though of unequal merit. Any of them would make a charming present for an intelligent child.

ON November 10 there was an earthquake in Salvador in Central America, and on the 12th a stronger one. At Simla there was an earthquake on November 25. Two sharp shocks were felt at Macedonia on November 26 at 11 P.M.

WHAT is called the Iquique earthquake took place on Oct. 8, at 1 A.M. Although alarming and lasting two minutes, with a terrible shaking of the earth, first vertical and afterwards oscillatory, it did no damage at Iquique. It was, however, simultaneously felt elsewhere, and has destroyed or damaged the towns of Tarapaca, Usmagama, Guasquina, Pica, Matilla, and the village of Pachica. Some persons were injured, but only two lost their lives.

AT a recent meeting of the Scientific Committee of the Horticultural Society, a letter was read from Mr. Anderson-Henry (printed in the *Gardeners' Chronicle* for Dec. 9), in which he gave some curious results of his observations on climbing plants. Mr. Henry stated that certain climbers evince a partiality for some other species, stretching out their tendrils or branches so as to come in contact with them, while to other species they have as strong an aversion, avoiding them and never touching them, though they may run up the same wall side by side. The subject is a curious one, and deserves further investigation.

"THE Fortunate Isles," translated from the French of Ogier, is an account of the Canaries. A chapter on the celebrated dragon tree contains the two passages here transcribed. Written apparently in sober earnest, they are, perhaps, not the least remarkable contribution to the scientific literature of the year now ended. "It is an undoubted fact that before the great Mediterranean deluge, and to a certain point even after it, strange creatures brought forth in transitional periods, inhabited the marshy grounds or those shallow seas which still remained warm. This epoch, called by modern geologists the Reptile Period, produced creatures belonging at once to the animal, vegetable, and mineral kingdoms, or to two only; monstrous products of creative forces; birds, quadrupeds, fish, plants, reptiles, all at once, either united or distinct; the greater number of these have been restored for us by geologists. . . . . The dragon has existed. The first men saw the last survivors of these prodigious creatures, and the memory of them has been preserved. The struggles of mankind with the mighty creatures which overran the earth must have been terrible. The excessive alarm of men possessing no weapons in the first ages, gave rise to the traditions of formidable beings attacking mankind and destroyed by the demi-gods, strong and brave men."

FROM the *Elizabeth Daily Journal* of New Jersey of Nov. 28 we have a marvellous story of a carrier pigeon, which we commend to the notice of Mr. Tegetmeier. It performed the journey from Sopus Farm, Warren Co., N.J., to Sandusky Ohio, a distance of 400 miles, in exactly an hour, and its condition on its arrival at the latter place is thus described:—"I found the greatest excitement had followed the arrival of the pigeon. Mr. Smythe told me that at precisely two o'clock the bird came like an arrow into his house. His movement was more like a blue streak than a well-defined bird. He seemed but little exhausted, although nearly all the feathers were off his body, except the small patch held on his back by the gutta-percha which fastened the note. A few miles more would have worn every feather from his wings, and then he would have to depend upon the momentum already acquired to carry him on his journey, and to steer by a tailless rump, and perhaps be killed in attempting to alight." No wonder the owner offers to match this pigeon "when he has grown a new suit of feathers" for 1,000 dollars against any carrier pigeon that has not done this distance in an equal time.

*PERIODICITY OF SUN-SPOTS**

IN the short account of some recent investigations by Prof. Wolf and M. Fritz on Sun-spot phenomena, which has been published lately in the "Proceedings of the Royal Society" (No. 127, 1871), it was pointed out that some of Wolf's conclusions were not quite borne out by the results which we have given in our last paper on Solar Physics in the Philosophical Transactions for 1870, pp. 389-496. A closer inquiry into the cause of this discrepancy has led us to what appears a definite law, connecting numerically the two branches of the periodic sun-spot curve, viz., the time during which there is a regular diminution of spot-production, and the time during which there is a constant increase.

It will be well, for the sake of clearness, to allude here again, as briefly as possible, to Prof. Wolf's results before stating those at which we have arrived.

Prof. Wolf has previously devoted the greater part of his laborious researches to a precise determination of the mean *length* of the whole sun-spot period, but latterly he has justly recognised the importance of obtaining some knowledge of the average character of the periodic increase and decrease. Hence he has, as far as he has been able to do so by existing series of observations, and his peculiar and ingenious method of rendering observations made at different times and by different observers comparable with each other, endeavoured to investigate more closely the nature of the periodic sun-spot curve, by tabulating and graphically representing the monthly means taken during two and a half years before and after the minimum, and applying this method to five distinct minimum epochs, which he has fixed by the following years:—

1823·2
1833·8
1844·0
1856·2
1867·2

In a table he gives their mean numbers, expressing the solar activity, arranged in various columns; and arrives at the following results:—

(1) It is shown now with greater precision than was previously possible, that the curve of sun-spots ascends with greater rapidity than it descends. The fact is shown in the subjoined diagram, which it may be of interest to compare with the curves given previously by ourselves in the above-mentioned place. The zero-point in this diagram corresponds to the minimum of each period; the abscissæ give the time before and after it, viz., two and a half years, or thirty months; the ordinates express the amount of spot-production in numbers of an arbitrary scale. The two finely dotted curves are intended to show the actual character of a portion of two periods only, viz., those which had their minima in 1823·2 and 1867·2; the strongly dotted curve, however, gives the mean of all periods (five) over which the investigation extends.

(2) Denoting by x the number of years during which the curve ascends, and presuming that the behaviour is approximately the same throughout the whole period of 11·1 years as during the five years investigated, we have the proportion

$$x : 11{\cdot}1 - x :: 1 : 2,$$

whence $x = 3{\cdot}7$,

or the average duration of an ascent is 3·7 years, that of a descent 7·4 years.

(3) The character of a single period may essentially differ from the mean, but on the whole it appears that a $\left\{\begin{matrix}\text{retarded}\\\text{accelerated}\end{matrix}\right\}$ descent corresponds to a $\left\{\begin{matrix}\text{retarded}\\\text{accelerated}\end{matrix}\right\}$ ascent. Thus the minimum of 1844·0 behaved very normally; but that of 1856·2, and still more that of 1823·2, shown in the following diagram, presents a retarded ascent and descent; on the other hand, the minimum of 1833·8, and still more in that of 1867·2, also shown in the diagram, both ascent and descent are accelerated.

Finally Prof. Wolf arranged in the manner shown in the following table the successive minima and maxima, in order to arrive at some generalisation which might enable him to foretell the general character and length of a future period. Taking the absolute differences in time of every two successive maxima, and

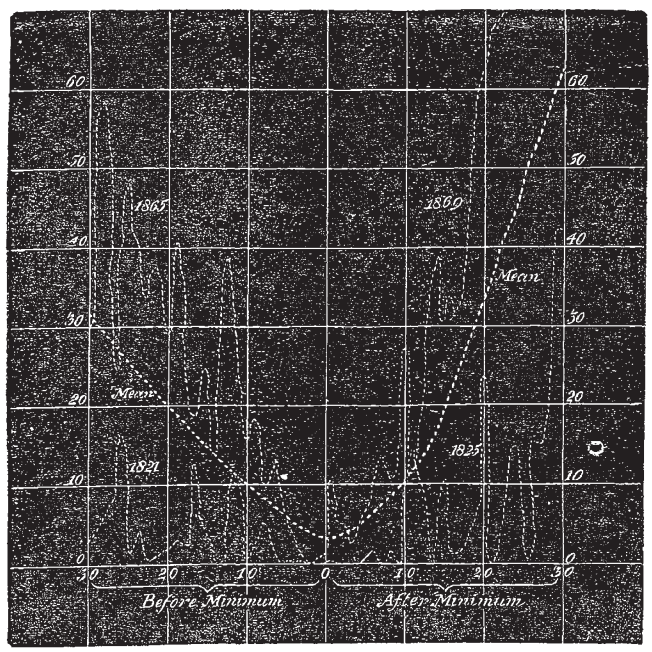
* Abstract of paper read before the Royal Society December 21, 1871. "On some recent Researches in Solar Physics, and a Law regulating the time of duration of the Sun-spot Period." By Warren De La Rue, F.R.S., Balfour Stewart, F.R.S., and Benjamin Loewy, F.R.A.S.

the mean differences of every two alternating minima, he shows that the greatest acceleration of both maximum and minimum happens together. This result strengthens our own conclusions, to be immediately stated, by new evidence, as it is derived from observations antecedent to the time over which our researches extend.

Minima.	Differences of alternating Minima.	Means.	Maxima	Differences of successive Maxima.
1810·5				
			1816·8	
	23·3	11·65		12·7
1823·2			1829·5	
	20·8	10·4		7·7
1833·8			1837·2	
	22·4	11·2		11·4
1844·0			1846·6	
	23·2	11·6		11·6
1856·2			1860·2	
1867·2				

From this Prof. Wolf predicts for the present period a very accelerated maximum—a prediction which seems likely to be fulfilled.

Comparing now M. Wolf's results with our own, it must not be overlooked, in judging of the agreement or discrepancy of these two independently obtained sets, that our facts have been derived from the actual measurement and subsequent calculation of the spotted area from day to day since 1833, recorded by Schwabe, Carrington, and the Kew solar photograms, which measurements are expressed as millionths of the sun's visible hemisphere, while the conclusions of M. Wolf are founded on certain "relative numbers," which give the amount of observed spots on an arbitrary scale, chiefly designed to make observations made at different times and by various observers comparable with each other. This will obviously, in addition to the sources of error to which our own method is liable, introduce an amount of uncertainty arising from errors of estimation, and the possibility of using for a whole series an erroneous factor of reduction. Nevertheless we shall find a very close agreement in various im-



portant results, and this seems a sufficient proof of the great value and reliability of M. Wolf's "relative numbers," especially for times previous to the commencement of regular sun observations.

The following is a comparison of the data of periodic epochs, as fixed by ourselves and M. Wolf:—

Minima epochs.	I.	II.	III.	IV.
De La Rue, Stewart, and Loewy	1833·92	1843·75	1856·31	1867·12
Rudolf Wolf	1833·8	1844·0	1856·2	1867·2
Maxima epochs.	**I.**	**II.**	**III.**	
De La Rue, Stewart, and Loewy	1836·98	1847·87	1859·69	
Rudolf Wolf	1837·2	1846·6	1860·2	

It will be seen from this comparison that only one appreciable difference occurs, viz., in the maximum of 1847, which M. Wolf fixes nearly one and a quarter years before our date.

The mean length of a period is found by us to be 11·07 years, which agrees very well with M. Wolf's value, viz., 11·1 years.

We found the following times for the duration of increase of spots during the three periods, and for the corresponding decrease, or for ascent and descent of the graphic curve, beginning with the minimum of 1833:—

	Time of ascent.	Time of descent.
I.	3·06 years.	6·77 years.
II.	4·12 ,,	8·44 ,,
III.	3·37 ,,	7·43 ,,
Mean	3·52 ,,	7·55 ,,

Prof. Wolf gives 3·7 years and 7·4 years for the ascent and descent respectively; and considering that he derived these numbers only from an investigation of a portion of each period, the agreement is indeed surprising, and would by itself suggest that the times of ascent and descent are connected by a definite law.

M. Wolf has expressed in general terms the following law with reference to this relation of increase and decrease of spots:—

"The character of a single period may essentially differ from the mean behaviour, but on the whole it appears that a { retarded / accelerated } descent corresponds to a { retarded / accelerated } ascent."

We, on the other hand, have, by an inspection of our curves (*vide* Phil. Trans. 1870, p. 393), been induced to make the following remark on the same question:—

"We see that the second curve, which was no longer in period as a whole than either of the other two, manifests this excess in each of its branches, that is to say, its left or ascending branch is larger as a whole than the same branch of the two other curves, and the same takes place for the second or descending branch. On the other hand, the maximum of this curve is not so high as that of either of the other two—in fact, the curve has the appearance as if it were pressed down from above and pressed out laterally so as to lose in elevation what it gains in time."

Although both statements appear to lead up to the same conclusion—viz., that ascent and descent are connected by law—still they differ essentially in this respect, that if A, B, C represent the three following consecutive events, descent, ascent, descent,

Prof. Wolf's law refers to the connection between A and B, while our remark refers to B and C. We consider two successive minima as the beginning and end of a single period, while M. Wolf, at least in this particular research, places the minimum within the period, and compares the descent from the preceding maximum with the ascent to the next one.

We have considered the connection thus indicated of sufficient importance to apply to it the following test. If, using the previous notation, a definite relation exists between A and B, the *ratio* of the times which the events occupy in every epoch ought to be approximately constant; similarly with respect to B and C; and this ratio should not be influenced by the *absolute* duration of the two successive events. It is clear that the greater uniformity of these ratios will be a test of their interdependence. The following is the result of the comparison:—

a. Prof. Wolf's law: comparison of A and B.

	Periods.	Duration of descent (A).	Periods.	Duration of ascent (B).
I.	1829·5 to 1833·8	4·3 years	1833·8 to 1837·2	3·4 years.
II.	1837·2 to 1844·0	6·8 ,,	1844·0 to 1846·6	2·6 ,,
III.	1846·6 to 1856·2	9·6 ,,	1856·2 to 1860·2	4·0 ,,

	Ratio $\frac{A}{B}$.		Difference from mean.
I.	1·265	Mean 2·093	−0·728
II.	2·615		+0·522
III.	2·400		+0·307

These differences from the mean are so considerable that in the present state of the inquiry a connection between any descent and the immediately *succeeding* ascent appears highly improbable. A very new and apparently important relation seems, however, to result from a similar comparison of any ascent and the immediately succeeding descent, or between B and C.

b. Comparison of B and C.

	Periods.	Duration of ascent (B).	Periods.	Duration of descent (C).
I.	1833·92 to 1836·98	3·06 years	1836·98 to 1843·75	6·77 years
II.	1843·75 to 1847·87	4·12 ,,	1847·87 to 1856·31	8·44 ,,
III.	1856·31 to 1859·69	3·38 ,,	1859·69 to 1867·12	7·43 ,,

	Ratio $\frac{C}{B}$.		Difference from mean.
I.	2·212	Mean 2·151	+0·061
II.	2·044		−0·107
III.	2·198		+0·047

PROF. AGASSIZ'S EXPLORING EXPEDITION *

WE have already announced the departure of the United States Coast Survey exploring steamer, *Hassler*, upon that scientific mission which, under the direction of Prof. Agassiz, will doubtless be productive of very important results. Just before starting on the expedition, Prof. Agassiz addressed a communication to the Superintendent of the Coast Survey, in which he ventured to assume the character of a prophet by stating in advance what it was probable would crown their efforts in the way of discovery.

The Professor makes this communication in the hope of showing within what limits natural history has advanced toward that point of maturity when science may anticipate the discovery of facts. Basing his expectations upon the ascertained principles of science, and taking into consideration the relationshlps between different forms of animal life, and the succession of geological epochs, and in view of the very interesting results of later deep-sea dredging expeditions in the North Atlantic, he anticipates the discovery, "from the greater depth of the ocean, of representatives resembling those types of animals which were prominent in earlier geological periods, or bear a closer resemblance to younger stages of the higher members of the same types, or to the lower forms which take their place nowadays."

Making no suggestion in regard to mammals, he remarks that if reptiles exist in the deep waters, they must be only such as are related to the extinct types of the Jurassic periods, such as the ichthyosauri, plesiosauri, and pterodactyles; but even of these he thinks there is very little probability that any representatives are still alive.

Among the fishes he expects to discover some marine representatives of the order of ganoids of the principal types known from the secondary zoological period. Among the sharks he thinks he shall find new forms allied to *Cestracion*, or *Hybodon*, or *Odontaspis*, as also new genera of chimæroids; and among ordinary fishes the allies of *Beryx*, *Elops*, &c. It is among the molluscs and radiates that objects of the greatest interest will probably be met with: and chief among these will be nautiloid cephalopods—perhaps even ammonites—and forms only known hitherto in the fossil state. Among *Acephala* he anticipates the discovery of a variety of forms resembling those from the Jurassic and Cretaceous deposits; while *Rudistes* will take the place of oysters, and brachiopods be found very abundant.

Among *Crustacea* it is not at all impossible that forms may be found resembling trilobites; while among echinoderms he confidently expects to meet with spatangoids approaching *Holaster*, and others akin to *Dysaster*, &c.

A careful comparison of the members of the deep-sea faunæ of the northern and southern hemispheres will probably prove of the greatest interest, and, judging from the peculiarities of the land and shore fauna of Australia, it is likely that the adjacent deep-sea animals will be equally divergent, and will represent remarkable forms, and especially of an extremely antique type.

The Professor also hopes that much light will be thrown upon the subject of the geology of the southern hemisphere, and upon the general features of the drift, since all the phenomena related to the glacial period must be found in the southern hemisphere with the same essential characteristics as in the northern, yet with this difference, that everything must be reversed; that is, the trend of the glacial abrasion must be from the south northward; the lee side of the abraded rocks must be on the north side of hills and mountain ranges, and the boulders must have been derived from rocky exposures lying to the south of their present position. This point, however, must be established by observation. The Professor thinks this will be found to be the case, with the exception, perhaps, of the present glaciers of Tierra del Fuego and Patagonia.

In reply to the possible inquiry as to what the question of drift has to do with deep-sea dredging, he remarks that the connection is closer than may at first appear. If drift is not of glacial origin, but the product of marine currents, its formation at once becomes a matter for the Coast Survey to investigate; but he expresses the belief that it will be found that, so far from being accumulated by the sea, the drift of the lowlands of Patagonia has been worn away to its present extent by the continued encroachment of the ocean, in the same manner as the northern shores of South America and of Brazil have been.

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SCIENTIFIC SERIALS

Annalen der Chemie und Pharmacie, clix., August 1871. Fittig and Remsen communicate a second paper "On the Constitution of Piperine and its decomposition products, Piperic Acid and Piperidine;" in the former paper two oxidation products were described, piperonal and piperonylic acid, which stand to each other in the relation of aldehyde and acetic acid. In the present communication several new reactions of these substances are described.—The second note, "A Reaction of free Phenol-hydroxyls," shows that the benzene derivatives, containing hydroxyl associated with this nucleus, give colours with a neutral solution of ferric chloride; the intensity of the colour produced seems to bear some proportion to the number of free hydroxyl atoms, the more intense colours being produced by bodies containing more than one hydroxyl.—A paper "On the relations between the Glycerin and Allyl compounds," by Huebner and Mueller follows. They show that the dichlorhydrin prepared by Berthelot's method is a mixture of two isomeric bodies, one of which boils at 174° and can be obtained in a pure state by the action of hydrochloric acid on epichlorhydrin, the other boils at 182° and is identical with dichlorallyl alcohol. Both of these compounds yield allyl alcohol when acted on by sodium in the presence of ether. Kraut and Popp have found that if sodium amalgam containing 3 per cent. sodium is placed in potassic hydrate solution, hard cubes are formed, which, however, possess no definite composition; by the action of sodic hydrate solution long needles are obtained, having the composition $Na_2\ Hg_{12}$.—A lengthy paper by Hoffmeister follows "On Phenyl Ether and Diphenyloxide." The former is prepared by the action of nitrous acid on aniline sulphate, the product from which is mixed with phenol when nitrogen is evolved and phenyl ether formed. It can also be produced by the dry distillation of cupric benzoate. Diphenyl oxide is produced by acting on phenol with phosphoric chloride, and again acting on