

give due attention from the Meteorological Office to the requirements of the Board of Trade and of the Board of Agriculture and Fisheries, even though for simplicity, and possibly for financial reasons, it is housed in the Air Ministry and its separate expenses included in the account of that Department.

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### Organisation of Scientific Work.

THE fostering and development of the resources of India by means of scientific research is not a mere question of academic interest, but one on which the very economic existence of the country depends. Fortunately the Government of India has realised the danger of the situation, and is anxious to develop the vast potentialities of the country through the application of science, as Japan has already done with her far more limited resources. It is obvious that the success of the proposed scheme will largely depend on the encouragement of investigation among the Indian students and workers, who will necessarily be the principal recruits for the work of the utilisation of indigenous talent in the services of their own country. A quarter of a century ago, when science teaching was in its infancy in India, I ventured to predict that, through an ever-increasing ingenuity of devices necessary for extending the boundaries of knowledge, there would in the near future be seen in India an advance of skill and of invention among our workers, and that, if this skill could be assured, practical applications would not fail to follow in many fields of human activity.

My anticipations have since been fully realised; for example, the extremely delicate instruments which have enabled me to carry out all my investigations have been constructed entirely by Indian mechanicians, and I have been assured that the most skilled American instrument-makers could not have produced apparatus more delicate. As regards scientific advance in its various departments, it is generally recognised that the present period in India may truly be described as a renaissance.

With reference to the practical scheme now under the consideration of the Government of India, the leading article in *NATURE* of February 19 states very fairly the comparative merits of the two alternatives, namely, that of centralisation under a proposed Imperial Department, and that of decentralisation, under which research workers will be given as free a hand as possible. Under the centralisation scheme the work of an investigator would depend on the previous sanction of the head of the Service, who would probably not be of any scientific eminence, or might even be without scientific qualification; and, most serious of all, he would not be able to publish his results without the consent of the official head of his special department. The possible abuses of such conditions are sufficiently obvious to all.

Every real investigator is making a great adventure into the unknown, and all the initiative and all the risk must therefore be his own. Nothing could be so disastrous for the growth of knowledge as to place competent men under an incompetent machine.

Finally, who should be the judge of the value of the work accomplished? Such judgment should not be departmental or secret; the verdict should come from the open court of the scientific world itself, and this would effectively put an end to official or non-official incompetence.

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### Photographs of Seven Vocal Notes.

DR. A. O. RANKINE, by means of the invention described by him in *NATURE* of February 5, has placed me under a great obligation in furnishing ocular confirmation, desirable for those whose hearing is undisciplined or poor, of observations made by the unassisted ear on the inherent pitches of vowel sounds. No one who can hear harmonics of a sustained note from the larynx reinforced successively by a continuous change in the pitch of the mouth-cavity acting as a resonator should remain in doubt as to their place in the tablature, for, the pitch of the voice being known, if a harmonic sequence is heard, such as 4:5:6:7, the vibration number of any one of these overtones is the product of a simple multiplication. The well-known spherical resonators, applied in turn to the ear, cannot be changed instantaneously, destroy the all-important contrast, and have failed. The late Lord Rayleigh's compound resonator (*Phil. Mag.*, 1907, p. 321) would do better service, but I do not know that anyone has used it for this purpose. The table in text-books of physics, physiology, etc., shows an extreme error of two octaves. The inherent pitches of the vowels of ordinary speech from *oo* to *ee* range from about *fi* to *div*. Taking two octaves as the extreme compass of the mouth shaped for vowels, this supplies such "real characters" for vowel sounds as Bishop Wilkins and his friends looked for in vain, and the use of an alphabet thus rectified will make it unnecessary for English-speaking children to learn to spell, while the re-formed print writing will obviate spelling reform. I have explained this seeming paradox in a book now in the press.

The films were marked before exposure.

(1) "128 not, ?6." This means that a note *c* physical pitch is to be sung in which the singer hears the sixth harmonic intensified in the mouth, the vowel-quality more or less resembling the vowel in *not* prolonged. When the negative was changed back into sound by Dr. Rankine, the harmonic no longer in question (6, *g*) was clearly heard by him, and afterwards by myself. The octave comes out in the photograph surprisingly strong. I suspect that it may be largely a self-combination tone. I do not with certainty distinguish the octave in any quality of my voice unless it is strengthened in the mouth, as when the vowel *oo* is sung to a top note of chest register.

Six more films were exposed on February 16. Brief samples of all six are here shown.

(2) "192 not, ?4." The voice being raised a fifth, to *g*, the mouth-tone *g* is now harmonic 4. The four light bands and four dark lines in each period are evident. The inequality of the spacing reminds us that the thing photographed is not a simple tone with the double octave imposed upon it, but a *voice* in which the fourth harmonic component is made especially prominent.

(3) "256 not, ?3." The voice at middle C, *c* physical pitch, the overtone *g* is now harmonic 3.

(4) "128 book, ?5." The pitch of the resonator is lowered to *e* by an unusual protrusion and rounding of the lips. The pitch of the vowel in *book* as spoken in southern England is considerably higher than *e*. One vibration in each periodic group is of the frequency 128×5. The rest appear displaced by the octave or the double octave.

(5) "256 book, ? high." The quality of the vowel is not affected, but now the pitch of the resonator is too remote from the nearest of the lower harmonics of *c*, 2 and 3, *c* and *g*; and the only tone audible from the mouth is a very high, thin sound, noted more than once as undoubtedly a sharp F, harmonic