Æther Waves and Electrons.¹

By SIR WILLIAM BRAGG, K.B.E., F.R.S.

NEWTON put forward a corpuscular theory of light, and Huyghens believed that it was essentially a wave motion. Each gave wrong reasons for his belief. Newton argued that it ought to be possible to see round a corner, since the passage of waves round a corner was a common effect. Huyghens declined the corpuscular theory on the grounds that corpuscles could not go fast enough, and that if two people looked into each other's eyes the corpuscles must hit each other and prevent mutual vision. But the wave theory carried all before it, and, developed by Young, Fresnel, and other workers, proved to be capable of explaining optical phenomena in perfect fashion.

With the advent of X-rays and radio-activity the process of radiation as a whole is seen to depend in part on the movement of electrons. In the X-ray bulb, to take an example, a stream of electrons, which is truly a corpuscular radiation, strikes a block of metal in the centre of the tube. Energy of radiation is carried outwards through the walls of the tube in the form of X-rays; that is to say, of wave motions in the æther. When they strike matter, such as the film of a photographic plate, the wave radiation disappears and is replaced by moving electrons which produce all the well-known effects ascribed to X-rays. It is probable that this mutual plane of waves and electrons is carried throughout the whole realm of radiation, and the ultimate explanation of all optical problems must involve the recognition of corpuscular

¹ Summary of the Robert Boyle lecture delivered at Oxford on May 12.

radiations, at times replacing and being replaced by the waves. Thus once more the corpuscular theory appears again as a working hypothesis.

But in its relation to the wave theory there is one extraordinary and, at present, insoluble problem. It is not known how the energy of the electron in the X-ray bulb is transferred by a wave motion to an electron in the photographic plate or in any other substance on which the X-rays fall. It is as if one dropped a plank into the sea from a height of 100 ft. and found that the spreading ripple was able, after travelling 1000 miles and becoming infinitesimal in comparison with its original amount, to act upon a wooden ship in such a way that a plank of that ship flew out of its place to a height of 100 ft. How does the energy get from one place to the other?

Very lately considerable new information has come to hand regarding the way in which atoms play a part in this extraordinary transference of energy. In many ways the transference of energy suggests the return to Newton's corpuscular theory. But the wave theory is too firmly established to be displaced from the ground that it occupies. We are obliged to use each theory as occasion demands and to wait for further knowledge as to how it may be possible that both should be true at the same time. Toleration of opinions is a recognised virtue. The curiosity of the present situation is that opposite opinions have to be held and used by the same individual in the faith that some day their combined truth may be made plain.

The Natives of the Gilbert Islands.

AT a meeting of the Royal Anthropological Institute on April 21, Dr. W. H. R. Rivers, president, in the chair, Mr. Arthur Grimble read a paper entitled "From Birth to Death in the Gilbert Islands." The paper, which was of considerable importance, as it dealt with a people about which we possess little information, described in detail the ceremonies used at marriage, birth, and death by the Gilbertese-speaking communities.

The rules relating to consanguinity among the Gilbertese are genealogical in character, and evidently allied to the Polynesian systems as typified by the Samoan; but the concubitant relations which exist between a man and his wife's sisters are of a type generally found in Melanesian communities. An extremely interesting relationship is that of *Tinaba*, under which a woman owes both filial and sexual duties to the brothers of her husband's father and a man to his wife's mother's sister. Incest is regarded with horror, and the hatred of the sun for incestuous couples is much stressed in native myth.

There were several forms of marriage ceremony in vogue. On certain islands marriage by capture was practised. Rather more common was the fishing fiction, in which the suitors seated in a loft let down lines into the room underneath, where the girl made a pretence of being caught by one of them. This act was succeeded by the anointing of the couple with coco-nut oil, and the union was complete. The most usual form of ceremony, however, was that known as *te iein*, of which the essential motive was to test the virginity of the bride. After birth mother and child

remained for three days in the place of confinement, while the infant's soul was encouraged into its body by merrymaking, in which fire played an important part.

A boy's training was conducted with the view of excluding all sexual interests. The cutting of his hair from time to time was performed with rigid ceremonial, until the climax was reached in the initiation ceremonies (which were chiefly trials by fire) undergone when his pectoral and axillary hair was well in evidence. After submitting to these ordeals he was isolated until he passed certain tests of strength and endurance. He would then be allowed to marry.

A girl on reaching the age of puberty was isolated in a darkened room for the purpose of bleaching her skin and thus rendering her like the fair-skinned ancestral gods of the race. On release from the bleaching-house she was ready for marriage.

Great precautions were taken at death to drive away the soul. The body was usually buried on the fourth day, sometimes on the tenth; occasionally it was sun-dried and kept for a number of years. The skull was often kept. In the lagoon islands the body lay on its back, fully extended, with toes pointing up; on Banaba the knees were flexed outwards in a frog-like position.

The paper closed with a summary of the beliefs concerning the destination of the departed spirit and of the possible inferences which may be drawn therefrom. The names of the various bournes of the dead have an extraordinary resemblance to certain place-names in Indonesia.