ing children quite as vigorous in physique and much better endowed mentally than the average native of Africa.

An interesting allusion is made in this book to the origin of fire, interesting because the native tradition quoted by Mr. Dennett is in accord with the observations and theories of several African explorers. On p. 216 he quotes the Yoruba legend that before man knew how to make fire, bush fires used nevertheless to occur almost yearly at the end of the dry season "when natural combustion took place." In Africa, at any rate, this was how fire became an agent of man. I have seen myself lightning set fire to a dead tree or to the dry grass near a tree, and thus start a bush fire in the dry season. Bush fires are very detrimental, in reality, to civilised agriculture in Africa. Nevertheless, in regions where the natives appreciate this fact and do not set fire to the grass or brushwood, bush fires occur from time to time in the dry season, and the natives assert that they are due to some natural cause, more especially to lightning, but also, it has been suggested, to some action of the sun, possibly of "a burning-glass" character acting through silica or some other mineral substance which concentrated the rays on to tinder. But lightning frequently starts a fire in Africa—as witness the cathedrals, barracks, hospitals, &c., which are burnt to the ground from this cause. The spread of the bush fire proved to be of enormous benefit to early man, since when he followed behind its ravages he was presented by nature with a variety of cooked or half-cooked beasts, birds, and reptiles. In this way he learnt the charms of cooked food and the usefulness of fire, and no doubt began to count on the annual opportunities offered to him in the dry season for the renewal of his household fire before he learnt to produce a flame artificially.

The chapter dealing with totems (p. 175 *et seq.*) is particularly interesting, and useful information is given on the laws and customs of land tenure.

H. H. JOHNSTON.

HIGH-FREQUENCY GENERATOR FOR WIRELESS TELEGRAPHY.

IT is announced in the daily Press that Dr. Goldschmidt has recently succeeded in sending wireless messages from Berlin to the South-Western frontier of Germany using his new high-frequency alternator to generate the electric oscillations. The production of undamped waves by means of high-frequency alternators has been the aim of numbers of inventors, as it is hoped that by producing a suitable generator it may be possible to avoid the defects of working that are associated with the usual arc and spark methods.

A number of alternators have been built, but owing to various reasons none of them have as yet come into extended use. Their design on the usual lines is very difficult, as even if the rotating parts are made to revolve at the highest speeds permissible from mechanical considerations, the number of poles required to produce the high frequencies necessary for wireless telegraphy is so great as to leave very little room for the windings, and the consequent cramping of the windings and great leakage between the closely spaced poles give rise to considerable drop of voltage when load is put on the machine.

Most of the machines that have been constructed hitherto have been of the inductor type, consisting of fixed windings placed under the influence of rapidly rotating armatures of iron containing a large number of projections or teeth, but the Goldschmidt machine is built on a quite different principle.

It is a phenomenon well known to those who have

to work with single-phase alternators that when load is put on such machines the armature reaction causes double-frequency currents to flow in the field winding, and that these double-frequency currents cause triple-frequency currents to flow in the armature winding, and so on. This may be explained by the consideration that a stationary alternating flux can be regarded as being composed of two equal and constant fluxes rotating with equal speeds in opposite directions, the speed of the two fluxes being such that one complete revolution is made by them in the time of one period of the alternating flux.

Applying this to the case of an alternator with stationary alternating-current winding and rotating field system, it will be seen that if the rotating field produces alternating currents of a frequency f in the stator, the component rotating fields produced by the stator currents will rotate at the same speed as the field system, one in the same direction as the field winding, and therefore having no inductive effect on it, and the other in the opposite direction, and therefore inducing a current of a frequency $2f$ in it. A continuation of this process would cause currents of frequencies $2f$, $4f$, $6f$, &c., to appear in the field winding, and currents of frequencies $3f$, $5f$, $7f$, &c., to appear in the stator winding. The production of the higher frequency currents in ordinary alternators is limited by the fact that the amplitudes of the series of harmonics decrease rapidly owing to the great impedance opposed to their flow in the windings, but the triple-frequency harmonic superposed on the fundamental is often sufficiently marked to cause undesirable distortion of the wave-shape of the electromotive force of the machine.

Dr. Goldschmidt has constructed a machine in which the effect referred to is utilised to produce currents of very high frequencies, although the fundamental frequency of the machine is comparatively low. In order to prevent the damping out of the higher harmonics, he connects in parallel with the stator windings a series of capacity-inductance shunts tuned to resonance with the odd multiples of the fundamental frequency of the machine, and in parallel with the field winding a series of such shunts tuned to resonance with the even multiples of the fundamental frequency. Owing to the presence of these shunts the high-frequency currents are able to attain considerable magnitudes, and the electrical energy is reflected backwards and forwards between the stator and rotor of the machine a great number of times, the frequency of the oscillations being increased at each reflection until a frequency corresponding to the free period of the radiating circuit is reached.

In Dr. Goldschmidt's machine, oscillations of 120,000 cycles a second are produced, and the rated output is 12 kilowatts.

Practical experience of working will be necessary before it is possible to say to what extent machines of this type are likely to replace the present oscillation generators, but it seems not unlikely that difficulties will arise in keeping the frequency of the oscillations constant enough to enable clear signals to be received. It would appear that any small variation of the speed of the generator would cause each successive harmonic to depart to an increasing extent from its proper frequency, so that the final frequency reached might be so far removed from its proper value that signals would no longer be able to be received; added to this the amplitudes of the harmonics might be expected to be greatly diminished by the fact that a change of the speed of the machine would put all the capacity-inductance shunts out of tune with the harmonics for which they are adjusted, and a considerable weakening of the signals emitted by the aerial would result.

A. J. MAKOWER.