

between plumage of all kinds that when the Anti-Plumage Bill was introduced in 1913 the trade insecurity engendered was so far-reaching as to constitute one of the principal causes of the serious slump in the South African ostrich industry, involving the loss of millions of pounds—a slump from which, the war supervening, the Union is only slowly recovering. The introduction of another Bill would be viewed with alarm in South Africa, and would have a serious international bearing, particularly upon our Ally, France, involving thousands of workers and millions of capital. It surely were wise not to attempt it when other measures are possible which would afford a wide stimulus to industry and to the study of bird-life.

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#### Musical Drums with Harmonic Overtones.

It is well known that percussion instruments as a class give inharmonic overtones, and are thus musically defective. We find on investigation that a special type of musical drum which has long been known and used in India forms a very remarkable exception to the foregoing rule, as it gives harmonic overtones having the same relation of pitch to the fundamental tone as in stringed instruments. Five such harmonics (inclusive of the fundamental tone) can be elicited from the drumhead in this type of instrument, the first, second, and third harmonics being specially well sustained in intensity and giving a fine musical effect. The special method of construction of the drumhead which secures this result will be understood from the accompanying illustration (Fig. 1). It will

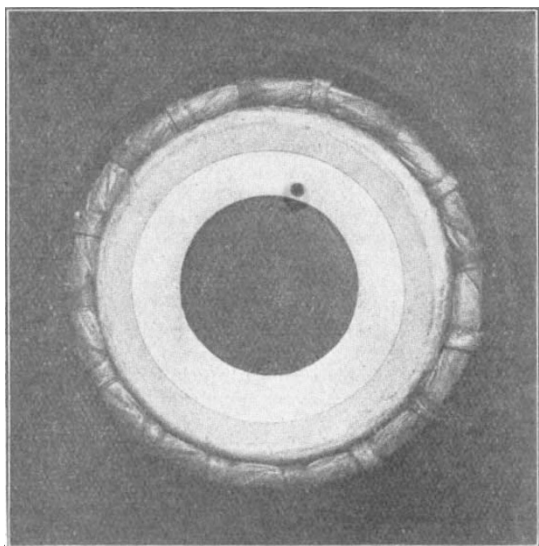


FIG. 1.—Drumhead giving harmonic overtones.

be noticed (1) that the drumhead carries a symmetrical distributed load, decreasing in superficial density from the centre outwards (this appears as a dark circle in the middle of the membrane, the load consisting of a firmly adherent but flexible composition, in which the principal constituent is finely divided metallic iron); and (2) that a second membrane in the form of a ring is superimposed on the circular membrane round its margin.

The character of the vibrations of this heterogeneous membrane which give rise to its remarkable acoustic

properties have been investigated by us. It is found, as might have been expected, that the fundamental pitch and the octave are derived respectively from the modes of vibration of the membrane without any nodal lines and with one nodal diameter. The third harmonic, we find, owes its origin to the fact that the next two higher modes of vibration of the drumhead (those with two nodal diameters and with one nodal circle respectively) have identical pitch, this being a twelfth above the fundamental. There is reason to believe that the fourth and fifth harmonics similarly arise from some of the numerous more complex modes of vibration of the drumhead becoming unified in pitch in consequence of the distributed load at the centre and round the periphery of the membrane. The central load also improves the musical effect by increasing the energy of vibration, and thus prolonging the duration of the tones.

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#### Power from the Sun.

MR. A. A. CAMPBELL SWINTON, in his letter on the above subject in NATURE of December 18, states that "it is hopeless to expect to be able to effect anything of this nature with the heat-engine, for with this we should scarcely reach the 2 per cent. efficiency nearly attained by vegetation."

For nearly four years immediately preceding the war I was engaged by the Sun Power Co. (Eastern Hemisphere), Ltd., and the Shuman Engine Syndicate, Ltd., on the problem of the utilisation of solar energy, upon which these companies spent a considerable sum of money, the experiments being conducted on a large scale in America and Egypt, while the trials of the necessary low-pressure engine (which made an easy record for such engines) were made in this country. The results of the whole of this work are recorded in my two papers both bearing the title "The Utilisation of Solar Energy," one being read before the Society of Engineers in April, 1914, and the other before the Royal Society of Arts in April, 1915.

At p. 540 of the Journal of the Royal Society of Arts of April 30, 1915, it was shown that the overall thermal efficiency of the sun power plant erected in Egypt was 4.32 per cent., which is to be compared with the performance of the best steam-engine and boiler of 11.5 per cent. At p. 560, *ibid.*, it was shown that the theoretical efficiency of an engine working between the same limits of temperature would be 5.9 per cent., and that, consequently, the relative efficiency of the sun power plant to this ideal engine was no less than 73.2 per cent. From this it will be seen that Mr. Campbell Swinton's estimate of the thermal efficiency of 2 per cent. for a sun-power steam plant is more than 100 per cent. too low.

It is well that any wrong impression which the lower figure might give should be corrected, for in these days of extremely expensive coal it is desirable that inventors, experimenters, and financiers should not be discouraged from attempting to utilise solar energy, which some of us think is bound to be realised in the future. In the Royal Society of Arts paper it was shown that the cost of solar energy was equivalent to coal at 3*l.* 10*s.* a ton, and from this it is obvious that had the companies had more time in which to develop and construct plants before the war, they would have been paying handsomely, with coal at its present prices, in Egypt, Chile, and other sun-bathed countries.

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