concerned only with what is measurable, and that much of importance for mankind, including values, lies outside its scope. Science, it will be said, is ethically neutral, and the uses we make of it must be judged by standards of value arrived at independently. Others, however, will reply that human values themselves are the product of evolution, and survive only as fulfilling social and biological needs. Some difficult scientific and philosophical questions arise. Perhaps the most fundamental is this. Science uses symbols to denote events, and the relations between them. If there are events or relationships, human or otherwise, which cannot be adequately represented by scientific symbols, must not some aspects of them fall outside the scope of science? One of the difficulties of living in a time of rapid change like our own is that knowledge outstrips thought about it, but I feel sure that not all our present antinomies are permanent. We are learning every year more about the nature of matter, the relationships between events and the observer, between the brain and the mind, and between the living organism and its environment; and information theory may provide unifying concepts between the gene and the mind.

I started with the nervous system. Let me end by using it as an analogy. As individuals, we are all receptors, capable of supplying the higher centres with information. What information they get, therefore, depends on us. We are also the motor nerves, and what society does is done by us. But we are again, collectively, ourselves the higher centres, the forebrain, which mediates for the social mind the difficult task of receiving the information, learning from past experience, reacting to it emotionally, yet controlling its emotions; and, above all, looking to the future.


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# SUMMARIES OF ADDRESSES OF PRESIDENTS OF SECTIONS

## THE SUN AND THE IONOSPHERE

THE subject of Mr. J. A. Ratcliffe's presidential address to Section A (Mathematics and Physics) is "The Sun and the Ionosphere". He directs attention to the fact that in recent years it has been possible to explore the upper portion of the ionosphere, above the peak of the *F* layer. This part has been called the 'topside' of the ionosphere. One of the most productive experiments makes use of an ionospheric sounder installed in an artificial satellite so that it sounds the ionosphere, downwards, from above. The principle is the same as that which is used in sounding from the ground; it consists in sending out short pulses of radio waves and measuring the time-interval before they return to the sender after reflexion at the ionosphere. The results are sent to the ground by telemetry. A very successful topside sounder of this kind has been made by workers in Canada.

In another experimental method, powerful waves are sent through the ionosphere on a frequency which will penetrate it completely, and the intensity, and spectral distribution, of waves scattered incoherently from it at different heights are measured. The electron distribution at still greater heights, out to distances of about five Earth radii, have been deduced from observations of a particular type of atmospheric called a 'whistler'. This results from the dispersion of the electro-magnetic pulse radiated by a lightning flash as it follows the lines of force of the Earth's magnetic field out to great distances.

The most distant parts of the ionosphere and the way in which it merges into the solar corona have been investigated by means of a space probe carrying a magnetometer. It has been found that the Earth's ionosphere merges into the Sun's ionosphere (the corona) at a distance of about ten to fourteen Earth radii. Experiments of a different kind have been made in the first Anglo-American satellite, *Ariel I*, which carried experiments designed by workers in England. These experiments were designed to measure a series of quantities in the neighbourhood of the satellite. The concentration of the electrons, their temperature, and the masses of the positive ions which accompany them, were the quantities important for the present discussion. The density of the neutral atmosphere at these great heights has been deduced by observing how the orbits of satellites change as a result of the air resistance they experience in their motion.

The results from all these experiments provide information about the distribution in the outer ionosphere of the constituent gases, atomic oxygen, atomic hydrogen, and helium, and about the temperatures of the electrons, the ions, and the neutral gas. Theoretical explanations of the results involve consideration of how the energy of the photo electrons is transferred, first to the ions, and then from the ions to the neutral particles. Consideration of the rate of production of electrons, and of the rate of energy input, leads to suggestions about the incidence of energetic particles on the Earth's outer atmosphere.