an exact fifth with each other; and, on counting the number of indentations contained in a given length of each series, it appeared that for 30 of the lower sound there were 45 of the higher, which numbers are in the exact proportion (2 : 3), which connects the lengths of two equally tense wires, giving that interval. Galileo, who had felt a tremor pass from the chisel to his hand at each experiment, inferred that what really determined a musical interval was the ratio of the numbers of vibrations performed in equal times by its constituent notes, and that that ratio was inversely as that of the lengths of the wires producing them. In order to bring out the crucial nature of his experiment, he goes on to remark, with extreme acuteness, that there was, prior to it, no reason for regarding the relations known to connect musical intervals with the *lengths* of wires as in any exclusive sense *representing* such intervals. With equal propriety might the ratio of the *tensions* under which two wires of equal lengths emitted sounds forming an interval be taken as its representative. In this case we should obtain the inverse square root of the ratio resulting from the former mode of comparison. Thus Galileo's experiment alone supplied decisive ground for concluding that the relations of *length* between similarly circumstanced wires, likewise governed those of *period* between corresponding aërial vibrations.

Prof. Tyndall, in referring to the above experiment, has described it as performed "by passing a knife over the edge of a piastre" ("Sound," 2nd ed., p. 51). This is an obvious mistake caused by incorrect translation. Galileo was scraping "una piastra d'ottone," *i.e.*, not "a piastre," but "a plate of brass." An excellent numismatist assures me that the *material* mentioned is alone decisive of the point, the piastre in Galileo's time being invariably made of *silver*.

SEDLEY TAYLOR

THE HOOSAC TUNNEL

THE following facts respecting the Hoosac tunnel, in which the borings from east and west communicated on Nov. 28, may prove of interest. The mountain penetrated is part of the chain of mountains that skirts, at a distance of two or three hundred miles inland, the Atlantic coast of the United States; of which the Blue Ridge in Virginia, the Alleghanies in Pennsylvania, the Catskills and Adirondacks in New York, the Green Mountains in Vermont, and the White Mountains in New Hampshire, are prominent examples. Hoosac Mountain has two summits, the eastern being 2,210, and the western 2,508 ft. above tide-water.

The enterprise has been the subject of various undertakings by different contractors, and the greater part of the earlier work during the years from 1848 to 1863, in length but one-twelfth of the whole distance, was on a smaller scale than the subsequent plan adopted, and had to be much enlarged and strengthened. The present contract requires a clear width of bore of 24 ft. and a height of 20 ft.; the total length of the tunnel is 25,031 ft. A central shaft pierces it from above, at a distance of 12,837 ft. from the eastern, and 12,194 ft. from the western portal. The shaft has a depth of 1,038 ft., and is of elliptical form, its major axis is 27 ft. being coincident with the line of the tunnel; its minor axis is 15 ft. The grade of the tunnel slopes up to the shaft from both ends, with a rise of $26\frac{4}{10}$ per mile. The shaft is not placed at the lowest point between the two summits of the mountains, as the exigencies of the work at the western extremity, and the presence of a stream of water at the point of lowest depression, made a site half a mile nearer the western portal preferable. The tunnel is 767 ft. above tide-water at its extremities. The temperature within averages 58° F.

The total excavation is about 1,000,000 tons of rock., requiring somewhat over 1,450,000 days' work. The boring was principally through mica schist, similar to that of the surface. The miners found it lying on the edge of the foliations and disposed to hang together after the blast. They compared the operation of working in it to pulling boards endwise from a pile of lumber. Rock of this character was found continuous until a point was reached within about 5,000 feet west of the central shaft. At that point the proportion of mica was diminished and the rock began to lose its foliated structure, becoming more homogeneous or granitic. In fact it might be characterised in general terms as granite with the ingredients differently proportioned at different localities, in some places feldspar, in some mica, and in others quartz predominating. This rock was harder to penetrate with the drills, but broke out more satisfactorily with the blast than the mica schist.

The chief trouble was occasioned by what received the name of "demoralised rock." This was rock saturated with water, which, exposed to air, disintegrated into mere mud, rendering the support of masonry absolutely necessary. The tunnel will not probably be ready for railway traffic before next July, as there is yet much work to be done, the total cost at that date, it is estimated, will not fall short of 12,500,000 dols.

NOTES

ON Monday last the French Academy of Sciences named Mr. J. Norman Lockyer, F.R.S., one of its Correspondents, to fill the place rendered vacant in the Astronomical Section by the death of Encke. We believe that the following is a complete list of the English scientific members of the French Institute at the present time:—Foreign Members—Prof. Owen, Sir C. Wheatstone. Correspondents: Geometry—Prof. Sylvester. Mechanics—Sir Wm. Fairbairn. Astronomy—Sir G. Airy, Mr. Hind, Prof. Adams, Prof. Cayley, Sir Thomas MacLear, Mr. Lockyer. Geography and Navigation—Admiral Richards, Dr. Livingstone. Physics—Dr. Joule. Chemistry—Dr. Frankland, Dr. Williamson. Mineralogy—Sir C. Lyell, Prof. W. H. Miller. Botany—Dr. Hooker. Anatomy and Zoology—Dr. Carpenter.

AT the meeting of the Paris Academy of Sciences, which took place on December 22, the places of Correspondents in the Physical Section, vacant by the death of M. Hansteen, and the election of Sir C. Wheatstone to a foreign associateship, were filled up by the election of MM. Angström and Billet.

HER MAJESTY'S Commissioners have resolved to commence, in connection with the series of international exhibitions, permanent collections which shall illustrate the ethnology and geography of the different portions of the British dominions, and ultimately form a great national museum of the empire upon which the sun never sets. They will be arranged for the present in the galleries of the Royal Albert Hall. Many portions of the empire are inhabited by aboriginal races, most of which are undergoing rapid changes, and some of which are disappearing altogether. These races are fast losing their primitive characteristics and distinguishing traits. The collections would embrace life-size and other figures representing the aboriginal inhabitants in their ordinary and gala costumes, models of their dwellings, samples of their domestic utensils, idols, weapons of war, boats and canoes, agricultural, musical, and manufacturing instruments and implements, samples of their industries, and in general all objects tending to show their present ethnological position and state of civilisation. It is proposed to receive for the Exhibition of 1874 any suitable collections, which will be grouped and classified hereafter in their strict ethnological and geographical relations. As, however, there is at present great public interest in the various tribes inhabiting the West Coast o-