

sponding Canadian and United States laboratories has continued in the development of a technique to use satellites for sounding the ionosphere from above—'top-side sounding' as it is called. The station at Port Stanley in the Falkland Islands, one of the Department's ionospheric observatories for many years past, will also be engaged in receiving signals from these and other satellites.

The ionospheric forecasting service provided by the Radio Research Station has always been used by civilian and defence organizations in the planning of their long-distance high-frequency communication circuits. With the knowledge of ionospheric behaviour that has been accumulated at the Station, consideration is now being given to the production of a reference book containing details of all ionospheric conditions likely to be encountered throughout the world. A single figure or index derived from observations at a few ionospheric sounding stations would be used as a guide to find out the conditions prevailing at any time and place.

During the period under review, the analysis of the atmospheric radio noise data obtained during the International Geophysical Year has been continued. The main experimental work during the year has been the recording of single atmospheric storms at known short distances; and the evaluation of the peak power and total radiated energy from lightning discharges. At frequencies greater than 30 Mc./s., interference from atmospheric noise is not of major importance for ground receiving stations. But the need to find a 'quiet' site for the Station's projected radio telescope has indicated that man-made noise, due to electrical machinery and the like, may cause serious disturbance. Accordingly, measurements are being made in the higher radio frequency bands to determine more precisely the levels of such man-made noise.

There are still many problems awaiting solution in connexion with the transmission of radio waves over both long and short distances through the troposphere. A detailed knowledge of the propagation conditions for very-high and ultra-high frequencies

is of particular importance in connexion with the future development and planning of broadcasting, including television, services throughout the world. Staff of the Radio Research Station collaborate with the Post Office and the British Broadcasting Corporation in experimental investigations in Britain. But, on a wider scale, they also participate in the work of the International Radio Consultative Committee (C.C.I.R.), concerning the planning, over a wide geographical area, of transmitters using the same or adjacent frequency channels, in such a way as to avoid mutual interference.

Closely associated with this work is the direct experimental study of the refractive index structure of the troposphere by two techniques: one of these uses an airborne micro-wave refractometer for direct measurements at various heights; the other comprises radar sounding of the tropospheric layers at vertical incidence. Preliminary investigations have been made by both methods, and improved equipment has been under development during the year.

While the work on the electrical properties of components and materials, such as transistors and ferrites, has been terminated during the year, the past experience gained in this type of investigation is proving valuable in the development of techniques and equipment used in other parts of the research programme. Apart from this, however, all aspects of the programme demand facilities for the accurate measurement of various parameters; it is a continuing policy of the Station to conduct research on the appropriate measurement techniques.

As in the case of former published reports, that for 1960 contains three appendixes. The first gives the references to 36 scientific papers published by the staff during the year. The second is a list of staff of the Radio Research Organization on January 1, 1961; while the third gives the terms of reference and constitution of committees of the Radio Research Board. These committees provide the expert advice on which the Board frames its recommendations for the present and future programmes of research.

BIOLOGICAL CONTROL OF CONCEPTION*

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THE Oliver Bird Lectures and the Oliver Bird Prize were instituted with the idea of reviewing and stimulating work bearing on the control of conception in man. Such review and stimulation were badly needed. In many countries of the world, population is increasing at an unprecedented and accelerating rate. The increase is not due to any sudden increase in human fertility; it is due to the work of medical science in decreasing mortality and increasing the expectation of life at birth in many parts of the world where the birth-rate is still high. Total world population is now around 3,000 million, just about double the number thought to have existed at the beginning of this century. Population growth cannot go on indefinitely at this rate. Something will happen to stop it, and the human race must

* Substance of the fifth Oliver Bird Lecture delivered on June 20.

decide whether that something is to be pleasant or unpleasant.

Different countries are contributing in very different degrees to this population explosion. In the United Kingdom the small natural increase in population now occurring is not in itself causing any new problems. But the practical, æsthetic and eugenic requirements of the individual in relation to the control of conception are far from satisfied. In countries faced with a crippling increase in population it is vitally necessary that a simple and effective method of controlling fertility shall be evolved. It is not surprising, therefore, that intensive, though belated, work is now in progress with the view of applying existing knowledge of the physiology and biochemistry of the processes leading to conception to provide better methods of preventing it, and to

extend our fundamental knowledge of the processes so as to broaden the basis of possible applications. In general, therefore, the trend of thought is towards what may be called biological means of fertility control, involving systemic treatment, and away from local action of a mechanical or chemical nature. Systemic treatment is, of course, most easily made by mouth, in other words by 'the pill'.

Biological control involves one or other of three things: (a) the prevention of formation or release of germ cells in male or female; (b) the prevention of fertilization; (c) the prevention of implantation of the fertilized egg. The first of these involves either preventing the release of ova from the ovary or the formation of spermatozoa in the testis. Spectacular progress has been made in the past few years towards the use of orally active progestagens (the 'Pincus pill') to depress the ovary-stimulating activity of the anterior pituitary body and thus to prevent release of the ovum. The Pincus pill has been the subject of extended trials, and is likely to come into routine use to at least a limited extent. The outstanding problem of the Pincus pill is not as to whether it works—it certainly works—but as to the extent of uncomfortable side-effects and of possible hazards arising from the long-term inhibition of a vital gland and the prolonged induction of an artificial rhythm in the uterus.

Work on the inhibition of spermatogenesis by oral medication is not so far advanced. Obvious disadvantages attend the depression of ovary or testis activity by the use of substances, particularly steroid hormones, reducing pituitary gonadotrophic activity; but encouraging results on the direct inhibition of spermatogenesis without interference with the androgenic interstitial tissue have been obtained by the use of various non-steroidal compounds. In any event, there is little doubt that a pill for males will be forthcoming in the future. When this happens the obvious course will be for husband and wife to take, say, yearly shifts in consuming pills, so as to minimize the risk of adverse effects arising in either sex through indefinitely prolonged treatment.

So far, little progress has been made with the problem of preventing fertilization by biological means in circumstances where both male and female are producing viable germ cells, that is to say, in preventing effective contact between egg and sperm. It is possible, though not certain, that the most hopeful line of work here is towards immunizing the female against spermatozoa and thence against pregnancy, a possibility which arises from the fact that spermatozoa are antigenic when administered parenterally to animals of a different species from the donor, and that the antibodies raised are organ- rather than species-specific. A serious difficulty, however, lies in

obtaining an effective concentration of antibody at the necessary site of action within the female reproductive tract, and only recently, by the use of adjuvants, has it been possible to obtain any serious indications of a positive result. However, other immunological approaches to fertility control exist.

Work on the prevention of implantation raises the important question as to what constitutes conception. Biologically there can be little doubt that implantation of the fertilized egg in the uterus, not fertilization of the egg, constitutes conception, and that contraception can therefore properly be exercised up to the time of implantation. This is important because much interesting work is now being carried out on inactivating the fertilized egg or preventing the changes in the endometrium necessary for implantation. A method of fertility control based on such work would have the great advantage of requiring retrospective action rather than action anticipating the uncertain contingency of exposure to the risk of pregnancy. Scope for inactivating the fertilized egg is perhaps limited, but there are many possibilities of disturbing the hormonal, metabolic, pharmacological, or neurohumoral relationships necessary for the development of progestational changes in the uterus. A particularly interesting line of thought in this field arises from the observation that newly mated female mice fail to become pregnant if exposed to the smell of alien males from a different strain. The effect is exerted first through nervous and then through hormonal pathways, and the observation is evidently of great interest and potentiality; the attractive idea of a contraceptive perfume is no longer quite incredible.

In conclusion, it must be remembered that the best methods will be of little value in countries faced with an explosive growth of population unless people can be persuaded to use them, and this may not be easy in countries conditioned to the idea of a high birth-rate and a high death-rate, and in which public health measures have reduced the death-rate so rapidly that the social background has had little chance to adjust itself. But at least we should ensure that demographic and personal aspects of human reproduction are as widely understood as possible, and that simple and reliable methods of fertility control are available for those who wish to use them. In this we have far to go. Established methods of fertility control, being archaic in principle, are a disgrace to science in this age of spectacular achievement. In general, I am in favour of science pushing on in every possible direction, but I sometimes think that the further exploration of inner man would be more immediately useful than the exploration of outer space.

SAFE HANDLING OF RADIOACTIVE SUBSTANCES

IN 1949 a printed version of the booklet *Introductory Manual on the Control of Health Hazards from Radioactive Materials*, prepared by the Atomic Energy Research Establishment, was issued by the Medical Research Council. This manual has been in great demand by those working with or just beginning to work with radioactivity, but, as it has not been

available for some years, a new edition*, commissioned by the Medical Research Council's Committee on Protection against Ionizing Radiations, is timely and welcome. It is intended to give guidance on the principles of safe working to those handling radioactive substances in laboratories and elsewhere, and contains a valuable summary of the recommendations on maximum permissible doses and the state of legislation in the United Kingdom at the end of 1960.

* Privy Council, Medical Research Council Memorandum No. 39: *Introductory Manual on the Control of Health Hazards from Radioactive Materials*. (Committee on Protection against Ionizing Radiations.) Pp. vi+21. (London: H.M.S.O., 1961.) 1s. 9d. net.