

imported hard wheat, which was formerly used to improve the baking qualities of bread made from Swedish native soft wheat. Investigations are also being carried out on synthetic rubber. The work has proceeded so far that the product has been evolved in the laboratories of the Institute, although it is too early yet to say whether domestic production can be started and its probable extent.

One of the foremost technical means of research of this Institute is the Svedberg ultra-centrifuge, which has become of the utmost importance to science. The rotor of this centrifuge is given a speed of up to 70,000 revolutions per minute by a number of oil turbines. The Institute also houses such instruments for research as one of the world's largest electro-magnets and a neutron generator, both of which have been made in Sweden. In the biochemical section the experiments for locating and cultivating infantile paralysis virus and tuberculein on the basis of a new method for analysing mixtures through molecule splitting are carried on under the direction of Prof. Arne Tiselius, who has devised this method. The object in the first place is to obtain a pure form of virus. The stoppage of the import of apes for these experiments for a while threatened the workers with the loss of indispensable test animals, but it is stated that their replacement with rats has now proved acceptable.

### Quality Control in Manufacture

AN article by H. Rissik on "Quality Control in Manufacture" in the *Electrician* of March 27 reviews the principles of the subject with special reference to the use of control charts. The theoretical foundations of the method were laid down originally by Prof. R. A. Fisher, and the technique itself, which was originated in the Bell Telephone Laboratories of the United States, has been applied successfully for more than twelve years throughout the various manufacturing organizations of the Bell system. The technique of quality control is, briefly, one of inspection-cum-production, based on known statistical methods which have been applied successfully in other fields, and it has proved to be a valuable aid to manufacturing concerns engaged on repetition work. Its advantages include reduction in inspection costs and in rejects, attainment of maximum benefits from quantity production and of uniform product quality even though the inspection test be destructive, immediate applicability as part of inspection routine, and utter simplicity of application.

Fundamentally, the problem is one of controlling variability in some directly measurable quality characteristic, for example, dimension, weight, tensile strength, electrical resistance, hardness, etc. In practice this means analysing the variability observed and comparing it with some objective standard. Thus, provided a product is known beforehand to be stable, limits may be assigned within which practically all observed values of the variable quality characteristic are expected to lie. If measurements on a succession of piece-parts, produced supposedly under the same essential conditions, are found to give dimensional values lying outside these limits, then it may be inferred that they were not, in fact, so produced, that is, the production process was not stable in the first place. This leads to the very heart of quality control as a technique enabling preventive action to be taken before trouble develops; and the basis of this is the so-called quality control chart which is, in effect, a continuous graphical record of

product quality. The article discusses the use of the control chart and makes reference to the recent British Standards Institution publications, *B.S.* 600-1942 and *B.S.* 1008-1942.

### Electrical Instruments

IN his chairman's address to the Meter and Instrument Section of the Institution of Electrical Engineers (*J. Inst. Elec. Eng.*, 89, Pt. 1, No. 13, January, 1942), W. Phillips surveys the design and performance of electrical instruments. Development since the 1890's has been twofold: first in widening the limits of measurement, and secondly in accuracy. Switchboard moving-coil instruments are now available to give full-scale deflection for 10  $\mu$  amp. or less, and ammeters having a range of 30,000 amp. are in use. In voltage, the range is from a few micro-volts, with apparently no upper limit, the sensitivity of d.c. moving-coil instruments now being limited only by the non-magnetic quality of the moving system. The standardization of frequency at 50 c./s., and its close regulation by supply undertakings, has fostered the design and use of testing apparatus for the measurement of power factor, peak factor, and current; and also of voltage testing sets and similar apparatus for use at fixed frequency. The Electricity Supply (Meters) Act created an immediate demand for standard and sub-standard instruments of all types, large sums being expended by supply authorities in equipping meter-testing stations. Great improvements in wattmeter performance have been made, particularly in the reduction of self-heating error and D.C./A.C. change-over error.

One of the recent major troubles with which instrument makers have had to cope is the almost complete stoppage of supplies of sapphire jewels. An English company now manufactures sapphire jewels from rough boules, but it cannot yet meet the demand. Substitutes are being provided, consisting of nitralloy steel jewels for meters, while for instruments a specially hard glass jewel is available requiring no expensive or elaborate manufacturing plant. The jewels at present being manufactured are mainly for use in miniature instruments, a small number only having been made for larger instruments.

### Electric Heating of Premises

MR. W. GILCHRIST, in a paper read recently before the Institution of Electrical Engineers on the above subject, deals with the various methods of applying electricity to space-heating, water-heating and sundry special applications with particular reference to large-scale space- and water-heating installations. The author records the fundamental principles of design and some of the results obtained from certain methods of heat application which do not, in some respects, follow existing practice. The possible economic limits of using electricity for direct heating are related to the capacity of both commercial and domestic buildings, there being a definite limit to the size of such installations both from the consumer's and supplier's points of view. Details are given of certain combinations of radiant and convection heating to achieve maximum comfort conditions at a lower cost to consumer and supplier than other existing methods. Examples are given of installations using a combination of thermal storage, local thermal storage and direct heating, and a method of applying water-heating to large installations is described which considerably improves the