

third harmonic of this note, then the vowel A is modified; the same applies to E and O, which have the second harmonic, and in passing from the one vowel to the other it is sufficient to change the aperture of the glottic opening. Thus for A, if the fundamental note is  $n$ , the oral resonator must be tuned to  $3n$ ; for E and O, if the fundamental is  $n'$ , the oral resonator gives  $2n'$ ; and for I and OU the resonator is in unison. If this is not so, then the quality of the vowel is much altered. Thus if the syren gives A, and the plate used is that for OU, then the sound is A modified. This agrees with the experience of teachers of singing, who hold that a badly sung vowel is a vowel-sound emitted into a cavity adjusted for another vowel. Marage has also found that when the sounds of his syren, aided by the masks, are examined by the manometric method, the flame pictures appear as they may be expected to do, that is, groups of three flames for A, of two for E, EU, and O, and of one for I, U and OU. Vowels then, according to him, are due to an intermittent aëro-laryngeal vibration, strengthened by the oral cavity and producing OU, O, A, E and I, when it is in unison with the sum of the vibrations; transformed by it, and giving origin to other vowels, when there is no unison; and the number of intermitances gives the fundamental note on which the vowel is emitted. If the oral cavity acts alone, the vowel is whispered; if the larynx acts alone, the vowel is sung; and if the two act the vowel is spoken. Marage has applied his method with much success in testing the ear and in the treatment of mutes who are not absolutely deaf. His memoir is characterised by great simplicity and at the same time by thoroughness.

But the study of vowels is not the only result of recent research in phonetics. The analysis of consonantal sounds is now being carried out by various workers, such as Pipping, Scripture and Lloyd. Meyer, in Hermann's laboratory, has investigated the pitch of words, sentences and syllables in speech. This has also been studied by phonographic tracings by Marichelle. The whole subject has also a practical bearing, as the knowledge acquired enables the teacher of deaf mutes so to instruct his pupils in the use of their organs as to avoid the dreary monotone of those who learn to speak by watching only the movements of the lips.

It only remains to notice the remarkable monograph of Jespersen. This is an attempt to aid the study of phonetics by the use of a scientific nomenclature to express sounds, so that just as the chemist represents by letters and figures the nature of a chemical substance of complex constitution, so the student of phonetics may be able to express the sounds of words by symbols. The visible-speech system of Melville-Bell consisted of symbols which expressed more or less accurately the physiological movements to be made, or the position to be assumed, during the pronunciation of a given sound; but the symbols of Jespersen are letters and figures. The letters or figures, however, to be useful must have a physiological meaning. Strictly speaking the symbols denote, not sounds, but the elements of sounds. Thus so simple a sound as  $m$  is physiologically the result of (a) lips shut; (b) point of tongue resting in the bottom of the mouth; (c) surface of tongue not raised towards the palate; (d) nasal passage open; (e) vocal cords vibrate; and (f) air expelled from lungs. The attempt of Jespersen may be called an alphabetic system of writing, symbolising, not sounds, but the elements of sounds. At present it is severely technical, but it seems to "provide a means of writing down and describing phonetic minutæ in a comparatively easy and unambiguous manner." It will do for the phonetician what symbolism does for the mineralogist. It is a kind of algebra for speech sounds.

In advocating the establishment of a photographic museum, to be a visual register of the past, Janssen recently wrote as follows:—"Photography registers the chain of phenomena during time, just as writing registers the thoughts of men during the ages. Photography is to sight what writing is to thought. If there is any difference, it is to the advantage of photography. Writing is subject to conventionalities from which photography is free; writing employs a particular language, while photography speaks the universal language."

But if there is to be a museum of photographs, appealing to the sense of sight, why should we not have a museum of sounds, in the shape of phonograph records, appealing to the sense of hearing? How little can we tell from written characters the exact sounds of ancient Sanskrit, or how

Demosthenes spoke in Greek or Cicero in Latin? Would it not now be interesting to hear the exact accent of old English, or the Scotch of the fifteenth century? All dialects should be carefully registered and put aside for future consultation, and thus we would do for the ear what we do for the eye. No doubt such a collection of phonographic records would help onwards the science of language.

#### THE ANCIENT GLACIERS OF SKYE.

IN the central portion of Skye there is a group of mountains unequalled elsewhere in Britain for rugged grandeur. To the south and south-west lie the Cuillin Hills, the serrated peaks of which rise to an elevation of more than 3000 feet; they are built essentially of a great laccolitic mass of gabbro, traversed by countless dykes and sheets of basalt. To the north lie the Red Hills, the smoother outlines and often ruddy aspect of which contrast markedly with the dark and rough elevations of Blath-bheinn, or Blaven, and the Cuillins; they are composed of granite and granophyre, and rise to heights rarely exceeding 2500 feet.

That the whole of this mountain district has been severely glaciated has for many years been recognised, but the detailed history of the ice-erosion has not hitherto been worked out. Mr. Alfred Harker, in the course of a special survey of the region, has had opportunities of study which have enabled him to write an essay on the subject which for completeness and lucidity is probably unsurpassed.<sup>1</sup> The district, as he points out, is one which had for long been subject to erosion; the drainage system in pre-Glacial times was a fully matured one, and the features then stood out in bold relief. Moreover, the amount of post-Glacial erosion has been so trifling that the effects of ice- and frost-action remain practically without modification by later agencies.

Mr. Harker tells how during the period of maximum glaciation the Skye mountains supported a true ice-cap, under which they were wholly buried, and this ice-cap was sufficiently powerful to withstand and divert northwards and southwards great portions of the ice-sheet from the Scottish mainland. He sees evidence of the movements of the lower layers of ice in the striae on the rock-surfaces and in the dispersal of boulders; the upper layers not improbably took a course less restricted by the form of the ground. He describes the way in which the ice must have been forced into hollows and openings; its action in grinding down and tearing away rocks, irrespective of their mineralogical composition or structure; and its mode of widening and deepening valleys. Attention is drawn to the formation of cirques or corries, due consideration being given to their aspect and relation to the amount of sunshine. The erosion by ice-action of rock-basins, such as those occupied by Loch Coruisk and other lochs and tarns, is clearly stated and is one of the most effective arguments lately published on the subject.

Mr. Harker's observations lead to the conclusion that the principal glaciation was followed by a later and minor period of ice-action, when glaciers occupied the valleys, and, as would be expected, it is not always possible to discriminate between the work done by the greater and lesser agents. The movement of the later ice was, however, very different on many parts of the lower ground from that during the principal glaciation, a difference due to the withdrawal of the Scottish ice-sheet. To the later glaciation are attributed the perched blocks which occur on the bare slopes of some of the Cuillin valleys. That the higher ridges and summits of the ranges show little or no effects of glaciation is due to the fact that they acted as ice-sheds, and escaped erosion owing to the lack of rock-débris in the ice overlying them.

The mountains, as pointed out by Mr. Harker, are for the most part of bare rock, so also are the higher corries, except where encumbered with screes; while in the lower corries and main valleys the drift is never so thick as to obscure the true form of the ground. Hence the story of the ice-erosion is very plainly engraved on the land, while the author's intimate knowledge of the petrology has enabled him to track the courses of many boulders of peculiar mineral composition with absolute certainty.

<sup>1</sup> "Ice-Erosion in the Cuillin Hills of Skye." By Alfred Harker, M.A. F.G.S. *Trans. Roy. Soc. Edin.*, vol. xl, part iii, 1901.