mineral springs, when that alteration exceeds certain limits, is one of the surest signs of a subterranean storm, and such alteration has always been noticed at Casamicciola, even without regular scientific observations. This time, as often before, the drying up of wells, subterranean thunder, and slight oscillations of the earth, have preceded the catastrophe, which shows what valuable indications might have been afforded by the delicate seismic instruments, the microphones, and telephones now at our command. The reluctance shown to follow my advice arose purely from a selfish fear lest the establishment of a meteorological observatory at Casamicciola should give an appearance of danger, and frighten visitors away. This false idea is so prevalent in the minds of even educated persons in the place that notices of the occurrence of small phenomena during the last few years have often reached me with great reserve, and very late. Let us hope that such a prejudice will not long continue to the damage of science."

The actual moment of the explosion has, according to the correspondent of the *Standard*, been variously stated. The clock in the Sala Belliazzi stopped at twenty-two minutes past nine, but it is generally agreed that the real time was fifteen or twenty minutes later—a singular detail, which has not been generally noticed.

Shocks of earthquake are reported to have occurred daily in Ischia since the 28th ult.

Prof. Palmieri states that all the later shocks felt at Ischia have been registered instantaneously by the seismographic instruments at the Observatory on Mount Vesuvius. On Friday morning, according to the Naples correspondent of the *Standard*, the instruments showed signs of considerable subterranean disturbance. Vesuvius was rather active, but the fear that a fresh crater was about to open immediately above Torre del Greco appears to be unfounded. Neapolitan passengers returning from Ischia appeared delighted to see Vesuvius blazing away in the distance. "Oh," said they, "so much the better; that may, perhaps, be a safety valve." Rossi and other observers, who differ from Palmieri on this point, predict nothing less than the reopening of the old crater of Monte Epomeo or the opening of a new one.

In making the tour of the hospitals on Wednesday, in order to collect the narratives of the wounded, the *Standard* correspondent found strong confirmation of the fact that there were signs of danger two or three days beforehand, which cannot have escaped the observation of the inhabitants of the island; but they were, unfortunately, he states, suppressed, in order to avoid giving alarm to the visitors, and so spoiling an unusually prosperous season. The Advocate Jeremiah Tonti, of Antria, Bari, who lies badly hurt in the Church of the Pellegrini, adjoining the great hospital, related to the correspondent that he had gone there with his wife to take the baths for rheumatism. The spring used comes forth from the ground so hot that it is necessary to temper it for the bath with one-fourth of cold water, but two days before the disaster the temperature of the spring rose so suddenly that it was found impossible to enter the bath until the supply of cold water had been largely increased. Dr. Dominico Bucco, who lies at the Hospital of the Pellegrini, says that the shocks at Forio and Lacco Ameno were vertical as well as undulatory, so that the floors of the houses fell in one upon another from garret to cellar, sometimes still leaving the outer walls standing. He was also conscious of a momentary whirling motion, as if being drawn into the vortex of a whirlpool.

A telegram from Athens states that a strong shock was felt at Piræus on Saturday last.

WE have received the following communication from Dr. Johnston-Lavis, of Naples :—

The island of Ischia is but too well known from the earliest historic times for the prevalence of earthquakes and even volcanic eruptions. In 1827 a shock destroyed the greater part of Casamicciola, some portion of Lacco Ameno, and injured Fontana Serrara, besides shaking severely Barano and Forio. On March 4, 1881, a quite similar shock to the former brought down a large number of houses and severely injured the rest. The present one occurred at about 9.30 on Saturday, July 28, and resulted in the absolute and total destruction of the whole town, most of Lacco Ameno, and a large part of Forio, Fontana, and Barano.

One remarkable fact is that the exact detailed area has been similarly affected in each case, so that the description of the earthquake of 1827 by Covelli, that of 1881 by myself, and the present would be much the same; the only difference being in intensity. The earliest killed under 50 people, the second 127, and the present will carry the number near a thousand.[1] The large increase of the deaths of the present one is due to its occurrence at the culminant point of the bathing season, so that the hotels were crowded with visitors; and the hour also found many of the peasantry going to bed.

The earthquake of two years since only ruined the worse built houses, and fissured the better ones, which were replastered and patched, so that the present shock has reduced every one to a heap of stones and mortar.

The shock was estimated to have lasted fifteen seconds, but a number of inquiries I have made as to what different persons had done to escape, and how the time was occupied between the first and last sensation, and the distance traversed during the movement, makes me believe thirty seconds nearer the point; for instance, one man awoke, jumped out of bed, stumbled over some furniture, opened the door, descended a flight of twenty steps, and when in the courtyard below still felt the movement.

The sound is said to have resembled a report followed

[1] Later information makes it near 5000.—ED.

by boob, boob -, boob —, boob ——, boob ———, boob ————, and so on.

In the short notice of the earthquake of March 4, 1881, I pointed out that the centre of the mesoseismal area or seismic vertical was at Casamenella, which occupies the same relative position to Epomeo as do Montagnone, Mount Rotaro, Cremate, and many other lateral cones. Also that this earthquake belongs to that subterranean class of movements that precede the bursting forth of an eruption such as the Vesuvian shock of A.D. 63, and the series that gave warning for some years before of the appearance of Monte Nuovo.

Prof. Samuel Haughton and myself are still engaged on a memoir of the last earthquake, and so far as we have gone we have found the following interesting facts:—

1. That the area of injury is very small.
2. That the angle of emergence rapidly diminishes as we recede from the seismic vertical.
3. That the focus is therefore very near the surface.
4. That there is another seismic vertical at Fontana. This is probably explained by conduction along a column of trachyte which occupies the old vent of Epomeo, as Fontana lies in the very centre of the old crater.

Mallet pointed out that shallow foci must produce violent effects in limited areas, that transmission to a distance of the earth-wave diminishes rapidly—conditions we find well illustrated in the present case. This led Prof. Palmieri to believe that the shock of 1881 was the result of the tumbling in of the clay caves near Casamicciola, and he again proposes a similar explanation, as for this one he had not noticed any movement of the seismographs of Naples of Vesuvius. On the former occasion I pointed out in my letter at the time that such could not be the case, not even as the result of the imagined spaces excavated by the dissolving action of the mineral waters. The real truth seems to be the inelastic nature of the tufas, which vary much in density and dip in every imaginable direction, so that the earth-wave has two powerful retarding agencies at work—the absorption by an inelastic medium, and continual reflection and refraction from its irregular structure. If really a falling-in had occurred as the cause of the earthquake, we should expect some signs of it, but such is not the case; there is not a true fissure in the locality, and no apparent changes of level. Nor can we conceive that the houses of Forio, four miles distant, would be shaken about the ears of their inhabitants; besides in this one, unlike the preceding shock, Naples felt the movement quite distinctly.

In addition to the destruction of the houses by the shock, fires have burst forth amongst the ruins, and two large landslips have swept down from the flanks of Epomeo, and converted gardens and vineyards into utter ruin.

In conclusion I would remark, as was done on a former occasion, that we must expect other shocks more violent in character, and that, as one follows the other, the interval of tranquillity will be less, until the final eruption bursts forth. What time such an occurrence may be expected it is only possible to judge by the force, character, and frequency of future events. Only last week I advised Dr. Dohrn of the peril of living at Casamicciola; and another friend, who would not heed my warning as to the event and the dangerous position of certain rooms in his house with regard to the seismic vertical, has lost his son in the part of the building indicated.

Would this not be a remarkably favourable occasion to carry out a thorough investigation of the whole of the phenomena accompanying this type of earthquake? If, for instance, some scientific society would choose a committee, provide a number of suitable seismographs to be placed in different parts of the island, and any other means that might be proposed, so as to study the progress of the focus towards the surface, if such is really the case, the form of the focal cavity, and many other points of interest, it might be the means of preventing further catastrophes by showing the nearing approach of volcanic matter to the surface.

The horrors of the occasion I will not touch upon, as it is the province of other newspapers, not to speak of the hurry in which I send off this rough memorandum of my visit to the island. H. J. JOHNSTON-LAVIS

Naples, July 30

P.S.—Since writing the above, notices from Isernia in the Apennines announce a severe earthquake in that locality, besides others at Sorrento and in other parts of Italy. The three Ischian shocks were each accompanied by a period of seismic activity in Italy and other parts of Europe. Vesuvius is slightly more active.

August 1.—Another slight shock occurred at Casamicciola about 4 p.m., and another a little before 12 p.m.

August 2.—At 12.30 another shock took place.

THERE has not yet been time to collect data which may throw light on the origin of the terrible catastrophe that visited Ischia on the 28th of last month. As in the case of the previous earthquake on the island, one of the most striking features of this last calamity is its extremely local character. There does not appear to have been any simultaneous perceptible tremor at Naples, and Professor Palmieri's delicate seismometers on Vesuvius registered no sympathetic movement on that mountain. That the source of the shock at Ischia must have lain comparatively near the surface may be confidently inferred. Had it been more than a few hundred feet deep, the waves of such a shock would assuredly have been propagated to a considerable distance all round.

Various possible causes of earthquakes have been assigned, each of which may at different times and places be effective in the production of the phenomena. The sudden snap of large masses of rock under great strain may be the origin of the frequent earthquakes of mountain chains, such as those so constantly experienced along the line of the Alps. On a smaller scale similar results may arise on a line of dislocation, as is probably the case at Comrie in Scotland. In volcanic regions the earthquakes that usually precede and accompany volcanic eruptions have been plausibly attributed to the explosions of elastic vapours, and particularly of steam. Ischia lies in a volcanic district, and is itself of volcanic origin. But its earthquakes do not seem to be part of the active volcanic phenomena of the district. So far as information is yet available regarding the recent catastrophe, there appear to have been no concomitant volcanic manifestations, though there were active vents where they might certainly have been expected to show themselves. The only facts yet known that might indicate a connection between the Ischian earthquake and the vulcanicity of the Neapolitan district are the reported outflow of lava from Vesuvius on the 31st, and the alleged increase in volume and temperature of the Ischian hot springs. As regards the descent of lava towards Torre del Greco on Tuesday of last week, it did not take place until three days after the calamity of the 28th ult., and may have been entirely independent of it. Disturbance of the thermal springs of the locality could hardly fail to accompany so severe a shaking of the ground, from whatever source the concussion might arise.

So far as materials exist for forming a judgment on the subject, the recent earthquake at Ischia appears to have been caused by the sudden collapse of some subterranean cavern, situated not far below the surface in the Casamicciola district. Such caverns no doubt frequently exist underneath volcanic vents from which large masses of material have been emitted. It is well known to geologists that one of the final phases in the history of a volcano is the subsidence of the cone. This downward movement probably continues during a long period of time. It may be on the whole gradual and imperceptible; but if, from time to time, the roofs of the huge vesicles, whence lava and steam have escaped, should give way, though there may be no perceptible change of level at the surface, such shocks will be generated as to convulse the area with earthquakes. We may infer that the Ischian earthquakes, though not directly connected with the present active volcanic phenomena of the district, are the result of the former extravasation of volcanic materials, and the consequent vesicular condition of the earth's crust at the locality. But we must await the careful collection of evidence before any positive conclusion on the subject can be embraced.

THE NORWEGIAN NORTH-SEA EXPEDITION

WITH the general work of the expedition sent out by the Norwegian Government in 1876-8 for the investigation of the physical and biological conditions of the North Atlantic, our readers have already been made familiar by communications from Dr. Mohn during the progress of the expedition. We have, moreover, already noticed one or two of the five volumes containing some of the results of the expedition. When the series of publications connected with the expedition is complete, it will form one of the most important contributions to a knowledge of the deep sea hitherto published. The present article is concerned with vols. iv. and v. of the series, containing a historical account of the expedition, a description of the apparatus used, the astronomical, magnetic, geographical, and natural history observations.

The historical account by Capt. Wille, who was in command of the vessel, the *Voringen*, tells us that so long ago as 1874 Professors Mohn and G. O. Sars memorialised the Norwegian Government on the importance of a thorough investigation of the North Atlantic. In the memorial we find an excellent summary of what had already been done by previous expeditions, and what might be accomplished by a new one. The Norwegian Government entered heartily into the proposal for an expedition, and after taking competent advice in the matter, resolved to agree to the prayer of the memorial, and appointed Capt. Wille to make the necessary preparations. Capt. Wille at once proceeded to England to confer with Sir George Nares, and to purchase apparatus. A suitable vessel, the *Voringen*, was purchased, and specially fitted and equipped for the work of the expedition; very brief and elastic instructions were issued for the general conduct of the expedition, while each member of the comprehensive scientific staff was furnished with special instructions for guidance in his work. The liberal scale on which the expedition was organised has guided the Norwegian Government in the publication of the results. These are contained in a series of large quarto volumes, beautifully printed (in Norwegian and English), and abounding with maps, coloured illustrations, and engravings. These volumes are liberally distributed among institutions and individuals in all countries, wherever indeed they are likely to be of service to science. Such liberality in a comparatively poor Government like that of Norway is in marked contrast to the conduct of the Government of the wealthiest country in the world in respect of the *Challenger* publications.

The general scope of the expedition was (1) to determine by soundings the contour of the sea-bed; (2) the rate and direction of currents; (3) the surface-temperature of the sea; (4) to investigate the physical conditions and chemical constituents of the sea-water; (5) zoological work; (6) botanical work; (7) meteorological observations; (8) magnetical observations; (9) whatever other observations time and place might render practical. Thus it will be seen the programme was comprehensive enough; and as the voluminous reports show, much valuable work was done in each department. Among the scientific staff on board were Prof. Mohn and G. O. Sars.

The *Voringen* prosecuted her work for about three months in the summers of the years 1876-7-8. During

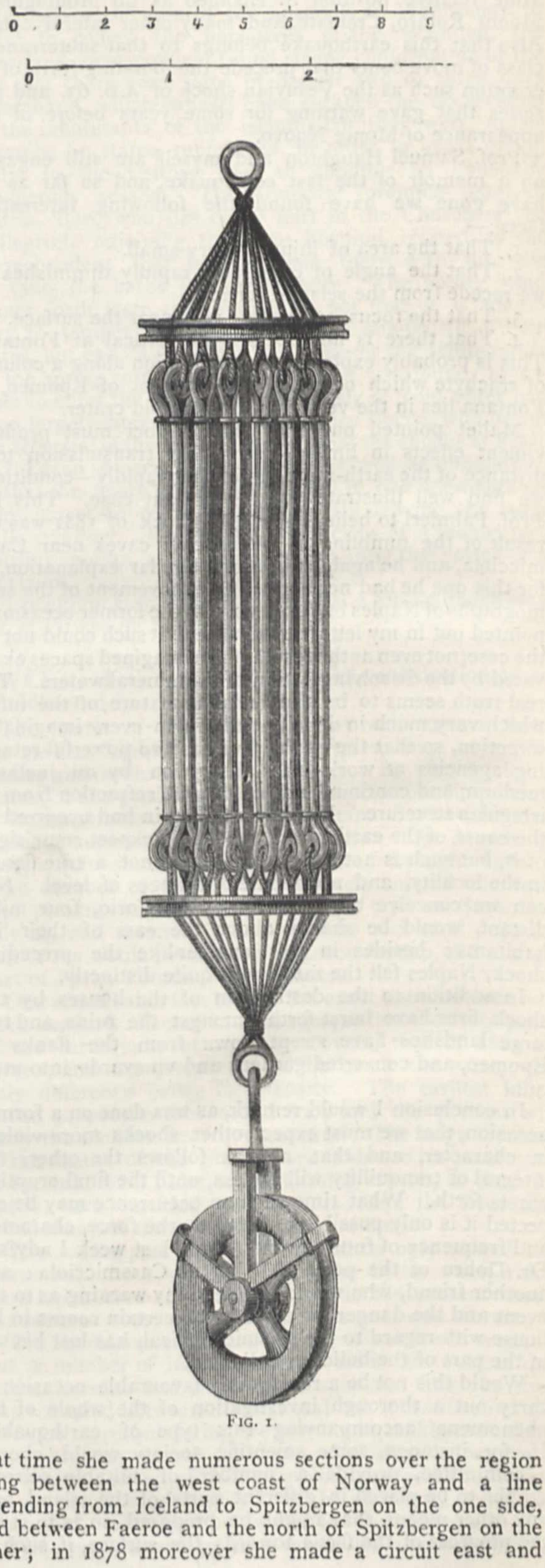


FIG. 1.

that time she made numerous sections over the region lying between the west coast of Norway and a line extending from Iceland to Spitzbergen on the one side, and between Faeroe and the north of Spitzbergen on the other; in 1878 moreover she made a circuit east and north from Vardoe to Bear Island. On every section stations were established for observations at very frequent intervals; off the coast of Norway these

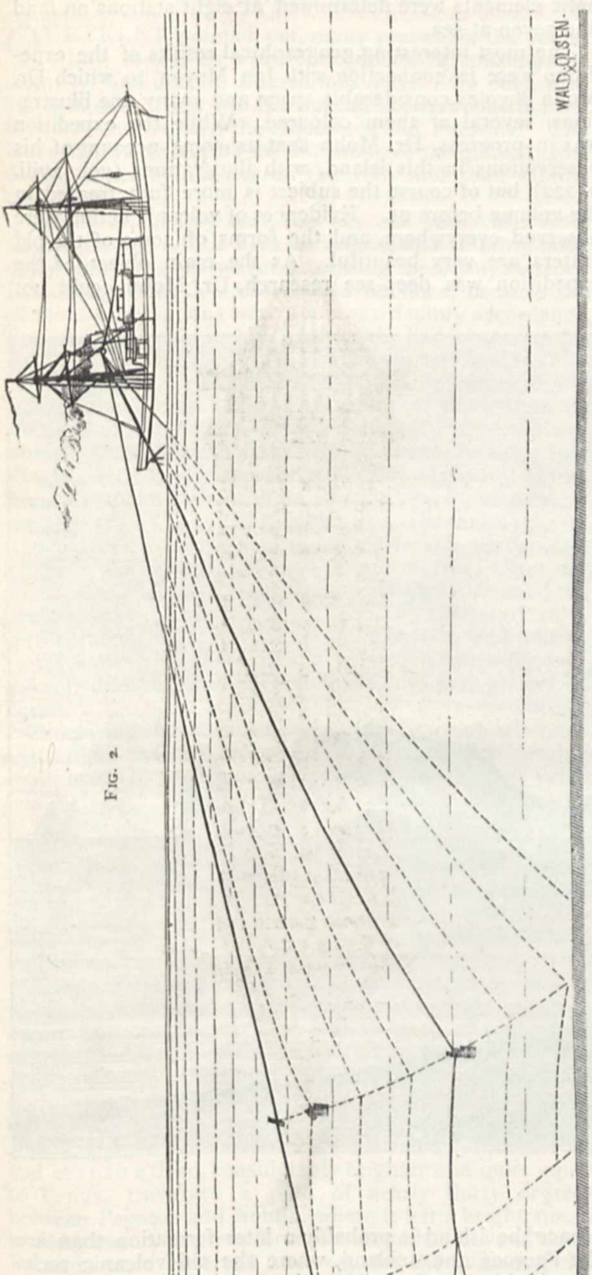


Fig. 2

stations were as close as they could well be. The vessel itself, of 344 tons, was admirably arranged for the work, the best possible use having been made of the not too large space for disposal. The apparatus was abundant, and in its construction the experiences of previous expeditions were fully taken advantage of. We are all so familiar with the apparatus used in deep-sea work that it is unnecessary to describe it in detail. The experience of the first year led to some improvements in the arrangements of the work-room, which occupied the whole breadth of the ship; and the light and ventilation were much improved. As a specimen of the apparatus, we reproduce the illustration of the sounding accumulator (Fig. 1), composed of fifteen straps. To the lower thimble is hung the cast-iron sounding-block, provided with a swivel on artificial rollers, and two hinged arms to act as fair leaders for the line. When in use, the apparatus hangs suspended from the port mainyard-arm. Its most important function is to take off the suddenness of the strain on the line when the vessel is rolling or pitching. For collecting water both from the bottom and intermediate depths, Capt. Wille devised a very ingenious water-bottle, which could hold five litres. The sounding-line, 3000 fathoms, was wound on the port side of the after-deck on a large, strong reel, secured by screws to the deck. For dredging, especially, very careful preparations were made, and a variety of apparatus taken on board. Capt. Wille gives the following interesting description of their method of dredging :—

"We steamed full speed ahead, with the wind a little on our starboard bow. So soon as the vessel had got sufficient headway, the engine was stopped, the dredge lifted by hand over the railing, and dropped into the sea. At the foremast, a man with thick leather gloves stood ready to pay out the dredge-rope, which another kept clear with a handspike as it ran out from the coil in the locker. On the dredge entering the water, the word was immediately given to veer, when the paying out commenced, slowly, however, to make sure that all was right. So soon as the dredge was clear of the propeller, the vessel again went ahead, steaming at a uniform rate of 4 knots, which the engineer was enabled to keep up by frequent reference to the water-log (see below). Meanwhile, we kept steadily veering, while taking care, by frequent holding on to the rope, that the length run out should be properly taut, and steering the course given to the ship when the dredge was put over. After paying out, according to depth, 200, 300, or 400 fathoms, we again stopped, hauled in the rope to the taffrail by means of the lizard and thimble, and fastened, below the latter, with spun-yarn, a wooden toggle to the rope. Starting again (same course and speed), we next ran out the whole length of rope deemed necessary for the operation—not less than double the depth, nay for smaller depths even more.

"The engine was now stopped, after which we hauled in the dredge-rope, as before, to the taffrail, and kept it up in a bight of rope's end. With the lizard was then made fast to the wooden thimble a weight proportioned to the depth, consisting of 3 or 4, and for the deepest dredgings of as many as 6, of the sinkers of the Baillie sounding-machine, weighing each 55 pounds. We now, after letting go the rope, tilted the weight overboard, which spun down along it till stopped by the wooden toggle. The shock of its arrest was distinctly perceptible to a person who had his hand on the rope.

"The vessel was now kept stationary, while the weight and the dredge were sinking. After some experience, we calculated the time required for the dredge to sink 100 fathoms to be about 12 minutes. Fig. 2 will give an idea of the descent of the dredge, or rather of the trawl. The supposed depth in the diagram being 1300 fathoms, the vessel and the trawl are of course on a much larger scale. The dotted lines represent the lines of descent of the weight, the shackle, the dredge-rope, and the beam of the trawl—assuming the trawl to sink more slowly than the weight. When the weight strikes the bottom, the trawl has still some distance to travel, and the last part of its line of descent will be well-nigh perpendicular. We found that, when worked in the manner described above, both trawl and dredge could as a rule without difficulty be made to reach the bottom in the right position. If the dredge or trawl descend much more slowly than the weight, it will fall vertically, with the heavy end foremost. If, on the other hand, its rate of descent be equal to or exceed that of the weights, it will, on reaching the bottom, have a horizontal component in its motion—which is pretty sure to keep it from clogging during the ensuing operation."

In vol. v. Dr. Mohn renders account of the astronomical observations, as well as the geography and natural history of the expedition, while Capt. Wille describes the magnetic observations. The vessel was well supplied with suitable instruments for determining latitude and longitude, and use was made of them whenever favourable opportunities presented themselves. Observations were thus made at nine important points. The various magnetic elements were determined at eight stations on land and seven at sea.

The most interesting geographical results of the expedition were in connection with Jan Mayen, to which Dr. Mohn devotes considerable space and many fine illustrations, several of them coloured. While the expedition was in progress, Dr. Mohn sent us some account of his observations in this island, with illustrations (vol. xviii. p. 222), but of course the subject is more fully treated in the volume before us. Evidences of volcanic action were observed everywhere, and the forms of some of the old craters are very beautiful. As the main object of the expedition was deep-sea research, Dr. Mohn could not

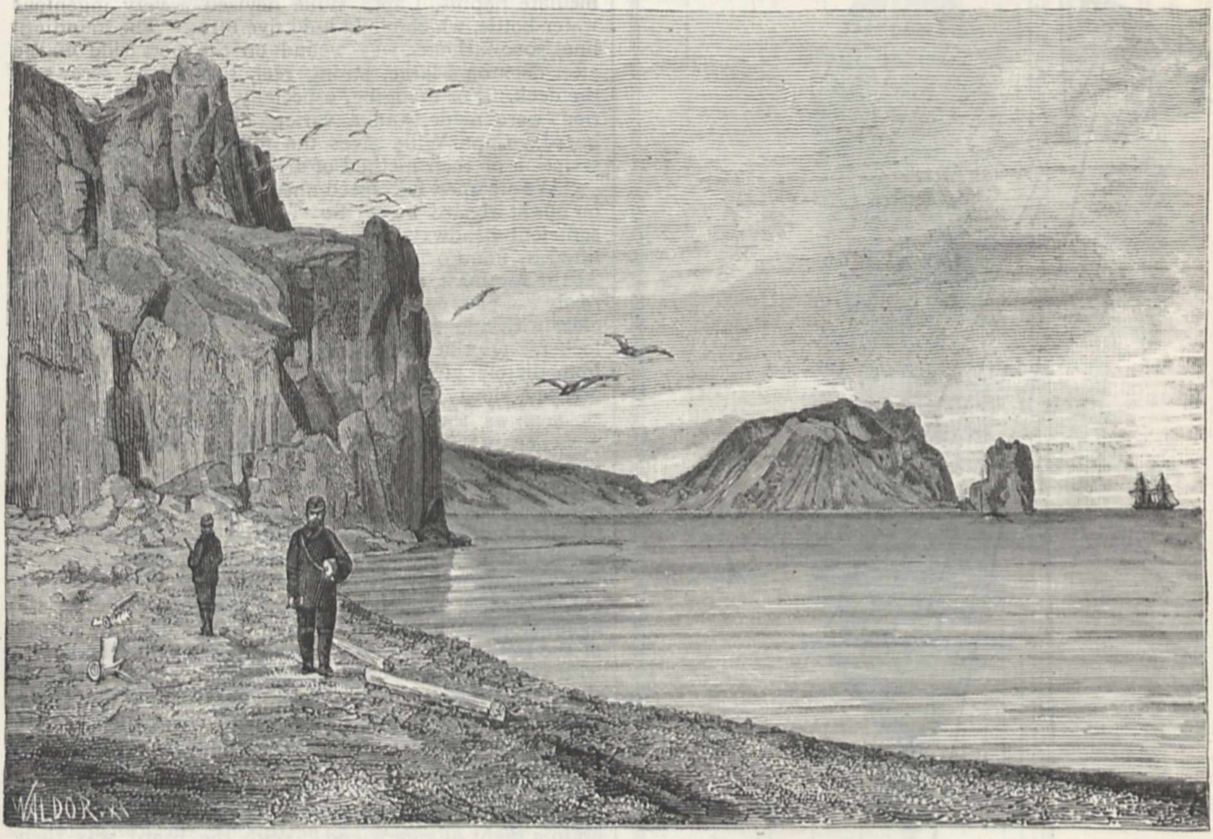


Fig. 3.

give so much time to the observations of the island as he could have wished; nevertheless, by bringing together the observations of the various members of the expedition, and comparing them with the results obtained by Scoresby and other previous observers, Dr. Mohn is able to give a very full and interesting account of this curious island, which we here quote:—

"Cut off on all sides by extensive ocean tracts from the nearest land, the Island of Jan Mayen occupies an isolated position in the Greenland Sea. Between Norway and Jan Mayen the depth reaches 1760 fathoms, towards Spitzbergen upwards of 2000 fathoms, towards Greenland upwards of 1300 fathoms, and towards Iceland upwards of 1000 fathoms. The direction of the island is from N.E. by E. to S.W. by W.; it points towards Denmark Strait, and lies parallel to the volcanic line of Mount Hecla. As previously stated, Jan Mayen is built up of volcanic rocks, all of which would appear to belong to the modern group. Hence the island is probably a later formation than are the Faeroes and Iceland, where the old volcanic rocks prevail either exclusively or in greater part. Its length slightly exceeds $7\frac{1}{2}$ geographical miles. It consists of two large parts or divisions, a northern and a southern, connected together by a lower and narrower tract. The greatest breadth of the northern part is a little more than 2 geographical miles, that of the southern $1\frac{1}{2}$ geographical miles, and the connecting tract (including the lagoon) measures at the narrowest point $1\frac{1}{2}$ English miles across (0·4 geographical mile). The area of the island is 7·32 geographical square miles."

Fig. 3 gives a view of the headland forming the north-east extremity of North or English Bay, the isolated rock in the distance being the Brielle Tower of the Dutch navigators.

(*To be continued.*)

THE SHOOTING STARS OF THE JULY METEORIC EPOCH

QUETELET pointed out, many years ago, the period July 26—30 as a meteoric epoch of considerable intensity, and recent observations have fully confirmed his opinion. There are two special showers contributing to this result, namely, the Aquariads and Perseids. The latter merely represents the oncoming of the great August display which culminates on the 10th and then rapidly dies out.

This year, on July 28th, the sky was very clear from clouds (though a little haze prevailed), and a fairly good opportunity was offered for witnessing these July meteors. It was important that this should be done, because the previous observations were not in satisfactory accordance. Professor Herschel in 1865, July 28th, had observed the chief radiant near the bright star *Fomalhaut*, and in 1881, July 25—30, M. Cruls of the Imperial Observatory at Rio Janeiro, found that the radiant point of more than 90 per cent. of the meteors observed during that period was situated five degrees north of *Fomalhaut*. In 1880, July 28—30, Mr. E. F. Sawyer, of Cambridgeport, Mass., found the major radiant to lie at α 330°, $\delta - 6°$, with minor showers at 328° − 15°, and 341° − 10°. Colonel Tupman, who watched these meteors with considerable success and accuracy during the last few nights of July, 1870, determined the focus of divergence as at 340° − 14°, and the writer from observations at Bristol in 1878 and 1879, corroborated this position, and found that in addition to these Aquariads, there was a very rich contemporary shower, directed from a point near the star cluster χ Persei.

Comparing the various observations to which we have just briefly referred, it will be seen that considerable doubt exists as to the exact centre of radiation of these July meteors. Obviously the point is either in Aquarius or further south in *Piscis Australis*, and near the conspicuous star *Fomalhaut* of that constellation. The observations also suggest that there may be several streams in marked activity at this epoch, and it was with the object of obtaining further evidence towards the settlement of this question, that I reobserved these meteors on the night of July 28 last.

I began watching the eastern heavens at 10.30, and at 10.36 a very fine meteor, as brilliant as Jupiter, appeared near γ Andromedæ. It had a short path of only four degrees, and left a vivid streak. The meteor was evidently much foreshortened and close to its radiant point slightly west of χ Persei, so that it was an early forerunner of the Perseids. At 11.4 another fine meteor, of exactly similar type, was seen falling between α and β Andromedæ, and at 11.10 a third, considerably brighter and quite equal to Venus, traversed a path of nearly thirty degrees between Pegasus and Aquila, where it left a bright streak of some twenty degrees for a few seconds. Several other Perseids were observed later on, and the radiant point was found to lie at 27° + 55°, which conforms fairly well with the position I found for the same display in 1878 at 32° + 53° (63 meteors). As to the expected shower of Aquariads I was not disappointed, though during the earlier part of the night only small ones were seen, and I could not get the position of the radiant with the necessary exactness. Between 13h. and 14h. however, I saw eight Aquariads, and three of these were brilliant. At 13h. 13m. one appeared just below β Andromedæ. It was brighter than a first magnitude star. At 13h. 37m. a fine Aquariad, rivalling Jupiter, was seen in the west region of Pisces, and at 13h. 54m. another of the first magnitude appeared in nearly the same place. They moved slowly and left trains of sparks.

During the $3\frac{1}{2}$ hours ($10\frac{1}{2}$h. to 14h.) that I continued to watch I saw eighteen of these Aquariads, and by the intersection of the paths, found the radiant very sharply defined at 337° − 11°, and close to the point I had determined in 1878 and 1879. This shower was far superior to the Perseids in the morning hours, and fully asserted its claim to be considered as the special display of the epoch. The meteors generally have long paths, as the radiant point is not far above the horizon. In all I saw 48 meteors during the night, and of these no less than 28 belonged either to the Perseids or Aquariads.

There can be no doubt that these July Perseids are identical with the celebrated shower of August 10, though the radiant point is some 8° west in July. I have watched these Perseids very carefully from July 25 up to August 16 in several years, and traced the gradual shifting of the radiant point. From my observations during the last week of July, 1878, I had supposed these July Perseids to form a distinct shower to the Perseids of August 10, but from observations obtained on intermediate dates, *i.e.* on August 3, 4, and 5, the connection of the two showers is most certainly established, and the displacement of the radiant point on each successive night can be clearly distinguished by those who will mark the tracks of such meteors as appear near this radiant from say July 25 to August 15.

As to the Aquariads, I believe the maximum takes place on July 27-28, when they are undoubtedly more numerous than the early Perseids. I feel certain that the radiant point is near δ Aquarii or at 339° − 13°. There is another shower near *Fomalhaut*, which appears to have developed remarkable energy in 1881 from M. Cruls' observations, and there are also other showers in Aquarius at this special period, which have led to the difficulty in determining the position of the major radiant. There is certainly a very fine shower of meteors at the end of July from a point a few degrees S.E. of β Aquarii, which has been observed as follows :—

	July 25-31	324° − 6°	Schmidt.
1870	July 28	326 − 13	Tupman.
1880	July 28-30	328 − 15	Sawyer.
	July 25-31	324 − 9	Denning.

I gave some details of this particular stream, which, it may be added, is one remarkable for its large meteors, in the *Monthly Notices of the Royal Astronomical Society* for November, 1881, p. 38.

It now becomes important to watch for the annual returns of these meteors of the July epoch at observatories in the southern hemisphere, where they may be more favourably observed than in high northern latitudes. Obviously, a shower near *Fomalhaut* will be in a great measure marred by the extremely low altitude of the radiant, as that star never attains an altitude even of 10° in this country. At stations further south, the shower of Aquariads appears to be one of great strength and to form a display of first-class importance. Observations made in 1879 show a wide disparity in the number of these meteors visible in different latitudes. Mr. D. W. Barker, during a voyage from London to Melbourne (*Monthly Notices*, Vol. XL., p. 364), in that year observed meteors falling at the rate of 180 per hour on July 28 and 120 per hour on July 29, between 0h. and 4h. a.m. on the dates referred to. Yet, at Bristol on July 28 of the same year, the hourly number was only 23, and on July 29, 11.

The further investigation of the July meteoric epoch offers an attractive field to observers. Apart from the rich shower of Aquariads there are the Perseids, equally interesting from the fact that these early members of the great shower prove it to be one of long duration, and to have a radiant point which shifts its position amongst the stars from night to night. These interesting details will no doubt come under frequent observation in future years.

W. F. DENNING

NOTES

THE meeting of the French Association for the Advancement of Science will take place this year at Rouen on the 16th inst.; extensive preparations are being made for the reception of the members. The electric light is to be a prominent feature of the meeting, owing to the project entertained by the municipality of lighting part of the city by the motive power of the Seine at Pont de l'Arche, as we mentioned in a recent note.

THE Lords of the Committee of Council on Education have sanctioned the addition of Hygiene to the list of sciences towards instruction in which aid is afforded by the Science and Art Department. The following is the syllabus of the subject:—Elementary stage: (1) food, diet, and cooking; (2) water and beverages; (3) air; (4) removal of waste and impurities; (5) shelter and warming; (6) local conditions; (7) personal hygiene; (8) treatment of slight wounds and accidents. Advanced stage: (1) food and adulterations; (2) water and beverages; (3) examination of air—chemical and microscopical; (4) removal of waste and impurities; (5) shelter and warming; (6) local conditions; (7) personal hygiene; (8) prevention of disease. Honours:—In addition to the topics enumerated under the elementary and advanced stages, questions will be set in the following subjects: trades nuisances, vital statistics, sanitary law.

THE new portion of the University of Indiana, at Bloomington, in that State, was set on fire by lightning during a thunderstorm on the night of July 12, the electricity travelling along a telephone wire which served the institution. The laboratory, museum, and library were completely destroyed. The museum contained a collection of fishes, made by Dr. Jordan, which was thought to be the largest and most valuable in the United States. There were 15,000 volumes in the library, besides the so-called Owen collection, the loss of which is believed to be irreparable. The general loss is estimated at $200,000, of which only $30,000 is covered by insurance.

THE U.S. bureau of education has, we learn from *Science*, just published a circular of information, containing the results of an inquiry into the effects of co-educating the sexes in 340 cities and large towns of the Union. Of these, 321 practise co-education throughout the public-school course, 17 co-educate for part of the course, and 2 separate the sexes entirely. A careful analysis of the reasons adduced for co-education enables the editor to formulate them as follows: co-education of the sexes is preferred where practiced, because it is (1) *natural*, following the usual structure of the family and of society; (2) *customary*, or in harmony with the habits and sentiments of every-day life and law; (3) *impartial*, affording to both sexes equal opportunities for culture; (4) *economical*, using school funds to the best advantage; (5) *convenient* both to superintendent and teachers in assigning, grading, instruction, and discipline; and (6) *beneficial* to the minds, morals, habits, and development of the pupils. The pamphlet concludes by observing that "both the general instruction of girls, and the common employment of women as public-school teachers depend, to a very great degree, on the prevalence of co-education, and that a general discontinuance of it would entail either much increased expense for additional buildings and teachers, or a withdrawal of educational privileges from the future women and mothers of the nation."

IN an article entitled "Cholera and Our Water-Supply," in the current number of the *Nineteenth Century*, Dr. Percy F. Frankland draws attention to the vital connection between water-supply and the diffusion of zymotic disease. He points out how, in consequence of the terrible epidemics of Asiatic cholera to which the metropolis has been subjected in the past, the companies supplying London with water from the Thames have been obliged to remove their intakes to a distance which shall insure the freedom of their supply from contamination with the London sewage, and thus at any rate to put an end to their former practice of "rapidly restoring to the inhabitants of London the drainage matters which the sewers had discharged." But although the Thames at Hampton is free from this source of pollution, yet it is similarly fouled, although in a less degree, with the sewage of a population estimated at upwards of half a million which enters the river above the intakes of the water companies. In extenuation of this obviously revolting state of things, many theories have been started: of these the most popular and fallacious is that which, under the title of "the self-purification of river-water," announces that noxious organic matters present in river-water are rapidly destroyed in the course of a few miles' flow. This doctrine, unsupported as it is by any facts or accurate observations, is wholly dogmatic and in complete opposition to all previous knowledge concerning the properties of organic substances in general. The late Rivers Pollution Commissioners, moreover, conclusively proved that water once polluted with sewage is only very slowly purified, and more recent research shows the great tenacity of life possessed by the lower organisms which are believed to be allied to those capable of communicating zymotic disease. Chemical analysis further proves that the Thames water reaches the intakes of the London Water Companies with a but slightly diminished proportion of organic matters. In the face of the now well known fact that London possesses within easy reach water of the purest quality and abundant in quantity, it is inexcusable that such manifestly impure sources should still be resorted to. Hitherto only one of the eight metropolitan water companies has entirely abandoned the polluted rivers and substituted them by the pure water obtained from deep wells sunk into the chalk. London should follow the example of other large towns in Great Britain; thus Glasgow now drinks the waters of Loch Katrine, Manchester is bringing a supply from Cumberland, whilst London, with water of the best quality much nearer at hand, is still compelled to drink the waters of the Thames and Lea.

THREE addresses will be delivered at Annonay by members of the Academy of Sciences on the occasion of the forthcoming inauguration of the Montgolfier statue. M. Dupuis de Lome will speak on the general history of ballooning; M. Tisserand, in the name of the Paris Observatory, on the scientific prospects of ballooning; and Col. Perrier, the representative of the President of the Republic, on the results of ballooning in warfare. M. Laussedat, the director of the Conservatoire des Arts, who was the first director of Meudon Châlet Aëronautical Establishment, will speak on the career of the brothers Montgolfier. The aëronautical ascents will be made with a Montgolfier by Eugène Godard, and with a gas balloon by M. Brissonet, *fils*, of Paris. We believe that M. Tisserand will recommend the use of balloons for certain astronomical observations.

THE Trustees of the Australian Museum (Sydney) have issued their twenty-ninth Annual Report for 1882. The increasing importance of the Australian Museum, and the growing interest of the public in it, are shown by the remarkable increase of 18,446 visitors during the past year; the attendance being 81,596 on weekdays as against 73,995 in 1881, and 52,505 on Sundays as against 41,660 in 1881, the increase on weekdays being upwards of 14 per cent., and on Sundays upwards of 26 per cent. Application has been made to the Government to consider the necessity of enlarging the Museum buildings. More room is urgently required, not only for purposes of exhibition, but for the office staff and workmen. A catalogue of Australian stalk- and sessile-eyed Crustacea, prepared by Mr. Wm. A. Haswell, M.A., B.Sc., has been printed and distributed extensively among various museums and natural history societies; and the work of cataloguing the whole of the Museum collections is being pushed forward as rapidly as possible. The most serious loss ever sustained by the Museum has occurred through the recent destruction of the Garden Palace—the large and varied collection of technological and ethnological specimens sent there for exhibition having been totally destroyed by the fire which consumed the building. The Technological Committee lost no time in commencing a new collection; and, having already obtained many ethnological specimens of great interest, they are taking steps to secure as many others as possible. This is a work which admits of no delay, as genuine ethnological examples from the islands are becoming scarcer every day, in consequence of the general spread of trade and civilisation through the whole of Polynesia. Suitable accommodation for the display of the technological and ethnological specimens already in hand should at once, if possible, be provided. The most important work carried on by the Trustees during the year has been the exploration of the caves and rivers of Australia. It was continued until the close of December at the Wellington Caves, where the bones of an immense Echidna and of a large Struthian bird allied to the Emu, as well as some smaller animals of less note, hitherto unknown to science, have been discovered and added to the Museum. Numerous other fossil bones valuable for exchanges with foreign museums have been obtained. The exploration of rivers was conducted by the assistant taxidermist in Queensland, where strong hopes of discovering some new Ganoid fishes were entertained. A special report of this work, with a list of the specimens procured, is given in appendices.

THE Clothworkers' Company have agreed to give a donation of 10,000*l.* for the enlargement of the Textile and Industrial Department of the Yorkshire College at Leeds. Altogether the Clothworkers' Company have given upwards of 25,000*l.* towards this institution.

THE Ornithological Society of Vienna wishes to call the attention of English ornithologists to the International Congress of Ornithologists which will be held next spring at Vienna in connection with the annual exhibition of the Ornithological Society of Vienna, under the protection of H.I.H. the Crown Prince Archduke Rudolf of Austria. The chief business of the Congress will be to pass preliminary resolutions for international legislation regarding the protection of birds. The Austrian Government will send out invitations to the different foreign Governments, and will grant a free passage to Vienna to the representative of each foreign Government. All those interested in the above subject should apply for further information to Dr. Gustavus von Hayek, Hon. First Secretary of the Ornithological Society of Vienna, 3, Marokkaner Gasse, Vienna.

THE following list of candidates successful in the competition for the Whitworth Scholarships, 1883, has been issued by the Science and Art Department:—James Hamilton, Engineer, 200*l.*; William E. Dalby, Engineer Apprentice, 150*l.*; John L. Barnes, Engineer Apprentice, 150*l.*; Thomas K. Mackenzie, Student, formerly Mechanical Engineer, 150*l*; William Sumner, Fitter, 150*l.*; Frank W. Dodd, Engineer Apprentice, 150*l*; Charles N. Pickworth, Mechanical Engineer, 150*l.*; Henry E. Kitton, Mechanical Engineer, 150*l*; James Layzell, Engineer Apprentice, 150*l.*; Horace W. Meteyard, Engineer, 100*l.*; Alfred S. Ormsby, Mechanic, 100*l.*; William P. Abell, Mechanical Engineer, 100*l.*; Alfred W. Bevis, Tutor, formerly Engineer Apprentice, 100*l.*; John W. Aston, Engineer Apprentice, 100*l.*; Alfred E. Mackett, Marine Engine Fitter, 100*l.*; Victor F. Whitehead, Engineer, 100*l.*; Charles Lang, Pattern Maker, 100*l.*; James Bradshaw, Mechanical Engineer, 100*l.*; Alfred J. Joshua, Fitter, 100*l.*; William A. Rogerson, Fitter, 100*l.*; William E. Donohue, Draughtsman (Marine), 100*l.*; Albert H. Case, Engineer, 100*l.*; Alexander Shannon, Engineer, 100*l.*; Mark R. Bullimore, Fitter, 100*l.*; John S. Bean, Engineering Draughtsman, 100*l.*

THE biennial marine excursion of the Birmingham Natural History and Microscopical Society, which took place at Oban in July last, and lasted for ten days, was on the whole most successful. It was attended by twenty-three members of the Society. A superior screw steam yacht, the *Aërolite*, was chartered for the occasion, and the weather being very fine, dredging was carried on daily at various stations which were all recorded on a chart at depths which varied from fifteen to one hundred fathoms. The principal object of this excursion was to secure further specimens of the *Pennatulida*, a few only of which were taken in the dredgings at the same place during 1881. These formed the subject of a special report made to the Society last year by Prof. Marshall, D.Sc., and Mr. W. P. Marshall, M.I.C.E., and for which the Darwin Gold Medal, given by the Midland Union of Natural History Societies was awarded at the Tamworth meeting held in June last. Some special instruments made of galvanised iron and armed with hooks were devised by Mr. W. P. Marshall for the occasion, called the "plough" and the "harrow." These, together with the dredges and trawl, were for the first time on these excursions worked by means of steam gear. A small dredge measuring a few inches was used by hand for testing the nature of the bottom of the sea, and all these various appliances worked admirably. A large number of specimens of *Funiculina quadrangularis* and *Pennatula phosphorea* in various stages of growth were secured in fine condition and unbroken. A number of specimens of Sponges, Zoophytes (including a rare free form of *Zoanthus conchii*, var. *liber*, Gosse), Echinoderms, Crustaceans, Annelids, Tunicates, Mollusca, &c., were also secured. These were exhibited and described to the members during the days and in the evenings by Mr. W. R. Hughes, F.L.S., chairman of the excursion, Mr. W. P. Marshall and Mr. J. F. Goode, Hon. Sec. of the Biological Section, who have also made a preliminary report thereon to a recent meeting of the Society. During the excursion phosphorescence was for the first time observed in *Funiculina*, the characteristic pale blue light coruscating over the whole series of polypes, the length of the specimen being between three and four feet, and presenting a very beautiful effect when viewed in the dark. In addition to the dredging, some attention was paid to the botany and geology of the district by several of the members. During a walk on July 1 fifty species of plants were gathered in flower. A collection of specimens of the rocks of Oban and the vicinity, including Staffa, Iona, Mull, Glencoe, Easdale, &c., was also made for future examination.

THE city of Geneva intends to utilise the current of the Rhone for lighting the whole of the city. A report on the question is being drawn up, which will be submitted to the Council of State.

A PRELIMINARY meeting of the members of the future Société des Électriciens took place at the Ministry of Posts and Telegraphs. M. Cochéry was present, but he declined to preside over the proceedings, and the honour was bestowed upon M. Berger.

AN electrical omnibus was recently tried on the Cour de Carrousel, Paris, before M. Cochéry to prove the facility with which this sort of carriage is handled in spite of its immense weight. The trial, which took place in the busiest hours of the day, attracted much notice from the passers-by, and was generally deemed satisfactory.

THE *Italia del Popolo*, in one of its latest numbers, gives the names of a number of localities from which birds and insects have disappeared just before invasions of cholera.

THE death is announced, at the age of 83, of Linant Pasha (Linant de Bellefinds), one of the leading personages connected with the existing Suez Canal. Under Said Pasha he was appointed head of the Ponts et Chausées department, and chief engineer of the Suez Canal project. In early life he travelled much in Abyssinia, Kordofan, and Darfur.

SIR CLAUDE DE CRESPIGNY, in company with Mr. Simmons, made a successful balloon voyage from Maldon in Essex across the North Sea to Flushing on Wednesday last week. The start was made at 11 a.m., and Flushing was reached about 8 p.m. The highest altitude reached was 17,000 feet.

WAUSCHAFF of Berlin has lately made a piece of apparatus for registering earth currents. It consists of a very delicate galvanometer inclosed in a case with a clockwork arrangement for moving a photographic plate steadily downwards. A fine ray of light is reflected on to the galvanometer mirror by a total reflection prism and is focused on the photographic plate. The speed of the movement of the plate is 80 mm. per hour, thus allowing variations from minute to minute to be observed.

MM. LELANDE AND CHAPERON have brought out a new battery of very remarkable properties. The battery is a single liquid cell and has a depolarising electrode of oxide of copper, the liquid used is caustic potash, and the other pole is zinc. The battery is made in various forms, its E.M.F. is nearly 1 volt, whilst it is said to give a steady current through even a low resistance for many hours. Finally it is claimed for this battery that when exhausted it can be restored by driving a current from an accumulator through it.

A NEW edition (the fifth) is announced of the "Dictionnaire des Arts et Manufactures et de l'Agriculture," edited by M. Ch. Laboulaye.

MR. BROWNE asks us to say that in his recent article on Glacier Motion, p. 235, by a slip of the pen he stated that the sides of a glacier move faster than the middle, whereas, as every one knows, the reverse is the case.

THE additions to the Zoological Society's Gardens during the past week include a Grivet Monkey (*Cercopithecus griseo-viridis* ♂) from West Africa, presented by Lord Hastings; two Black-backed Jackals (*Canis mesomelas*), two Triangular Pigeons (*Columba guinea*) from South Africa, presented by Mr. R. Southey; two Indian Brush-tailed Porcupines (*Atherura fasciculata*) from Ceylon, presented by Mr. A. Dent; three Puffins (*Fratercula arctica*), British, presented by Mr. H. Becher; a Common Cormorant (*Phalacrocorax carbo*), British, presented by Mr. W. R. Temple; a Common Barn Owl (*Strix flammea*), British, presented by Mr. H. Hanaeur; a Common Wombat (*Phascolomys wombat* ♂) from Tasmania, a Common Cormorant (*Phalacrocorax carbo*), British, a Common Boa (*Boa constrictor*) from West Indies, deposited; a White Stork (*Ciconia alba*), two Common Spoonbills (*Platalea leucorodia*), two Purple Herons (*Ardea purpurea*), European, purchased; a Musk Deer (*Moschus moschiferus* ♂) from Central Asia, received on approval; a Collared Fruit Bat (*Cynonycteris collaris*), two Amherst's Pheasants (*Thaumalea amherstiæ*), two Summer Ducks (*Aix sponsa*), bred in the Gardens.

A CONTRIBUTION TO THE STUDY OF THE TRANSMISSION EASTWARDS ROUND THE GLOBE OF BAROMETRIC ABNORMAL MOVEMENTS

IN his paper on "Abnormal Variations of Barometric Pressure in the Tropics, and their Relation to Sun-spots, Rainfall, and Famines," published in NATURE (vol. xxiii. pp. 88 and 107), Mr. Fred. Chambers pointed out, when treating of the barometric records of the stations, St. Helena, Mauritius, Bombay, Madras, Calcutta, Batavia, and Zi-ka-wei, that abnormal movements which had occurred at a westward station—*e.g.* Mauritius—reappeared at an eastern station—*e.g.* Bombay—some time later, and then again at a further eastern station, Madras, still later, and so on, until they finally reached the most distant station eastwards. It appeared therefore that there were abnormal movements of the atmospheric pressure which travelled from west to east; the rate of travel seemed to vary at different times; and Mr. Chambers summed up his results in the following words:—"It appears then that these atmospheric waves (if such they may be called) travel at a very slow and variable rate round the earth from west to east like the cyclones of extra-tropical latitudes."

In his "Brief Sketch of the Meteorology of the Bombay Presidency in 1880," Mr. Chambers proceeded to test the validity of his conclusions by applying them to an examination of the barometric records of Zanzibar for that year and a portion of the next as compared with the records of Belgaum for the same period; and he again noticed that "there was much similarity in the abnormal movements of barometric pressure at Zanzibar and Belgaum, although these stations are about 2500 miles apart, but that the Belgaum curve lagged decidedly from two to three months behind the Zanzibar curve."

This discovery, if substantiated, would obviously prove of great practical value, inasmuch as it would make it possible to obtain a forecast of the barometric movements about to occur at any particular station by watching the movements already taking place at a point westward of that station. And as definite variations in the atmospheric pressure may be, and in some cases are known to be, accompanied by definite variations in the other meteorological elements, a method of weather prediction would thus be furnished.

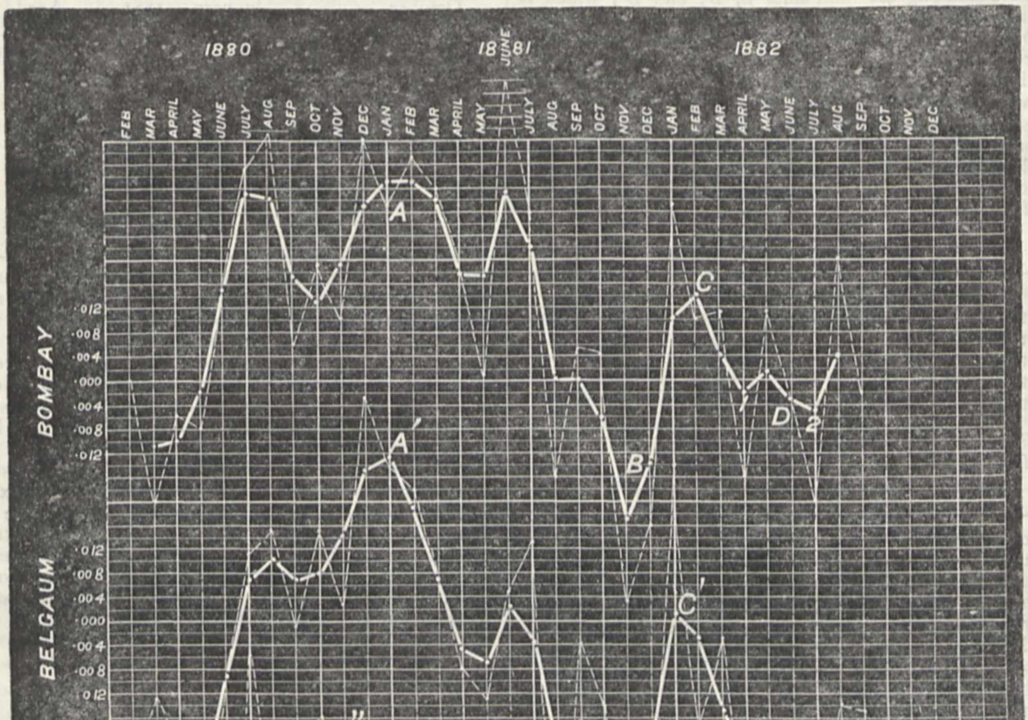
It has fallen to my lot to receive and discuss the Zanzibar observations succeeding those last discussed by Mr. Chambers; and the results obtained by my examination of them seem to involve matters of some practical and theoretical interest.

TABLE I.—*Monthly Abnormal Barometric Pressure at Zanzibar, Belgaum, and Bombay*

Months.	Monthly Abnormals (unsmoothed).			Monthly Abnormals (smoothed).		
	Zanzibar	Belgaum	Bombay	Zanzibar	Belgaum	Bombay
February 1880	− ·014	− ·024	·000	—	—	—
March ,,	− ·005	− ·013	− ·020	− ·004	− ·017	− ·011
April ,,	+ ·008	− ·022	− ·006	+ ·003	− ·022	− ·010
May ,,	+ ·005	− ·032	− ·008	+ ·006	− ·023	− ·002
June ,,	+ ·008	− ·008	+ ·015	+ ·018	− ·009	+ ·014
July ,,	+ ·054	+ ·011	+ ·035	+ ·034	+ ·007	+ ·031
August ,,	+ ·022	+ ·015	+ ·041	+ ·034	+ ·010	+ ·030
September ,,	+ ·038	− ·001	+ ·006	+ ·035	+ ·007	+ ·017
October ,,	+ ·044	+ ·015	+ ·019	+ ·038	+ ·008	+ ·013
November ,,	+ ·026	+ ·003	+ ·010	+ ·031	+ ·014	+ ·019
December ,,	+ ·028	+ ·037	+ ·040	+ ·025	+ ·015	+ ·029
January 1881	+ ·018	+ ·026	+ ·029	+ ·019	+ ·027	+ ·033
February ,,	+ ·014	+ ·022	+ ·037	+ ·009	+ ·019	+ ·033
March ,,	− ·007	+ ·008	+ ·032	+ ·005	+ ·007	+ ·030
April ,,	+ ·023	− ·008	+ ·020	+ ·005	− ·005	+ ·018
May ,,	− ·017	− ·013	+ ·001	+ ·003	− ·007	+ ·017
June ,,	+ ·024	+ ·005	+ ·049	+ ·013	+ ·002	+ ·031
July ,,	+ ·025	+ ·013	+ ·028	+ ·019	− ·003	+ ·022
August ,,	+ ·003	− ·046	− ·016	+ ·017	− ·020	·000
September ,,	+ ·037	− ·004	+ ·005	+ ·021	− ·017	·000
October ,,	+ ·009	− ·014	+ ·004	+ ·002	− ·020	− ·006
November ,,	− ·047	− ·051	− ·037	− ·024	− ·035	− ·023
December ,,	− ·014	− ·028	− ·024	− ·015	− ·020	− ·010
January 1882	+ ·012	+ ·026	+ ·029	− ·005	+ ·001	+ ·014
February ,,	− ·033	− ·017	+ ·010	− ·016	− ·003	+ ·014
March ,,	− ·012	− ·003	+ ·011	− ·011	− ·015	+ ·004
April ,,	+ ·012	− ·040	− ·016	·000	− ·026	− ·002
May ,,	− ·009	− ·024	+ ·011	+ ·002	− ·026	+ ·001
June ,,	+ ·017	− ·018	− ·002	+ ·016	− ·023	− ·003
July ,,	+ ·040	− ·034	− ·019	+ ·031	− ·025	− ·005
August ,,	+ ·029	− ·014	+ ·020	+ ·027	− ·019	+ ·004
September ,,	+ ·012	− ·015	− ·002	—	—	—

From these observations the variations from the normal monthly barometric movements have been obtained. They are tabulated in Table I., and are represented graphically by the thin dotted line of the lowest curve in the accompanying plate. Alongside of them are arranged, both in the table and the plate, the barometric abnormal movement of the meteorological stations, Belgaum and Bombay. In order to facilitate comparisons between the curves of these three stations the actual normal movements, which are represented in the plate by thin dotted lines, have been put through a double process of smoothing; the results are tabulated under the heading of "Monthly Abnormals (smoothed)," and are represented on the plate by the thick continuous lines. The observations not previously discussed are those taken from June, 1881, to September, 1882, of all the stations, together with the Bombay record from February, 1880, to June, 1881.

The addition of this series to the Zanzibar record seems to confirm the result of previous observations, viz. that there are abnormal movements of the atmospheric pressure which affect



a very wide area, and which are not simultaneous in all parts of that area, but travel from west to east. An inspection of the smoothed curve will show what amount of truth there is in this statement. Thus the Zanzibar curve shows an upward bend at A″ and a downward bend at B″, a second upward bend at C″, and a second downward bend at D″. The Bombay and Belgaum curves both show a similar general form, having upward bends at A and A′ corresponding with the upward bend A″ of the Zanzibar curve, downward bends B and B′ corresponding with the downward bend B″ of the Zanzibar curve, and similarly C, C′ and D, D′ corresponding with C″ and D″ of Zanzibar. And it is at once seen that the movements at Zanzibar are in advance of those of Bombay and Belgaum. Thus the Zanzibar maximum A″ took place in October, 1880, whilst the corresponding movements did not appear at Belgaum until the month of January, 1881, and at Bombay until between January and February, 1881; that is to say, at periods of three and three and a half months later. Then again the minimum movement B, B′, and B″ which occurred at Zanzibar in the month of May, 1881, did not appear at Bombay and Belgaum until the month of November of the same year; that is to say, after an interval of six months. Again, the maximum movement C, C′, and C″ occurred at Zanzibar in the month of September, 1881, but not at Belgaum until January, 1882, and at Bombay until February, 1882; that is to say, until after intervals of four and five months respectively. Again, on examining the minimum D, D′, and D″, which is divisible into two minor minima, the first of these minor movements appears at Zanzibar in the month of November, 1881, but at Belgaum between the month of April and May, and at Bombay in the month of April, 1882; that is to say, after intervals of five and a half and five months respectively. Lastly, the second minor movement of the minimum D, D′, and D″ occurred at Zanzibar in the month of February, 1882, and at Belgaum and Bombay in July of the same year; that is, after an interval of five months.

These facts may be presented briefly and concisely thus:—

TABLE II.

	An interval of		An interval of
From A″ to A′ ...	3 months	From A″ to A ...	3·5 months
,, B″ to B′ ...	6 ,,	,, B″ to B ...	6 ,,
,, C″ to C′ ...	4 ,,	,, C″ to C ...	5 ,,
,, D''_1 to D'_1 ...	5·5 ,,	,, D''_1 to D_1 ...	5 ,,
,, D''_2 to D'_2 ...	5 ,,	,, D''_2 to D_2 ...	5 ,,
Average from Zanzibar to Belgaum	4·7 ,,	From Zanzibar to Bombay	4·9 ,,

In the case before us, then, it does appear to be matter of fact that there are movements taking place at the two stations, Belgaum and Bombay, similar in character to movements which have taken place at Zanzibar on an average about five months previously. And assuming that the same course of events will occur in the future, it may be expected that from the month of August to the month of December, 1882, the abnormal variations of the barometer at Bombay and Belgaum will in a general way follow the same course as was taken by the variations at Zanzibar during the months of April, May, June, and July; that is to say, an upward movement.

This prediction might be considered fairly reliable to within about a month one way or the other, were there no modifying conditions. But the curves are seen at a glance to present most decided departures from absolute parallelism; there are movements at Zanzibar which do not reappear at the eastern stations, whilst the eastern stations experience movements which do not appear to have been previously experienced at Zanzibar. Moreover, the rate of transmission of movements from Zanzibar to the west of India has been shown to vary from three to six months. And further, the movements at the eastern stations are sometimes much less or much greater than those which took place at the western station. Evidently, then, there is some influence which tends to produce irregularities in the eastward transmission of the abnormal movements; and this influence must be discovered and its occurrence foreseen and allowed for before the Zanzibar curve could be used for the purpose of predicting the nature of the movements at Belgaum and Bombay, and, as a consequence, the nature of the seasons in Western India.

A second inspection of the curves seems to indicate that not only are there abnormal movements which travel from the western station to the eastern ones, but there are also variations which are felt at all the three stations simultaneously. Thus in the months of July, 1880, June, 1881, and January, 1882, there are simultaneous upward bends of the curves at all the three stations. And again in the months of May, August, and November, 1881, there are simultaneous downward movements at all the three stations. These simultaneous movements are especially observable if the unsmoothed monthly abnormals (the thin dotted lines) be referred to instead of the smoothed curve (the thick continuous line). They are then seen to be exceedingly numerous—so numerous, indeed, that they may well be supposed to frequently mask the non-simultaneous or travelling movements, and cause those movements apparently to present many irregularities. The following table shows concisely the times when upward and downward movements have taken place at all the three stations simultaneously:—

TABLE III.—*At Zanzibar, Belgaum, and Bombay simultaneous Barometric Abnormal Movements*

Occurred in an upward direction in	Occurred in a downward direction in	Cannot be easily traced in
June 1880	May 1880	February 1880
[1] July ,,	November ,,	March ,,
October ,,	January 1881	April ,,
December ,,	March ,,	August ,,
February 1881	[1] May ,,	September ,,
[1] June ,,	[1] August ,,	April 1881
[1] September ,,	October ,,	July ,,
December ,,	[1] November ,,	March 1882
[1] January 1882	[1] February 1882	April ,,
	September ,,	May ,,
		June ,,
		July ,,
		August ,,

Thus out of thirty-two months there were nineteen in which it can be seen that simultaneous movements occurred at the three stations; and out of these nineteen months there were eight in which the movements were very distinct. In the remaining eleven months out of the nineteen the movements were not so prominent or well marked, but were always distinct enough to be readily recognised, and it does not seem unreasonable to suppose that the influence of such movements may have been felt in some if not all of those months in which they cannot be easily traced; that in fact the simultaneous movements may have been so small as to show themselves only in an excessive or deficient movement, upward or downward as the case may have been, of the curve which represents the non-simultaneous or travelling movements. In any case eight of these movements appear to be sufficiently distinct to disallow of doubt; and considering that Zanzibar is about 2500 miles distant from Belgaum, the fact seems to be interesting.

A. N. PEARSON,
Acg. Meteorological Reporter for Western India

Bombay, January 10

(*To be continued.*)

THE INSTITUTION OF MECHANICAL ENGINEERS IN BELGIUM

THE Institution of Mechanical Engineers has this year held its summer meeting in Belgium—the first time that it has crossed the Channel, except on the two occasions of the exhibitions in Paris. The reception was organised by the Association of Engineers from Liége University (Honorary Secretary, M. Édouard de Laveleye), and was of the most cordial character. The great works of Belgium were thrown open without reserve, and numerous excursions were organised to visit them. Amongst those specially to be noticed are the colossal establishment of the Cockerill Society at Seraing, the great iron and steel works at Ougrée and Sclessin, the vast zinc works of the Vieille Montagne Company, the cloth factories at Verviers, and the splendid collieries of Mariemont, probably the finest examples of colliery plant in the world. Space forbids our entering into a description of these works, and we shall confine ourselves to the papers read, so far as these possess more than a technical interest.

The proceedings opened on Monday evening, July 23, with a reception by the Mayor of Liége, after which the president, Mr. Percy Westmacott, delivered an interesting and suggestive address. After speaking of the great modern extension of Belgian industries, and of the debt which the world owes to the inventive skill of the engineer for providing those processes on which all trades are dependent for cheap and rapid production, he went on to develop his special theme, namely, the advantage of High Speed and its connection with high workmanship. The following extracts are well worth quoting:—

"The keen and continual attention bestowed upon the work to be done, and the means of doing it, has led engineers in general to regard speed of production as one of the first elements of success. There is indeed a proverb, 'more haste, less speed;' but this, though true of human labour, which ceases to

[1] In these months the movements are very distinct.

be accurate when forced beyond a certain rate, does not hold good of mechanical processes. Generally it may be said that rapidity of working not only reduces cost but improves the result, and also confers great benefits from the way in which it brings out and perfects the highest qualities of the engineer. To be able to do a thing leisurely and quietly simply requires the rudest materials and the rudest workmanship; but if work is to be done quickly, or the appliances made to move quickly, the case alters. Mechanical energy increases as the square of the speed; and so it may be said that the mental energy and skill required to carry on work increase also at something like the square of the speed with which that work is performed. The materials used must be far stronger and far finer; everything must be well proportioned and balanced; there must be the most perfect arrangement in each structure and in every part of a structure, and the most perfect workmanship in the fitting of those parts together; and thus we may almost reverse the proverb, and say of mechanical processes, 'The higher the speed, the better the work.'

"The torpedo boat is an excellent example of the advance towards high speeds, and shows what can be accomplished by studying lightness and strength in combination. In running at 22½ knots an hour, an engine with cylinders of 16-inch stroke will make 480 revolutions per minute, which gives 1280 feet per minute for piston speed; and it is remarked that engines running at that high rate work much more smoothly than at slower speeds, and that the difficulty of lubrication diminishes as the speed increases: doubtless the experiments on friction which are now being conducted by this Institution will throw light upon this subject.

"An important experiment on high speed in light vessels, which will doubtless be watched with much interest, is now being carried out. Mr. Loftus Perkins is building a steel vessel with a screw at each end: she is 150 feet long; her boiler pressure will be about 800 lbs. per square inch, and she has a four-cylinder compound condensing engine of 800 h.p. working on to a single crank, and making from 400 to 500 revolutions per minute. When this vessel is laden with 300 passengers, her total weight will not much exceed 150 tons. Should this experiment be successful, it will materially advance the solution of the problem, how to put the largest possible amount of propelling power into a vessel, and so to drive her at the highest possible speed.

"Again, in touching upon speeds, the mind naturally reverts to railway travelling. Here, however, it would seem as if for the present we had reached a maximum. It is surprising how soon the speed of the locomotive was brought up to something approaching its present limit. George Stephenson was laughed at in 1825 for maintaining that trains would be drawn by a locomotive at twelve miles an hour, but the 'Rocket' herself attained a speed of twenty-nine miles an hour at the Rainhill competition in 1829, and long afterwards ran four miles in four and a half minutes. In 1834 the average speed of trains on the Liverpool and Manchester Railway was twenty miles an hour; in 1838 it was twenty-five miles an hour. But by 1840 there were engines on the Great Western Railway capable of running fifty miles an hour with a train and eighty miles an hour without. In 1841 we find Stephenson himself ranged on the side of caution, and suggesting that forty miles an hour should be the highest regular speed for trains. In 1851 Mr. Crampton, who had already in 1849 inaugurated the express service of the Continent on the Northern Railway of France, conveyed a train twenty miles in nineteen minutes, four miles in the journey being at the rate of seventy-five miles an hour. Thus, it is a remarkable fact that the highest speed at which locomotives run in ordinary practice scarcely seems to have been raised during the last thirty years; on the other hand, the weight of the trains has been perhaps doubled.

"What are the causes which have tended to prevent any improvement in this particular? In the first place it may be said that the permanent way would suffer seriously by further increase in speed; but this could surely be overcome in time by improving the permanent way itself, which also remains very much in the same condition and of the same construction as it was twenty-five years ago. Again, it may be said that the running at a higher speed would require more powerful engines, and hence that trains now worked by a single engine would require two, or would have to be split up into two trains at a great increase in running expenses. This, however, assumes that it is not possible so to improve the engine that it shall be able to exert a considerably higher power without an inadmissible increase in weight. By utilising a larger part of the total weight of the engine as adhesion weight it would be easy to obtain the amount of adhesion required for the increased tractive force; and for this purpose Mr. Webb's compound locomotive (to be described by the author in a paper he has prepared for this meeting) which enables the number of driving wheels to be increased without the use of coupling-rods, appears to merit particular attention.

"Another point in which improvement may possibly arise in the future should be noticed. On the Russian railways, where both coal and wood are dear, the burning of petroleum has now taken a practical form. Our member, Mr. Thomas Urquhart, has been very successful in this direction, and is now running locomotives regularly which use only petroleum refuse, and which show a marked economy over coal or wood. To test the point he prepared three locomotives of exactly the same type, and started them on successive days under exactly similar conditions of weather, train, and section of road. The trips were made both ways, and the results per verst, including fuel required in lighting up, were as follows:—

	Copecks.
Anthracite, 52·9 Russian lbs., cost	26·35
Wood, 0·0107 cubic sashin, cost	23·54
Petroleum refuse, 27·36 Russian lbs., cost ...	11·64

"There is thus in this instance an economy of at least 50 per cent. on the side of petroleum, the boiler pressure being from 120 lbs. to 130 lbs. and the gross load over 400 tons. At the same time the weight of fuel used, as against coal, is diminished by about 50 per cent., which is a most important item.

"Although petroleum is scarcely a product of Western Europe, we have to notice on the other hand the progress which has lately been made in the extraction of oil as a waste product from coal, &c. Mr. Jameson has extracted as much as nine gallons per ton from mere shale. It is suggested that markets for such oil will be difficult to find; but it seems allowable to hazard the idea that we may hereafter see our locomotives, even in England, running with oil fuel, which would be at once much lighter and much more easily renewed than the coal which is used at present, and get rid of the intolerable nuisance of smoke and dirt. There might in fact be an oil tank and a water tank side by side at every stopping station, and the engine would replenish her store of fuel at the same time as her store of water.

"Another point in which speed and perfection of workmanship have gone hand in hand is the important industry connected with textile fabrics. When Arkwright first brought his inventive mind and mechanical skill to bear upon this subject, the tools he had to work with were rude compared with the tools of the present day, and could not produce the accurate work now attainable; and therefore the speed at which he was able to drive his spindles was not remarkable. But our member, Mr. John Dodd, of Messrs. Platt Bros., informs me that the average speed of mule spindles at Oldham, in new mills with new machinery, and spinning No. 32 yarn from American cotton, is about 8500 revolutions per minute; whilst speeds as high as 9500 or even 10,000 revolutions have been attained. When we consider the delicate nature of the material under treatment, the disastrous result of the slightest hitch or unevenness in working, and the perfection of mechanism required to bring up a multitude of spindles to such a speed from that of the comparatively slow main shaft of the mill, we may give every credit to the constructive skill which has achieved such a result. In woollen mills (of which we hope to see some excellent examples at Verviers on Thursday next) the speed is 4000 revolutions per minute. The progress made here has not been so great, mainly, in Mr. Dodd's opinion, from wood being still adhered to as the material for the bobbins. Here therefore is a case where improved material may yet produce improved speeds; but with cotton Mr. Dodd considers that the extreme possibilities as to speed have been very nearly attained. The limit however is imposed by the feebleness of the material, not by any lack of skill or enterprise on the part of the engineer. 'If higher speeds were required,' says Mr. Dodd, and I fully believe him, 'we could make spindles which would be equal to the demand.'

"The construction of modern artillery, and with still greater justice the methods of employing it, may properly be brought under the scope of this address. I doubt whether of late years any mechanical appliances or arrangements have given greater impetus to skilful work and to the improvement of materials, especially of steel. Twenty-five years ago the largest piece of ordnance in use was a gun weighing 4¾ tons, firing with a maximum charge of about 15½ lbs. of powder a ball of 66 lbs., and made of cast-iron, a treacherous material for such purposes. We have now guns built up on well understood mechanical principles, of the most trustworthy and suitable material known, weighing 100 tons and firing with charges of 772 lbs. of powder shells of 2000 lbs. Already considerable experience has been obtained with guns of this weight. No fewer than fourteen have been issued from the Elswick Works, and several more are in the course of construction.

"Perhaps the most interesting feature in these formidable pieces of ordnance is the ease, rapidity, and noiselessness with which they are worked. It is of course impossible that such ponderous pieces could be brought into practical use without the aid of some mechanical appliances; but it is scarcely an exaggeration to say that nothing can work with greater precision and ease and be better under control than the hydraulic machinery employed for opening and closing the breech of the gun, ramming home the charge, elevating or depressing, running in or out, and training with accuracy on a given object. Two men working levers perform all these operations, and they, together with the machinery, are under complete protection from an enemy's fire.

"The projectile when fired has an energy imparted to it equal to nearly 48,450 foot tons, yet the gun is under such entire control that its recoil, due to this enormous force, is completely absorbed in a distance little exceeding three feet, without undue strain to any part of the mechanism. When it is remembered that the internal dimensions of the costly turrets in which guns of this size are ordinarily mounted depend mainly upon the space allowed for recoil, it is clear that it is of very great importance to reduce this space to a minimum.

"The fact which lies at the basis of these results is of course this, that the attainment of a high speed requires a more perfect machine, and with a more perfect machine more perfect work is turned out.

"In conclusion, it should be remembered that high speed, especially the speed of rotation, is almost necessary to give perfect accuracy and steadiness to motion, as in the case of an ordinary spinning top, of a gyroscope, and again of the ingenious centrifugal machines now in use for separating cream, &c. The speeds which we find in Nature are beyond all conception high, and her operations under those speeds are absolutely true and perfect. We cannot hope to vie with Nature even to an infinitesimal fraction of her powers of speed and accuracy; but in this, as in many other great lessons taught by her, we see the direction in which we must travel in our efforts towards the perfection of work.

"Finally, it is unfortunately a necessity that nations should still provide themselves with materials for war; and engineers have to devote their minds to the perfecting of such materials. It does not seem impossible that projectiles may be gradually developed, of such precision and devastating power as to make the existence of life within a certain range well nigh impossible. Were this accomplished, it is clear that nations would hesitate more and more before rushing into a war so destructive; and even if they did so, its rapid termination would unquestionably go far to diminish the various miseries which war always brings in its train. Hence it may not unfairly be said that the attention and skill given to the arts of war is really our best warrant for the continuance of peace."

On the next morning the papers read were on the "History of the Coal and Iron Industries in the Liége District," by M. Edouard de Laveleye, and on the "Manufacture of Zinc in Belgium," by M. St. Paul de Sinçay. The first of these was generally of an historical character, giving many interesting details as to the development of collieries and ironworks in Belgium. A claim was put in on behalf of Belgium for two most important discoveries in the metallurgy of iron, namely, the blast furnace and the cementation process. With regard to the present position of coal-working in this district, it was observed that all the difficulties which generally beset the mining of coal have to be encountered in their severest form. The chief of them—fire-damp—is nowhere so destructive, though its effects have been to a great extent obviated by the introduction of the Davy lamp and afterwards the improved safety-lamp of Mueseler. This lamp will resist a current of air of 15 feet per second, and has also the great property of self-extinguishment. In the recent disaster at L'Agrappe, which cost the lives of more than 100 miners, a sudden escape of gas issued from the shaft and burnt for several hours like an enormous gas-burner; but there was no explosion inside the mine, the 220 Mueseler lamps which were underground at the time having all been extinguished. Similar escapes of gas have taken place on other occasions and in enormous volume, without having previously given any indication of their appearance. Science appears to be powerless to prevent these disasters.

The second paper gave a sketch of the manufacture of zinc, which is a special trade in Belgium. Little was said as to the details of metallurgy, but it appears that the Belgian process, invented by Dony, of Liége, in 1810, is superseding all others, even in England. The difficulty and loss in reduction are, however, very great, and the labour is described as harder even than that of the puddler.

The third paper, by M. Mélin, was on "The Manufacture of Sugar from Beetroot," and formed a complete and exhaustive monograph on a manufacture of which but little is known in England. We regret that we can only give the briefest possible sketch of the processes. The beetroot, of which the cultivation was fully described, contains about 95 per cent. of juice in weight, and 5 per cent. of cellulose. These 95 parts of juice contain 10 parts of sugar, 2 of solid matter, and 83 of water. In manufacturing, the special point to be considered is the percentage of sugar, together with the purity of the juice. The manufacture is carried on in the winter only, and the beetroots are piled in silos until they are required for use. They are then washed, and are now ready for the extraction of the juice. For this purpose two systems are employed. On the first or hydraulic system, the roots are immersed in powerful rasping machines, and so reduced to pulp. This pulp is collected in sacks, which are piled up one upon the other between the table and the pressure head of a hydraulic press. The press is started, and acts with a pressure of about 450 lbs. per square inch on the pile of sacks, squeezing the juice through them. The dry pulp is used for feeding cattle, and is of considerable value. On the second or diffusion system the beetroots are cut up by a cutting machine into small slices called *cossettes*. These are placed in cylindrical vessels with an opening at the top for charging, and another at the bottom for emptying. These vessels are filled with water, and the result is that a current of endosmosis takes place from the water towards the juice in the cells, and a current of exosmosis from the juice towards the water. These currents go on until equilibrium is produced; and if fresh water is substituted they begin afresh. In this way the whole of the sugar contained in the cells is gradually drawn out. On the other hand, the water passes from the more exhausted to the less exhausted cells, and thus gradually increases in richness. A number of such vessels are used, forming what is called a diffusion battery; but in each of them the process going on is the enriching of the juice on the one hand and the impoverishing of the slices on the other. The slices are finally pressed in order to remove the residue of juice, but this is never effected so completely as by the hydraulic method.

The next process is that of defecation, which consists in adding milk of lime to the juice, in order to neutralise the organic acids which are precipitated, and also to decompose the salts of potassium, sodium, and ammonia. The result is that the dark brown juice becomes perfectly clear and of an amber colour. The scum which floats on the top, and which contains much juice, is passed through filtering presses, and the dried cake is sold as manure. After defecation the juice is filtered, twice at least, through animal charcoal under a sufficient pressure. It is then evaporated and transformed into syrup in a series of three vertical vessels, of which the first communicates with the second, the second with the third, and the third with a condenser. Steam is admitted to the first, and passes through to the last; and, owing to the partial vacuum produced by means of the condenser, causes an evaporation of the juice in all three. The next process is that of boiling this group, so as to allow the sugar to crystallise. This goes on within cast-iron vessels under a high vacuum, and heated by steam at high pressure circulating through worms. After a certain amount of evaporation, crystallisation begins in the form of an immense number of small grains of sugar. To develop these grains syrup is pumped in at regular intervals and with great care, so that the crystals may grow steadily and may be large, regular, and hard. Finally the crystals are dried by ceasing to supply syrup and introducing a current of steam. After eight to ten hours the sugar is removed from the boilers, and placed in vertical turbines running at 1000 revolutions per minute. Under the action of centrifugal force the boiled mass is spread upon the outsides of these turbines, which are perforated, and the syrup passes through the holes, while the sugar remains behind. This sugar is cooled, and is called sugar No. 1. The syrup is boiled over again so as to obtain a second sugar called No. 2, and by a similar process a sugar No. 3 is obtained. The time of crystallisation, however, increases greatly, and for syrup No. 3 it is as much as six months. The final residue is molasses, which contains a large proportion of sugar that cannot be reduced by boiling. It is sold to make alcohol, or subjected to osmosis, by which the salts contained are drawn off and replaced by water; the sugar is then revivified and rendered capable of being crystalised. The paper concluded by giving careful analyses of the juice and of the products in all the stages of manufacture.

The next paper read was "On the Application of Electricity to the Working of Coal-Mines," by Mr. A. C. Bagot. The writer described a system of electric signals replacing the old system of signalling from the bottom to the top of the shaft by a gong worked by means of a wire. Galvanised iron telegraph wire was found to form the best communication, and the most suitable batteries to be 12-cell Leclanché. The system used for signalling in underground haulage planes, which are frequently the scene of accidents, was also described. Electricity had also been applied to signal the indications of an anemometer placed in the return air-way up to the engine-room at the surface. By an arrangement of clockwork and revolving tape, the engineer obtains an automatic and continuous record of the speed of the main air current at any part of the mine. Lastly the telephone might be applied with advantage for hearing the action of the pump-valves in the pumping shaft, without having to send the sinkers down.

Electricity may, however, be brought to bear for other purposes in mines, such as illumination and transmission of power. For lighting the pit bank, powerful arc lamps are found very serviceable, and the ordinary staff of a colliery, after a week's instruction, is capable of maintaining the appliances in operation. Alternating high-tension machines are very unadvisable on account of the likelihood of accident, and the Edison low-tension machine is said to be the best that can be used. At Risca Colliery a cable is taken down the pit from a dynamo at the surface, and is connected with a series of Crompton incandescent lamps at the bottom. These give an excellent light, and greatly facilitate the work of the men about the bottom of the shaft. But Mr. Bagot's opinion is strongly against the use of electric lamps in the working stalls and faces; partly because such lamps do not, like safety-lamps, indicate the approach of gas, partly because the line-wires may easily be broken, and partly because the hewer requires to be constantly shifting his light. With regard to the transmission of power by an electric tramway, as now in use at Zankerode, the writer holds that small locomotives worked by steam or compressed air are at present far more economical; so that the question of electric haulage need not in his opinion be considered at present.

These latter opinions did not pass without challenge. M. Tresca, who was present, pointed out that there was another form of electric transmission, viz. by a fixed cable with a dynamo at each end. Where work had to be done at some special part of a colliery, especially on an emergency, he believed that this would be found a handy and economical system. At the mines of La Perronière power was thus conveyed to a distance of 500 metres, and with a useful effect of about 30 per cent. This, in spite of over-bold statements to the contrary, was about the utmost which at present could be obtained in practice. The various sources of loss in such transmission were enumerated as follows:—First getting up the speed from that of the motor engine to that of the generator; secondly, loss within the generator itself; thirdly, loss in transmission along the cable; fourthly, loss within the receiver; fifthly, loss in slowing down the speed of the receiver to that of the main shaft. These defects were all now fully recognised, and might gradually, he hoped, be overcome. With regard to the amount of power which could thus be transmitted, the well-known experiments of M. Deprez showed 5 to 6 h.p. But within the last week he had succeeded in transmitting 31 h.p. from a Gramme machine to a great distance. The facility of installation was a great advantage in this system of transmission. It was far superior to that by an electric locomotive, as to which at present he had little to say; but on the whole he was more firm than ever in the view that a negative conclusion with regard to the electrical transmission of power was at any rate premature.

The next paper was by Mr. Webb, of Crewe, upon "Compound Locomotive Engines." It described the system devised by him, and now carried out in several engines running upon the London and North-Western Railway.

The last paper read at Liége was on the St. Gothard Railway, by Herr Wendelstein of Lucerne. This paper gave an interesting description of the works of the railway, and of the Brandt hydraulic drill, which was used with great success for one of the spiral tunnels. It then passed on to the question of ventilation, which was very fully gone into. Tables were given of the temperature in the great tunnel during and after construction, together with an account of the observations made on the ventilation both of that tunnel and of the spiral tunnels. The subject is as interesting from a scientific as it is important from a practical point of view, the result being that artificial measures of ventilation, the necessity for which was fully discussed, are found to be wholly needless. We regret that space does not allow us to reproduce this part of the paper.

During a subsequent visit of the Institution to Antwerp, a paper was read by M. Royers, describing the great harbour works which are now being constructed at that city, especially the long quay wall which is being built far out in the river by a special system of floating cofferdam designed by Mr. Hersent. In addition to these papers a large number of notices of the various works to be visited, &c., had been prepared and were distributed at the meeting. We understand that copies of any of these, or of the papers above mentioned, may be obtained on application to the Secretary, 10, Victoria Chambers, Westminster, S.W.

GEOGRAPHICAL NOTES

IN the *Transactions of the Berlin Geographical Society* (May-June) is an interesting paper by Herr Arthur Krause on South-eastern Alaska, or that strip of coast stretching from Mount Elias to Fort Simpson, comprehending about 120 miles breadth of continent, and the numerous islands lying alongside of it. Herr A. Krause passed the winter of 1882 with his brother at a factory to the north of the Lynn Canal, making short tours the following spring into the interior, as far as the Yukon district, and Herr Krause's paper is the result of his observations. The lower course of the Yukon River, as far as Fort Yukon, has been traced and astronomically observed by Raymond in his "Reconnaissance of the Yukon River, 1871." Its upper course and sources, on the other hand, have only seldom been visited by people of the Hudson's Bay Company and by gold seekers. The most important head stream is the Polly River, which springs from France's Lake on the west of the Rocky Mountains. From the south the Polly receives a powerful current, figuring in certain maps as the Lewis River. A northern offshoot of the Lynn channel cuts so deeply into the interior that in two short days' marches you can pass thence to the Yukon river. To the north of the Lynn Channel is the varied district of Chileat, forming the watershed between the coast and the Yukon river, and parting two distinct zones of flora and fauna. The Chileat district, like the whole of the west coast, is mountainous, and its peaks condensing the vapour driven by western winds from the warmer region of the sea, the whole western tract is distinguished by its violent falls of rain in summer and snow in winter, as also by its abundance of glaciers. Glacier Bay, to the west of the entrance of the Lynn Channel, is quite filled with ice in consequence of vast glaciers falling into it. All the valleys, too, along the coast abound in glaciers. As soon, however, as the watershed and the slope towards Yukon river are reached, the glaciers disappear. With this change also appears a corresponding change in vegetable and animal forms. The low banks and islands along the coast are covered with poplars, alders, willows, and thickets. Higher up on the slopes you meet a thick belt of pine. A few green trees of diminutive size, birch, maple, and mountain ash, may be observed, but these are mostly interwoven in the enormous thick underwoods of the pine forests. In some lower-lying spots an almost tropical luxuriance of vegetation surprises the traveller. On the inland side of the watershed the whole physiognomy of vegetation is in striking contrast with that on the sea side—is barer, drier, and lighter. Instructive particulars are also given by Herr Krause regarding the fur and fishing trades of this region.

IN the *Bulletin of the Italian Geographical Society* for July is a paper giving a historic survey of the Harar district, Somaliland, by the Rev. P. Taurin Cahague. Great interest attaches to this place since Frederick Müller has shown that it forms a distinct ethnologic enclave allied to the Semitic group of Abyssinia in the midst of the Hamitic populations of Somaliland. The town of Harar itself was never the capital of an independent kingdom, as has been wrongly stated by many writers, but simply a large emporium and station of great importance between the old Abyssinian empire and Massawa on the Gulf of Aden. Some years ago it was attached to the possessions of the Khedive, but on the withdrawal of the Egyptian troops the district was overrun by the fierce Oromo (Galla) people, who exterminated most of the old Ambaric (Abyssinian) population.—In the same number is an editorial note, with illustration, on a human foot incised by the Bushmen of South Africa on a stone, which has been presented by Dr. Holub to the Society, and is now deposited in the Royal Prehistoric Museum, Rome.

THE general census of Japan, taken on the first day of the present year, gives the total population of the country at 36,700,110, made up of 18,598,998 males, and 18,101,112 females. The population of the larger towns is given as follows:—Osaka, 1,772,333; Hiogo, 1,418,521; Nagasaki, 1,204,629; Tokio, 987,887; Kioto, 835,215. To avoid erroneous conclusions it may be well to state that the figures here given are not the populations of the towns and cities mentioned, but of the administrative districts, locally known as *fu* or *ken*, bearing these names. In some instances, *e.g.* Hiogo and Nagasaki, these districts are as large as a medium-sized English county, and in all cases they include the towns and villages for several (from ten to thirty) miles around. Thus these statistics can by no means be accepted as data for the respective sizes of the towns. These would run, we believe, as follows: Tokio, Osaka, Kioto, Nagasaki, Hiogo; the two latter being smaller than probably a dozen other Japanese towns which might be mentioned—Nagoya, Sendai, Niigata, Kagoshima, Shimonoseki, &c. Statisticians should therefore receive these figures with the explanation here given.

AMONG the papers in parts 3 and 4 of the *Verhandlungen der Gesellschaft für Erdkunde zu Berlin* for the current year, we find one by Dr. Schwarz on Montenegro, the land and people; another by Dr. Uble of Dresden on the divinity *Batara Guru* of the Malays; and also some geographical sketches of Portugal by Herr Müller-Beeck.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, July 30.—M. Blanchard, president, in the chair.—Active or dynamic resistance of solids. Graphic representation of the laws of longitudinal thrust applied to one end of a prismatic rod, the other end of which is fixed (continued), by MM. de Saint-Venant and Flamant.—Experiments on the reproduction of albite (white shorl) in an aqueous medium, by MM. C. Freidel and Ed. Sarasin. From a composition of silicate of soda and albite (Na_2O, Al_2O_3, $6SiO_2$) in a temperature ranging from 432° to 517° C., abundant precipitates of albite were obtained in the form of minute particles, which appeared as fine needle-points and short thick crystals with facets distinctly visible under the microscope. Steel and platinum vessels strong enough to resist this high temperature were specially constructed by MM. Golaz, père et fils.—Separation of gallium (continued). Separation from vanadium, by M. Lecoq de Boisbaudran.—Experimental researches on the action of a liquid introduced by a special process into the tissues of the vine for the purpose of destroying phylloxera (continued), by M. P. de Lafitte.—Capacity of various soils for retaining water under conditions suitable for viticulture, by M. P. Pichard. Appended is a comparative table showing the various degrees of resistance offered to the infiltration of water by siliceous, argillaceous, calcareous, and other soils in the south-east of France.—On the integration of a certain class of partial differential equations of the second order with two independent variants, by M. A. Picart.—On the critical temperature and critical pressure of oxygen, by M. S. Wroblewsky. The critical point is approximately determined at − 113° C.—A determination of the inward inert resistance of any electric system, independently of the disturbing action of its interior electromotor forces, whose number, seat, and size remain unknown quantities, by M. G. Cabanellas.—On the visibility of the ultra-violet rays, by M. J. L. Soret.—A silicophosphate of crystallised lime obtained by liberating phosphorus in the process of iron-smelting, by MM. Ad. Carnot and Richard. —On the artificial production of rhodonite (silicate of manganese) and tephroite, by M. Alex. Gorgeu. A new and easy method is explained for producing these two natural crystallised silicates of manganese based on the reciprocal action of silicium and the red chloride of manganese in aqueous vapour.—On the "chloride of menthylum" obtained by Oppenheim from menthol by the action of a concentrated solution of chlorhydric acid, by M. G. Arth.—Experiments on poisoning by the oxide of carbon, with a view to ascertain whether this gas passes from the mother to the fœtus, by MM. Gréhant and Quinquaud. The authors, who experimented on bitches, arrived at an opposite conclusion from Andreas Hogyes of Klausenburg, who experimented on rabbits, and who concluded that the fœtus remained unaffected by the poison which was fatal to the mother.—On the open epithelium ("cellule epithéliale fenêtrée") of the closed follicules of the intestine of the rabbit, and its temporary stomata, by M. J. Renaut.—Researches on the structure of the constituent parts of the vent in Cephalopods, by M. P. Girod.—Observations and experiments on the circulation of the sap in plants under the tropics, by M. V. Marcano. From the experiments carried on at Caracas, Venezuela (10° 30′ 50″ N. lat.), the author considers that in intertropical vegetation the cycle of circulation is completed within a period of twenty-four hours, presenting two *maxima* of relative fixity, and that the inner pressure of the sap is inferior to that of the atmosphere during the dry but far greater during the rainy season, a phenomenon attributed mainly to the water directly absorbed by the leaves.—On the differentiation and anatomic variations of the branches of forest and fruit-bearing trees, and some other plants, by M. Laborie.—On the action of silica on the growth of maize, by M. V. Jodin.—On the alterations produced by age on wheat-flour preserved in bins and sacks, by M. Balland.—Experiments on evaporation made at Arles during the years 1876–82, by M. A. Salles. In his remarks on this paper, M. Lalanne dwells on the great importance of the subject in connection with the projected inland sea towards the southern frontier of Tunis.—Observations on Part IV. of M. de Koninck's work on the carboniferous fauna of Belgium, by M. Hébert.

CONTENTS

PAGE
Two "Eminent Scotsmen" 337
The Heavenly Bodies 338
Our Book Shelf:—
"United States Commission of Fish and Fisheries" . 339
Letters to the Editor:—
Cyanogen in Small Induction Sparks in Free Air.—Prof. C. Piazzi Smyth (*With Diagrams*) . . . 340
The Earliest Known Plotting Scale.—W. M. Flinders Petrie 341
A Result of our Testimonial System.—Dr. M. Foster, F.R.S. 341
Birds and Cholera.—Rev. O. Fisher; Henry Cecil; D. Wn. 342
Animal Intelligence.—F. R. Mallet; Joseph Stevens; J. de B. F. P. 342
Different Sources of Illumination.—George Forbes. 343
A Remarkable Form of Cloud.—Rev. W. Clement Ley 343
Disease of Potatoes.—A. Stephen Wilson . . . 343
"Zoology at the Fisheries Exhibition."—Bryce-Wright 344
"The Student's Mechanics."—Walter R. Browne . 344
Sand.—James Melvin 344
Treble Primary Rainbow.—R. 344
Fuegian Ethnology. By Prof. A. H. Keane . . . 344
The Ischian Earthquake 345
The Norwegian North Sea Expedition (*With Illustrations*) 348
The Shooting Stars of the July Meteoric Epoch. By W. F. Denning 351
Notes 352
A Contribution to the Study of the Transmission Eastwards round the Globe of Barometric Abnormal Movements. By A. N. Pearson, Acg. Meteorological Reporter for Western India (*With Chart*) 354
The Institution of Mechanical Engineers in Belgium 356
Geographical Notes 359
Societies and Academies 360