Saturday are reported from Antequera, and nine from Archidona. That the disturbance has not yet ceased is shown by the report from Torrox that the shocks were renewed there on the morning of the 29th, shaking the foundation of the Town Hall, and causing cracks in the walls of other houses; while other violent shocks are reported from Malaga and Granada on the evening of the 30th, one at 7 and the other at 10 o'clock. In connection with these after-shocks, a report from Tarvis, in Carinthia, states that an earthquake was felt there on Sunday, which by the oscillation it caused cracked the walls of many houses. The Spanish earthquake was not felt in the north and north-western provinces. No precise information as to the times of the shocks at the various places has been received. At Xerez and Cadiz, according to one account, the first smart shocks occurred shortly before 9 o'clock, and other slighter shocks about midnight and 4 o'clock the next morning. At Ciudad Real no damage appears to have been done, beyond the alarm to the inhabitants, who passed the night in the open, fearing a recurrence of the shocks. At Velez Malaga and Malaga proper several shocks injured the theatre and the churches, the falling masonry killing several persons. The clocks are stated to have stopped in various parts of Andalusia at from ten to seven minutes before nine, which may therefore be taken as the time of the first shock.

We have received the following correspondence on the subject of the earthquake:—

YESTERDAY, 25th, at 8h. 53m. p.m., slight earthquake in Madrid: two distinct shocks in 3 to 5 seconds; house bells set ringing and lamps and other suspended objects swinging; the oscillations were almost due east and west, which gives north and south as the direction (rough) of seismic disturbance. This was evidently stronger in some parts of the town than others, as out here it produced no effect outside, whereas according to this morning's paper much alarm was produced in some streets by people rushing out of their houses. But earthquakes are very uncommon in Madrid, and this accounts sufficiently for the scare. There really was no particular cause for alarm. Official telegrams report shocks felt at about the same time in Cadiz, Malaga, Granada, and Cordova.

F. GILLMAN

Quintana, 26, Madrid, December 26, 1884

I HAVE reason to believe that this commotion extended to England. On the night of December 25 I left my family quietly seated round the fire at 10 o'clock. Being in bed myself at about 10.20, I perceptibly felt a shock of earthquake such as I have often experienced in the vicinity of Naples, and I said to my wife, who came up shortly afterwards, "I have felt a distant shock of earthquake. if there is nothing moving downstairs," which from the distance of the offices there certainly was not. The motion, we learn, was from south to north, and the usual rate of movement corresponds well with the time of the occurrence—say 6 minutes to 9 at Madrid.

The Rookery, Ramsbury, Wilts ALFRED BATSON

THE HABITS OF THE LIMPET

THE following observations upon the habits of the common limpet (*Patella vulgata*) were made during last July at the Scottish Marine Station, Granton, Edinburgh. I am much indebted to Mr. John Murray, the manager of the Station, for kindly placing its resources at my disposal, and also to Mr. J. T. Cunningham, B.A., the director, for much kind advice and assistance.

The *Ark* is moored in the centre of a flooded quarry, upon whose faces large numbers of limpets are to be found. As parts of these faces are almost or quite vertical, it was easy to take a boat round and make observations during all states of the tide. The few that were made bear on the feeding and locality-sense of the form in question.

By far the larger number of limpets "roost" upon rocks whose only covering consists of minute green algæ and nullipores, together with numerous acorn barnacles. These last are seen to be of very unequal degrees of "cleanness," some being covered with vegetable growth, others quite white and bare. Those immediately surrounding a limpet or group of limpets are invariably free from algæ. As might have been anticipated, Patella is the cause of this freedom. At low tide anyone on the look-out can hear a quick, regular, rasping sound in all directions, and see numerous limpets slowly crawling about. Scrutiny of any particular individual shows that the rasping noise is caused by strokes of the radula, which speedily scrapes away the incrusting algæ. Whilst "on the feed" a limpet moves steadily on, pretty much in a straight line, and continually sweeps its elongated snout from side to side, feeling out probably suitable patches whereon to graze. When such a one is discovered, it is gradually licked quite clean. If the patch happens to be the surface of a moderate-sized barnacle, the circular lip is completely spread over it, almost tempting one to believe that the crustacean is about to be "sawn out." Such, however, is not the case, "house-cleaning" being the sole end in view. Indeed, limpets are often serviceable to one another by thus clearing away esculents growing upon their shells. To secure a dinner, a good deal of licking is requisite, and perhaps this habit may help to account for the inordinate length of the tongue-ribbon. Certainly it must be used up at a very great rate.

But this is not the only, though I believe the chief, way in which the limpet feeds. Those individuals which live near large sea-weeds, such as Fucus, feed extensively upon them, as their gnawed condition testifies. I can speak confidently in this matter, having caught more than one limpet in the act. The operation was as follows:—The edge of a thick flat part of the thallus was seized by the lip (as a traveller might commence on a colossal sandwich), and being, I suppose, held firmly by the upper jaw, a semicircular "bite" was gradually excavated by successive scrapes of the radula, the edges of the bite being bevelled on the under side. So far as my observations extended, limpets do not feed when covered by water, but always settle down firmly before the rising tide reaches them. The intervals between which any particular limpet feeds seem to be very irregular; but, as a rule, the largest limpets are apparently least fond of long fasts.

In regard to the second point, the locality-sense, great doubt seems to exist in the minds of naturalists as to whether limpets go back to the same place to roost. I believe the question was answered in the affirmative long since by a Mr. King, but, as far as is known to me, he did not publish any details of his observations, and this is my excuse for giving an outline of mine. Following a suggestion of Mr. Murray, I marked a number of limpets with white paint, and made corresponding marks near their "scars" with a view to "keeping my eye on them." As Dr. S. P. Woodward remarks, it seems probable from an *a priori* point of view, that limpets have a settled home, for they occupy scars, often sunk to a considerable depth, which *exactly* correspond to the outline of the shell. My observations, made on numerous specimens of various sizes, completely confirm Mr. King's opinion, and the method of marking rendered cases of "mistaken identity" quite out of the question. The greatest distance from its scar at which I noticed a marked limpet to be, was about three feet; yet this distance, though extremely rough, and covered with barnacles, was re-traversed without difficulty. The excursions from the roosting-places were made in any direction where food offered; so there were nothing like beaten tracks formed. But a limpet always returns home before the rising tide reaches it, and invariably

roosts with its snout pointing in the same direction. As might be expected, this direction is only constant for individuals. As the shape of the scar corresponds exactly with the shape of the shell, comfort, of course, could only be gained and a firm hold effected by limpets roosting permanently in the same direction on their scars.

The question now arises, What sense is employed by the limpet in finding its way back to its scar? The appreciation of locality displayed is certainly, for so simply-organised an animal, very keen. The sense of sight is evidently out of court, for an eye like the limpet's, consisting of no more than a sensitive cup, could do little if any more than distinguish between light of different degrees of intensity. The tentacles seemed at first sight to be extremely likely organs to use for the purpose, and to decide this I excised those of two marked individuals which were off their scars. One speedily found its way back; the other seemed confused by the operation for several days, but after that time was found on its scar. This shows a remarkable power of memory, unless the scar was found by accident, which is possible, as the individual was near home when the operation was performed. But even in that case the scar must almost certainly have been *remembered*. Thus, the tentacles do not seem to be the means by which home is returned to. The sense of smell then suggested itself, and it occurred to me that one reason why limpets kept on their scars when covered by the water was to prevent the "scent" of the track traversed from being washed off. With a view to determine this the space between a wandering limpet and its scar and the scar was carefully washed again and again with sea-water. In spite of this the limpet in question readily found its way back again. Further experiments are, however, needed on this head, for any ordinary washing would be very ineffective compared with the prolonged soaking the tide would effect in the case of a limpet (like the one just mentioned) living some distance below high-water mark. Still some limpets live so near this last that they are covered but a very short time, and yet these remain on their scars during that time. Hence I think some other motive probably induces them to remain firmly fixed to their scars when under water. Of course they can hold on best when so fixed, and this suggests the most likely reason for the habit, *i.e.* to avoid being washed off the rocks by the tide. I am inclined to think that the snout plays some part in helping the limpet to get home, as this organ is extremely sensitive, and certainly plays an important part in discovering suitable food. I intend carrying on more extended observations with a view to the more complete elucidation of this puzzling question in regard to the limpet's locality-sense, but this preliminary notice may possibly be of some interest. J. R. DAVIS

University College of Wales, Aberystwith

THE MEDITERRANEAN FAUNA[1]

VERY welcome to all zoologists, especially to those living in Europe, will be the first part of what promises to be a most useful work on the animals known to inhabit the Mediterranean Sea. For more than twenty-five years Prof. J. Victor Carus tells us he has been collecting the materials for such a volume, and now that he has to be congratulated on the appearance of so much of it, we trust it may not be long ere we shall be enabled to announce that it is complete. The first part gives a list of the Cœlenterates, Echinoderms, and Worms. The next will treat of the Arthropods, Mollusks, and Vertebrates. The author on mature deliberation resolved to omit from the enumeration the Protozoa and Sponges, not seeing his way to give of these satisfactory detailed diagnoses, and also because, while Haeckel and others have done a good deal towards increasing our knowledge of the Mediterranean Protozoa, and Oscar Schmidt and others have done the same with the Sponges, yet the groups have not been rigidly systematised in the same way, for example, as the Cœlenterates.

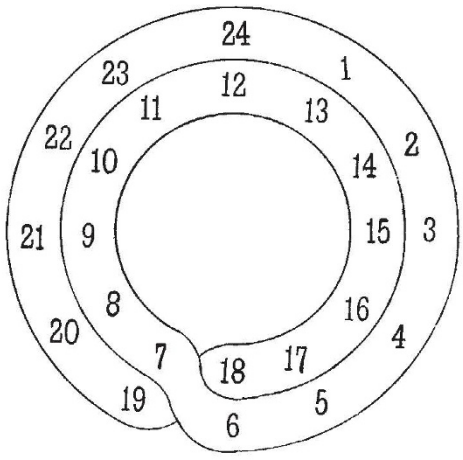
In the Prodomus, a diagnosis of each sub-order, family, genus, and species is given, with the synonymy of each species, its general distribution, and then its known habitats in the Mediterranean. When the species has been found only in the Mediterranean it is specially marked, the only exceptions we notice to this rule being in the case of the parasitic worms, and from the nature of their hosts they are just as likely as not to be found out of bounds. We have examined the list of the species with a good deal of attention, and have been greatly struck with the immense care that has been evidently used in its compilation. Many of the records and descriptions of these species are not to be found in monographs or special treatises on the fauna of certain well-known bays, like those of Naples, Marseilles, &c., but lie scattered over the numerous pages of our periodical literature, often difficult to be got at; indeed, in some few cases, we notice the record of the habitat is based on the authenticated examples in museums. In admitting some doubtful species on the authority of authors of good repute, Prof. Carus has acted wisely, for, should it be necessary, a stroke of a pen would suffice to reduce these to synonymic rank, while, should they be ultimately approved of, they are already in their places.

This Prodomus is dedicated to Sir Henry Wentworth Acland, K.C.B., who for these long years past has taken so much interest in zoology in connection with Christ Church, Oxford, and who well merits this tribute of respect and confidence from Prof. Carus. Those whose knowledge of zoology in Oxford only dates from the period of the New Museum, and who have no leisure for mastering the details of the past, may not be aware how much the collection of zoology and comparative anatomy owes to the labours of Victor Carus, who collected, we believe, for Sir Henry Acland during a great part of 1850, at the Scilly Islands, the series of British Invertebrates then placed in Christ Church Museum, and now Prof. Carus, having taken a larger area within his grasp, associates this Prodomus of its Fauna with our Oxford Professor, as a sign and token that he has not forgotten those earlier days.

[1] "Prodomus Faunæ Mediterraneæ, sive Descriptio Animalium maris Mediterranei incolarum quam comparata silva rerum quatenus innotuit adjectis locis et nominibus vulgaribus eorumque auctoribus in commodum Zoologorum congessit Julius Victor Carus." Pars 1. Cœlenterata, Echinodermata, et Vermes. (Stuttgart, 1884.)

OUR FUTURE CLOCKS AND WATCHES

IN connection with what we have said before on this subject we give a drawing of the new dial in use on some of the American railways where the new system is already



at work, the clocks indicating a certain number of hours plus Greenwich, according to the longitude of the section.