

trochtes, a Stomias with phosphorescent spots, and several Malacostei.

Between Senegal and the Cape Verde Islands our trawls reached depths varying from 3200 to 3699 metres, and brought up most of the preceding species besides many others (Crustaceans, Mollusks, Zoophytes, Sponges) which had never elsewhere been met.

These last takes brought to a close the first part of our programme, and on July 20, after ninety-one days of navigation, we cast anchor in the Bay of La Praia, at Santiago in the Cape Verde Archipelago. This volcanic group detained us a few days, and while zoological, botanical, and geological excursions were being made ashore, the *Talisman* was searching the irregular beds on the coasts for marine animals, and especially for the red coral, which for some years back has formed the object of an active trade in these islands. I will not dwell on these in-shore explorations, nor on those of the islet Blanco, where we were able to study on the spot the large Saurians (*Macroscoincus coctei*) which seem limited to this isolated rock.

All these details are recorded in the report which I have addressed to the Minister and which will soon be published.

In the deep waters of the Cape Verde Archipelago life displays a surprising energy. Our nets came up overflowing with specimens after a single plunge. We captured at one take more than 1000 fishes belonging mostly to the genus *Melanocephalus*, about 1000 *Pandali*, 500 prawns of a new species of the genus *Nematocarcinus*, with disproportionately long claws, as well as many other species.

On the evening of July 30 the *Talisman* took a north-westerly course in the direction of the Sargassum Sea. I need not enter into details on this part of our journey, and it will suffice to say that we nowhere met those dense floating masses of vegetation mentioned by the old navigators. The Gulf weed was seen in isolated patches drifting either with the marine or atmospheric currents, and harbouring a whole pelagic population, whose colours harmonised admirably with those of the algæ that afforded them a refuge. Our naturalists made a careful study of these forms.

The soundings of the *Talisman* in this region show in a general way that, starting from the Cape Verde Islands, the marine bed falls regularly as far as about the 25th parallel, where it attains a depth of 6267 metres. Then it gradually rises towards the Azores and the 35th parallel, where it is about 3000 metres. These results are far from agreeing with the curves indicated on the most recent bathymetric charts. The bed of the Sargassum Sea seems formed of a thick layer of a very fine mud of a pumice nature, covering fragments of pumice and volcanic rocks. Here there would appear to stretch, at over three miles from the surface of the ocean, a vast volcanic chain parallel with the African seashore, and of which the Cape Verde Islands, the Canaries, Madeira, and the Azores are the only parts not submerged. The submarine fauna is poor, consisting of few fishes, some Crustaceans, such as *Paguri*, which lodge in colonies of *Epizoanthus*, prawns of the genus *Nematocarcinus*, *Pasiphaæ*, a few mollusks (*Fusus*, *Pleurotoma*, and *Leda*), which scarcely sufficed to repay the time required for such deep dredgings. Not that our captures did not again become abundant towards the northern limit of the Sargasse Sea, when the depths shrank to 3000, 2000, and 1500 metres. It was here that we took the giant of the family of the Schizopodes, a *Gnathophausia* of a blood-red colour measuring nearly 25 centimetres in length.¹

A short delay at Fayal, and again at San Miguel in the Azores, enabled us to compare the volcanic phenomena still active at certain points with those we had studied on the summit of the Peak of Teneriffe. The analogy is very striking between the rocks, the gaseous products, and the

¹ *Gnathophausia goliath*, new species.

sulphur deposits of the two islands. From what is now taking place on the surface of the ground, an idea may be formed of the submarine convulsions which have covered the bed of the Sargassum Sea with pumice and igneous rocks.

The return voyage from the Azores to France was effected under the most favourable conditions, and we were able to make daily dredgings in depths of from 4000 to 5000 metres. These difficult operations, very skilfully carried out by Captain Parfait, brought us an extremely valuable harvest. Under this tremendous pressure, in perfect darkness, and without a trace of vegetation, animal life is still vigorous. Large fishes of the genus *Macrurus*, as well as some *Scopeli* and *Melanoceti* seem to be here far from rare. Some *Pagures* and *Galatheæ* of new form, a gigantic Nymphon of the genus *Colossendeis*, some unknown *Ethusæ*, besides *Amphipods* and *Cirripeds* represent the Crustacean group. But this abyssal fauna owes its peculiar physiognomy to the number, variety, and size of the *Holothurians*.

The marine bed is carpeted throughout this region with a thick white mud, composed almost exclusively of *Globigerini*, and covering pumice deposits and fragments of various kinds of rocks. Some of these rocks brought up in our nets bore the impress of fossils, amongst others of *Trilobites*. But what still more surprised us was to find at a distance of over 700 miles from the European coast pebbles polished and striated by the action of ice. The sharpness of the striæ excludes the supposition of transport by the currents. The presence of these pebbles is probably due to the action of the icebergs, which in the Quaternary epoch advanced further southwards than at present, and which, by melting in the region of the Atlantic comprised between the Azores and France, deposited on the bottom of the sea the stones carried off from the glacier beds and conveyed to this distance from Europe.

On August 30 we dredged for the last time on the steep slope by which the oceanic depths are connected with the Bay of Biscay, and our captures added to the fauna of the French waters a large number of new or interesting species.

It was high time to return to Rochefort. Our casks and cases were full, our alcohol exhausted. This voyage has furnished us with unrivalled materials for study, materials which must now be put in order. The Minister of Public Instruction has recognised their importance, and has supplied me with the means of beginning the publication of the results. It is my intention to place before the public the collections that have been made during the explorations of the *Travailleur* and *Talisman*. These treasures will be exposed in a special exhibition, which will be held in one of the halls of the museum towards the beginning of January.

MUSIC AND SCIENCE¹

IT would seem that Science, like History, may at times repeat itself: for in this bright little pamphlet we have a revival of the Old World controversy, which dates from the days of Pythagoras, Plato, Aristotle, and Euclid. The author takes, however, for its text, a somewhat declamatory and *ad captandum* modern passage from the *Revue de Paris*, which declares, with an emotional warmth totally uncalled for under the circumstances, that harmony is not a science, and that music is an art, "but a divine art." To appreciate thoroughly the question in debate it is necessary to go back to the sense of the original Greek words—*ἀρμονία* and *μουσική*. The former means "mathematical agreement"; the second "artistic culture." It is with their "second intentions," or acquired and more limited meanings, that we now have

¹ "La Musica è una Scienza." Saggio Acustico fisiologico Del Dott. Primo Crotti. Pp. 55. Luigi Bettei Editore. (Parma, 1883.)

to deal. Is music, in the English sense of the word, which no wise differs from the Italian, an art or a science? It is clearly both; but the art, *μουσική*, so far predominates in public acceptance and cultivation over the science, *ἁρμονία*, that the latter is, and has been for many centuries, in danger of succumbing altogether. Indeed, though excellently begun by Euclid in his "Sectio Canonis," it remained all but unadvanced until the recent researches of Helmholtz. It is to Aristotle that we owe the general test by which to distinguish an art from a science; a test so satisfactory and so neat, that it produces the effect on the mind of a mathematical demonstration; a form of proof which is too often only a roundabout way of restating a self-evident proposition. Aristotle said that art at its best only works by "rule of thumb"; and states that *τέχνη* is governed by rules. When these rules are found to rest on recognised laws, the art becomes an *ἐπιστήμη*, or science. This observation, made two thousand years ago by the shrewdest of all shrewd observers, remains as true and as fresh as on the day when it was promulgated. To no branch of human learning does it apply with such force and directness as to music. For perfection in this art has always been, is now, and must continue to be, confined to a few sensitive, delicate, finely-strung natures, which differ from those of their fellow-creatures in possessing a peculiar technical power and organisation such that they instinctively reproduce, and as it were consonate to the musical conceptions of other minds. In all other respects they may be self-indulgent, unbusinesslike, unpractical; even, as indeed not uncommonly they are, over-sensitive and disagreeable. Types of this class are Beethoven, Cherubini, Mozart, Weber, and Berlioz. In them, in fact, the full development of artistic perfection has eaten up all other good qualities, and left no time or inclination for what Plato calls "the practice of virtue." The world at large, secretly conscious of its special inferiority, and always willing to discharge itself of an unwelcome responsibility, too commonly looks upon these exceptional natures as representing the whole, and not only the artistic and executive side of music. But the other exists notwithstanding; and its fuller cultivation will tend much to restore the balance so disturbed. In this respect the little book of Dottore Crotti has special value. It deals with the foundation of rhythm and of music, and with the strange and hitherto unexplained emotional difference between the major and minor scales, which in the Italian are prettily and correctly named *Gaia* and *Triste* respectively. The ratios of musical intervals and their combination are fully treated, and with some features of novelty, especially as concerns their physiological effects on the ear. The great fact, so much forgotten in this century since the brilliant jigs of the Rossinian school have become popular, that it is the bass, and not the treble or melody, which is fixed and fundamental, is stated with abundant emphasis, and distinction is made between the characters of repose and of movement in different kinds of music. The assumption that the scale is founded principally on the fractions representing the major and minor tones with only a simple semitone of $\frac{1}{2}$ seems hardly sufficient to meet theoretical requirements; but otherwise there is much of interest comprised within the 55 pages of which the pamphlet consists. It has the merit, moreover, beyond the historical point already noted, of bearing out its title of "acoustico-physiological," and of adverting to the mental or receptive side of musical impressions more than occurs in some modern treatises.

W. H. STONE

THE REMARKABLE SUNSETS

THE following letter has been sent to Mr. Norman Lockyer:—

The remarkable sunsets which have been recently witnessed upon several occasions have brought to my

recollection the still more remarkable effects which I witnessed in 1880 in South America, during an eruption of Cotopaxi; and a perusal of your highly-interesting letter in the *Times* of the 8th inst. has caused me to turn to my notes, with the result of finding that in several points they appear to have some bearing upon the matter which you have brought before the public.

On July 3, 1880, I was engaged in an ascent of Chimborazo, and was encamped on its western side, at 15,800 feet above the sea. The morning was fine, and all the surrounding country was free from mist. Before sunrise, we saw to our north the great peak of Illiniza, and twenty miles to its east the greater cone of Cotopaxi, both without a cloud around them, and the latter without any smoke issuing from its crater—a most unusual circumstance; indeed, this was the only occasion on which we noticed the crater free from smoke during the whole of our stay in Ecuador. Cotopaxi, it should be said, lies about forty-five miles south of the equator, and was distant from us sixty-five miles.

We had left our camp, and had proceeded several hundred feet upwards, being then more than 16,000 feet above the sea, when we observed the commencement of an eruption of Cotopaxi. At 5.45 a.m. a column of smoke of inky blackness began to rise from the crater. It went up straight in the air, rapidly curling, with prodigious velocity, and in less than a minute had risen 20,000 feet above the rim of the crater. I had ascended Cotopaxi some months earlier, and had found that its height was 19,600 feet. We knew that we saw from our station the upper 10,000 feet of the volcano, and I estimated the height of the column of smoke at double the height of the portion seen of the mountain. The top of the column was therefore nearly 40,000 feet above the sea. At that elevation it encountered a powerful wind blowing from the east, and was rapidly borne for twenty miles towards the Pacific, seeming to spread very slightly and remaining of inky blackness, presenting the appearance of a gigantic inverted L, drawn upon an otherwise perfectly clear sky. It was then caught by a wind blowing from the north, and was borne towards us, and appeared to spread rapidly in all directions. As this cloud came nearer and nearer so of course it seemed to rise higher and higher in the sky, although it was actually descending. Several hours passed before the ash commenced to intervene between the sun and ourselves, and when it did so we witnessed effects which simply amazed us. We saw a green sun, and such a green as we have never, either before or since, seen in the heavens. We saw patches or smears of something like verdigris-green in the sky, and they changed to equally extreme blood-reds, or to coarse brick-dust reds, and they in an instant passed to the colour of tarnished copper or shining brass. Had we not known that these effects were due to the passage of the ash, we might well have been filled with dread instead of amazement; for no words can convey the faintest idea of the impressive appearance of these strange colours in the sky, seen one minute and gone the next, resembling nothing to which they can be properly compared, and surpassing in vivid intensity the wildest effects of the most gorgeous sunsets.

The ash commenced to pass overhead at about mid-day. It had travelled (including its detour to the west) eighty-five miles in a little more than six hours. At 1.30 it commenced to fall on the summit of Chimborazo, and before we began to descend it caused the snowy summit to look like a ploughed field. The ash was extraordinarily fine, as you will perceive by the sample I send you. It filled our eyes and nostrils; rendered eating and drinking impossible; and reduced us to breathing through handkerchiefs. It penetrated everywhere, got into the working parts of instruments, and into locked boxes. The barometer employed on the summit was coated with it, and so remains until this day.