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## AUTOMATIC CONTROL\*

THE conception of automatic control arises basically from the use of devices which measure the departure of the physical state of a system from a desired normal, and the utilisation of this information to restore, by mechanical or electrical means, the system to the normal state. Many and varied devices of this kind have existed for a long time. Every steam engine had its governor and a patent was filed for a D.C. cross-field generator to give constant current as far back as 1882. The automatic pilot was flying aeroplanes in 1925 and one of the several fields of automatic control that was already entering upon a phase of active development before the war was that of the automatic control of quantities involved in the manufacture of chemical products, the field now often referred to as process control. What is new is the emergence in recent years of a philosophy of automatic control, a change of out-

look based on the recognition of a common basis of principle in a great variety of engineering devices. And it is precisely this recognition that is mainly responsible for the present acceleration of progress in all the many fields of application from sensitive self-balancing bridges for measuring purposes to power machinery like rolling mill drives.

It is probable that the development of the feed-back thermionic amplifier was the decisive contribution in weaving these various strands of development into a unified pattern. The main theoretical concepts that enable us to deal so effectively with so large a variety of control problems were nearly all first developed in connection with the use of feed-back in amplifiers. It was in this connection that Nyquist, in 1932, developed the criterion of stability now known by his name, that has played so important a part in the development of all forms of automatic control.

The perception of the essential identity of the basic problems in these various fields was accelerated by the pressure of war requirements. The rapid solution of many automatic

\* Abstract of the Presidential Address of Sir Ben Lockspieser, at the opening of the D.S.I.R. Conference on Automatic Control at the Royal College of Aeronautics, Cranfield, England.

and manual control problems became of first importance, as may be appreciated on recalling such examples as the automatic gun layer, the automatic tracking of targets or the control of guided missiles. The solution of these problems led to the production of many new elements suitable for use in control systems. But the outstanding result of the stimulus of war on the development of automatic control was this appreciation, for the first time, of the essential unity of the subject, including mechanical servo-systems, automatic controls as used in the chemical industry, feed-back amplifiers, both of the thermionic, rotary-machine and static-magnetic types, and in fact the possibility of bringing under the control of a common scheme of analysis all those systems in wide fields of engineering and elsewhere that involve what is called a 'closed sequence of dependence.'

The scope of this conception was soon seen to extend even beyond engineering. There is no doubt that in biology, in economics, and perhaps even in still wider fields, this conception of the closed sequence of dependence, and the characteristics of system behaviour associated with it, may prove to be a valuable tool of thought, and in some cases a means to the formulation of problems in these difficult fields in such a way that the analytical methods already worked out by engineers may be brought to bear on them.

The subject of automatic control is of outstanding importance, both in connection with industrial development and the increase of pro-

ductivity, and also with defence requirements. Writers of eminence have not been lacking, particularly in the United States, who have seen in the development of automatic control systems an important contribution to the emergence of an entirely new type of industrial era. There is some disparity between such views of the future potentialities of automatic control and the somewhat slow, though steady and important progress that has been made so far in the application of automatic controls in industry.

It may be true that if economic considerations are set aside, there are now only remote limitations to the technical possibilities of devising mechanisms that will carry out certain kinds of functions usually performed by human muscular skills, but, in fact, the economic considerations remain and it is an important purpose of a Conference of this kind to make the sort of progress that in the long run will result in the production of simple and, therefore, cheaper equipment. Several of the papers to be discussed during the Conference are concerned with the alternative ways in which a given specification of requirements may be met and the possibilities of devising procedures in design that will indicate the optimal design without the inordinate amount of labour and calculation that is at present involved in the design of such systems. Such developments, if they can be carried to a successful conclusion, will also help to cheapen the application of automatic control and so widen its field of use.

#### INTERNATIONAL COMPUTATION CENTRE

**T**HE International Computation Centre proposed by the UNESCO is to have the following functions in the fields of Research, Education and Service:

(1) to organise study and scientific research on questions relating to the use and development of Mechanical Computation devices, in particular to establish, in co-operation with scientific organizations concerned, a programme of pure science problems to be studied on the international level; to publish and circulate in appropriate form the results of the research which it has undertaken; to promote collaboration between computing institutes throughout the world, to assist in the co-ordination of their work, and to promote their activities;

(2) to organise and develop a programme for the training and improvement of research

workers in the field of Mechanical Computation; and, to this end, establish and maintain one or more laboratories equipped with various types of calculating machines and requested to carry out numerical computations.

Also it has been recommended that UNESCO should create and administer the Centre and should secure for it the resources necessary for its functioning. The proposed budget for the first year is \$220,000, mounting to \$300,000 in the third year.

Three countries—Italy, the Netherlands, and Switzerland—have offered to act as host for the proposed Centre, but no decision is to be made until a final report is presented to a suggested meeting in November of accredited delegates from different countries when the Centre will be set up officially.