other international organizations engaged in the broad field of water control and utilization.

The complex nature of the inter-relationship between the various factors which have an influence upon, or are in turn affected by, the availability of water is first stressed—the needs of agriculture, inland navigation, industrial and domestic demands, electric power and the like are considered in relation to techniques of conservation to prevent excessive run-off, soil erosion and flood damage. The report then directs particular attention to three aspects: the first need in any activities on water control is the organization of a continuous collection of hydrological data which must be available for a considerable stretch of years to be of any value; in this connexion the suspension of the United Kingdom Inland Water Survey (referred to in *Nature* of November 7, 1953, p. 823) is again seen to be a retrograde step.

Secondly, attention is directed to the topic of watershed management, as this is regarded as an important but neglected aspect of water conservation. It is claimed that effective control in these initial stages reduces the need for river-training works and downstream flow-control measures. It is suggested that there is a regrettable lack of understanding of watershed management, not only on the part of the general public but also among those who are responsible for the political and economic decisions which are often made on water supply. The need exists to build up a body of information on this subject and also to arrange for its dissemination, perhaps through Unesco. The third aspect selected for special attention is the use of water for industrial purposes. This is considered to be the largest single factor making for the increased demand for water which is being experienced in most countries of the world to-day. Some dramatic illustrations of the growth of this demand are given: in 1950 the industrial use of water in the United States was higher than the agricultural use, and the Paley Commission estimates that by 1975 industries will use two-thirds of all sweet water and that availability of water will be the main determining factor for industrial location. To produce a ton of steel now requires 65,000 gallons of water, and to refine a barrel of crude oil requires 18½ barrels of water; a ton of sulphate paper needs 64,000 gallons, while almost astronomical figures are required for thermal generating stations and atomic power stations.

To meet these and related problems of water pollution, the report considers the possibility of a more effective integration and co-ordination at various levels of the interested agencies and organizations. A strong case is made for the creation at national level in each country of a 'water board' representing all the interested government departments and local government bodies concerned with any of the numerous aspects of water conservation and utilization. This is a recommendation that might well receive careful consideration in the United Kingdom, although we are not alone in this lack of one central body: few countries have so far succeeded in co-ordinating their local activities on water development. Until this has been done, however, there seems little hope of efficient and successful co-ordination and co-operation at the regional and international level. Meanwhile, it is recommended that the United Nations Organization should encourage the holding of technical conferences and meetings of existing hydrological agencies. The United Nations Organization should also serve as a clearing house on water matters and perform such other functions as it may appropriately undertake in implementation of the Economic and Social Council's resolution on water control (Resolution 417, XIV).

W. G. V. BALCHIN

NETWORK ANALYSER OF THE ELECTRICAL RESEARCH ASSOCIATION

THE alternating current network analyser has now become established as an essential tool for the design, operation and study of electrical power systems. The direct representation of the electrical characteristics of the network components by variable calibrated elements with suitable sources of alternating current, flexible means of interconnexion and sensitive measuring equipment readily applied to any point on the network makes possible examination of a complicated network for power flow, transmission efficiency, stability and fault conditions with an ease and accuracy quite beyond the range of human computation, while permitting an experimental approach as yet impracticable with a digital computer. The same equipment can in principle be used in the study of any systems capable of representation by linear differential equations and certain non-linear problems within a range dependent on the versatility of the components and measuring equipment.

The network analyser constructed by the Electrical Research Association, the first completed section of which was exhibited to the technical and scientific press on April 28, has been designed for application to the widest possible range of problems. To this end the equipment can operate at any frequency from 160 c./s. to 16 kc./s., so that frequency can be a variable or one of the unknowns in a problem. The maximum accuracy is at the 'base' frequency of 1,592 c./s. ($\omega = 10^4$). This versatility is accompanied by the possibility of extension to a size not less than that of any existing analyser. The equipment is believed to be unique in providing steady-state, transient and harmonic solutions on the same installation.

The impedance elements, mounted in racks, are connected by twin cables to terminals on a 'plug board' and thence by pairs of flexible cords to plugs which can be inserted into sockets in an interconnecting board to form the nodes of a network. The potential drop across a 20 milliohm shunt in series with one of the flexible cords associated with each element, and the potential difference between any two nodes of the network may be connected by a selection system to the terminals of the central measuring equipment which indicates simultaneously current, voltage, load and reactive load at the selected points. Two independent selection systems, which can be cross-connected, make this measuring equipment extremely versatile. Monitoring and fault-finding indications are provided.

Physically small components used in the network elements yield an inexpensive and compact design with short interconnecting leads and thus increased frequency-range. Small components require a low power-level, to avoid thermal effects in resistors and non-linearity in inductors. The level adopted is 2·5 mW., 500 mV. and 5 mA. for the base (that is, 100 per cent) values, with a range up to 400 per cent

in voltage and current. This means that only 100 μV. is available across a shunt for the measurement of current at 100 per cent level. At the same time a resolution and repeatability of 0·1 per cent of amplitude (and 0·1° of phase angle at amplitude levels greater than 10 per cent) has been aimed at, with an absolute accuracy of 1 per cent and 1° at the base frequency. Such stringent requirements call for a bridge method of measurement.

For voltage measurement a voltage derived from the network is compared in a transformer with an internal reference signal. The latter is derived from a three-phase master oscillator through a magslip phase shifter and a potentiometer amplitude adjustor. The same oscillator energizes the network through phase shifters and potentiometers in active units representing generators. The difference of the two signals is derived from the transformer and provides the input to a servo-system which adjusts the shafts of the reference phase shifter and potentiometer until the reference signal becomes equal in phase and magnitude to the unknown voltage and the error signal disappears. The phase and magnitude of the network voltage (referred to a phase of the master oscillator) are then indicated on dials ganged with the shafts of the reference phase shifter and potentiometer. The current bridge is identical except for a difference in the operating level.

The shafts of both bridges drive the elements of a small analogue computer, also servo-operated, which indicates the products $P = VI \cos \varphi$ and $Q = VI \sin \varphi$. Here φ is the direct phase angle between the voltage V and current I measured, and hence P and Q represent the active and reactive volt-amperes.

Although the equipment is for use primarily in the service of the electrical industry, it is intended that so far as possible its versatility and flexibility shall be made available for the solution of problems within its range irrespective of their origin.

FAMILY PLANNING

IN an article on family planning*, Dr. Philip M. Bloom discusses the principles of family spacing which have been commonly accepted by most civilized communities. Besides accounts of the 'safe' period and the more usual methods of contraception like the condom and cervical cap, Bloom discusses investigations now being made into the development of oral contraceptives. At present, research is along four lines. In the first place an anti-fertility substance, phosphorylated hesperidin, is being investigated. It is thought that the sperm liberates an enzyme, hyaluronidase, which acts on the capsule of the newly-discharged ovum in such a way as to allow penetration and fertilization by the sperm. Phosphorylated hesperidin is a non-toxic inhibitor of hyaluronidase ; an American worker has administered it orally to three hundred couples in an attempt to control fertility. He claims much success but corroboration is needed.

Secondly, an anti-fertility factor of an entirely different nature is that contained in the plant, *Lithospermum ruderale*. It is likely that it either inhibits the secretion of the pituitary gonadotrophic hormone or neutralizes it. Dried extracts of *Lithospermum* used on laboratory animals of both sexes have reduced fertility ; nothing is really known of its effects on human beings. In England, a gromwell (*Lithospermum officinale*) has been found to contain this anti-fertility factor, and properly prepared extracts are non-toxic. They permit the possibility of trials in human volunteers. A third line of research is that of finding substances such as anti-vitamins or anti-hormones which will prevent development of the ovum or curtail its ability to embed itself in the endometrial lining of the uterus. Fourthly, there is the possibility of active immunization. An antigen which would produce immune bodies in the female capable of preventing either fertilization or nidation offers interesting speculation. Langer in New York has used such an antigen in female mice. With extracts of human umbilical cord given in three weekly injections, he found that female mice brought into contact with fertile males following a wait of three weeks showed delays in producing young in about 80 per cent of cases. Further, some of these substances may act as early abortifacients and would not be readily accepted by large sections of society. Others, by interfering with ovulation, would produce irregularities in menstrual cycles which may cause considerable emotional upsets in women. A great deal of further research work has to be done before an easy oral contraceptive is discovered and accepted ; but it is probable that at some future time such a substance will be found.

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SALMON MIGRATION AND THE ENVIRONMENT

By Prof. A. G. HUNTSMAN

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WHAT fish do of themselves is simple enough ; but where they go is greatly complicated by environment and weather. This is a general conclusion from twenty years investigation of salmon and other fishes with the view of their management. Where they go is basically important in management and needs to be predicted.

Where salmon go may, as is most natural for us, be considered psychologically in the belief that they go where they will, and they are free to go anywhere in the water. Or it may be considered physiologically in the belief that their internal processes determine where they go, and physiology has now the highest repute among zoologists. But, to follow either of these courses is to reckon without one's host. The host in this case is the environment. Claude Bernard concluded that living is the continuous adjustment of internal conditions to external : "Ce n'est point par une lutte contre les conditions cosmiques que l'organisme se developpe et se maintient ; c'est, tout au contraire, par une adaptation, un accord avec celles-ci"[1]. This means that the environment sets the pace, that it determines living.

If we can rid ourselves of preconceived ideas, there is no mystery in salmon migration. It is easy to see that the anadromous salmon is carried downstream and swims back up, and that the katadromous eel swims upstream and is carried back down. It is also easy to see that fish are carried downstream when they wander and do not resist the current sufficiently by heading and swimming upstream, and also that, when wandering vigorously, they head and swim