RADIO FREQUENCY MEASURING TECHNIQUE

RECENT issues of the *Proceedings* of the Radio Section of the Institution of Electrical Engineers, forming Part III of the *Journal* of the Institution, contain seventeen papers describing advances in the technique of measuring various electrical quantities at increasingly higher radio frequencies. Another series of papers was read at the Radiolocation Convention held by the Institution; and the publication of these in the near future will be awaited with interest.

The measurement of frequency itself in the range 100–10,000 Mc./s. is dealt with in a paper by Dr. L. Essen and Mr. A. C. Gordon-Smith published in the December issue of the *Proceedings*. This paper is an official communication from the National Physical Laboratory and describes how the usual heterodyne methods of measuring a frequency by comparison with an appropriate harmonic of a standard quartz oscillator can be extended to the highest frequencies now in general use. A self-contained portable apparatus is described, incorporating both a quartz-controlled oscillator and two interpolating oscillators, the whole set, excluding the power supply equipment, weighing about 30 lb. A measurement of an unknown frequency can be made in a few seconds, so that the frequency drift of the interpolating oscillators is very small. The accuracy of measurement in terms of the frequency of the quartz oscillator is $\pm$ 1 part in 10^5; but for an overall accuracy of this order, it is usually necessary to check the frequency of the quartz oscillator.

Another paper in the December issue of the *Proceedings*, by Mr. R. F. Proctor and Dr. E. G. James, describes a radio-frequency capacitance and conductance bridge which operates at a frequency of 1 Mc./s. This bridge is suitable for the measurement of capacitances from 0 to 28 $\mu\mu F_2$ and parallel conductances from 0 to 11 micromhos (90,000 ohms). One side of both the generator and the detector is earthed, and the bridge has the great advantage that the capacitance between earth and each electrode of the partial capacitance being measured does not affect the balance condition. The design of the bridge lends itself to operation at frequencies up to 50 Mc./s., provided that the usual precautions are taken with regard to residual capacitances and inductances.

The numerous war-time applications of centimetric waves gave rise to the need for developing new techniques for measuring the properties of dielectric materials at extremely high frequencies, with particular reference to low-loss materials such as polythene and polystyrene. At frequencies above 100 Mc./s., lumped resonant circuits become increasingly difficult to devise and operate, and they are consequently replaced by resonant elements of either transmission lines or wave guides. The theory and experimental development of such techniques suitable for frequencies of more than 600 Mc./s. (wave-lengths less than 50 cm.) are described in a paper entitled "Resonance Methods of Dielectric Measurement at Centimetre Wavelengths", by Messrs. F. Horner, T. A. Taylor, R. Dunsmuir, J. Lamb and Prof. Willis Jackson, and published in the January issue of the *Proceedings*. The relative suitability of three forms of resonator, one a short-circuited length of coaxial transmission line, and the other two cavity-resonators operating in different modes, is discussed. It is shown that for dielectric measurements, complete filling of the resonators with dielectric is unnecessary, a conclusion which has considerably facilitated the experimental work on solid dielectrics. The paper contains a description of apparatus used for measurements at frequencies of about 3,000 Mc./s. (wave-length 10 cm.) and a statement of typical experimental results obtained with a specimen of polythene, which at the above frequency had a permittivity of 2·27 and a power factor of 0·0004. The accuracy attainable in such measurements is discussed in the paper.

The March issue of the *Proceedings* contains a paper entitled "Radio Measurements in the Decimetre and Centimetre Wavebands", by Mr. R. J. Clayton, Drs. J. E. Houldin and H. R. L. Lamont, and Mr. W. E. Willshaw; and this describes a wide field of radio-frequency measuring technique as it evolved in the Research Laboratories of the General Electric Co., Ltd. Such a technique was a necessary aid to the development of valves, circuits and equipment required during the War for increasingly higher frequencies; and the paper begins with a review of the circuit theory of coaxial and wave-guide transmission lines, followed by a short discussion of high-frequency oscillators. Succeeding portions of the paper deal with the measurement of the fundamental quantities of frequency, power, impedance, voltage and current. The concluding sections of the paper are concerned with measurements derived from the above quantities; such as receiver sensitivity, aerial gain and impedance, and radio field-strength. Descriptions are given of some of the practical equipments developed for these measurements; and the discussion which took place at the reading of the paper before the Radio Section of the Institution, brought to light some information on similar work which has been in progress elsewhere in Britain during the war years.

CIVIL ENGINEERING AS A CAREER

THE Institution of Civil Engineers has given a fine lead to other professions in its recently published brochure entitled "Civil Engineering as a Career". With the ever-increasing width of human activity, the percentage of young men who can have anything but an elementary idea of the kind of life to which their chosen job is going to lead them must be small, and here in compact but fully informative form is an admirably drawn picture of a profession, rightly encouraging, but without any trace of propaganda. It merits the most careful study by anyone whose responsibilities entail advising scientifically inclined young men what lies open to them. It should certainly be in the hands of every young engineer in his early days at the university, when he is faced with the choice of what branch of the profession he is going to adopt.

The excellence of this publication must not blind one, however, to a serious disadvantage from which civil engineering seems to suffer, and which is somewhat of a high price to pay for the undoubted interest and satisfaction to be found in this branch of the profession. This disadvantage is the lack of security, not in earlier years, of course, when a young man's thoughts should be turned towards fitting himself for the high responsibilities ahead, but later on when most men have home responsibilities. Civil engineering is a profession of high adventure, but high adventure normally signifies high reward for those

with the courage and spirit to see it through, and it is very doubtful if such reward falls to the lot of the reasonably successful civil engineer.

Civil engineering is, if we may use the mathematical analogy, the second differential of the profession, the aim of which is the acceleration of normal progress; and in the earlier years of this century when everything was alive with expansion, there was no doubt in the truth of the statement that a civil engineer could walk the length of Victoria Street, London, and find himself with a dozen excellent assignments to choose from. Those good days are, however, past, and we live in more sober times, added to which the 'dynamic' side of engineering has made immense strides both in the width of its products and in their application to industry. What could offer higher adventure than the development of the jet engine, or radar; or the smooth and effective running of a complicated human machine such as a works of some thousands of hands, with all the problems of production control and the enjoyment of the command of men: and with all this, more security of tenure and, we think, very appreciably greater financial reward? Higher executives in engineering firms or industry can look to salaries of £1,000–£1,500 or more from about the age of thirty-five onwards, a level which we doubt can be expected by a resident civil engineer of comparable age, technical training and experience.

This, then, is the competition which civil engineering has to face. The insecurity, save for the fortunate few who may perhaps become partners in a firm of repute, seems inevitable. Manufacturing industry is a continuous process, slow or fast maybe, but in steady motion, whereas big public works are dependent for their life on a wide variety of circumstances and are the first to be hit by any period of depression. May it be hoped, therefore, that to attract to this branch of the profession the best young men, as it well deserves, the rewards will be very real. Consultants' expenses are high, but surely on a contract totalling some hundreds of thousands of pounds a rise in the price of that essential raw material, namely, the resident engineer's skill and devotion, would scarcely make an appreciable difference.

Certain branches of civil engineering are of the 'service' type, with a planned career, but we are not sure even here whether the terms offered are fairly aligned with those in other careers of a similar nature. It might not be unwarranted to draw an analogy between such careers and the financial world, where the yield of government securities largely regulates the gilt-edged market. This analogy is pointed by the terms recently offered by the Government Scientific Service, designed to attract the best material of Britain to a career which cannot offer more than a fair reward compatible with security and pension. It would be extremely interesting to compare these with the prospects ahead of a young engineer in, say, one of the railways.

Civil engineering suffers from a further disadvantage at the other end of the scale, namely, the conditions of entry. Criticism on this count is now, to some extent, disarmed by the reference on page 12 of the brochure to recent arrangements made between the Institution of Civil Engineers and both the Institution of Municipal and County Engineers and the Federation of Civil Engineering Contractors, for the proper training of young engineers entering the profession through these two latter channels. We understand, although it is not mentioned, that the scheme envisages a salary of the order of £250–£300 a year for a two-year indenture. This is a most excellent move on which the Institution of Civil Engineering is to be congratulated, the level being approximately the same as that now offered by the big 'training' firms in the electrical and mechanical world. Contracting and municipal engineering are, however, only branches of civil engineering so to speak, and it is a matter of some regret that the lead in improved conditions for training has not been given by the 'core' of the profession, namely, the consultants. The chapter on consulting engineering includes only a somewhat vague and unsatisfactory reference to the proper method of entry, together with an ominous, and surely unnecessary, warning of the perils of aiming at too high a salary in early years. The young engineer of to-day is a young man with a very realistic view of life and a readiness to learn his craft thoroughly—provided it does not entail his being a burden on his heavily taxed parents.

BOMBYLIIDÆ OR BEE FLIES OF EGYPT

THE Bombyliidæ or bee flies are very well represented in a warm, sunny country like Egypt. They are an exceptionally interesting group of Diptera to the entomologist, not only on account of the remarkable range of form displayed by the adult flies but also owing to the curious parasitic habits of their larvæ. Prof. Efflatoun Bey has recently made a very detailed study of the Egyptian species*, and the results of his labours form Part VI of his well-known "Monograph of Egyptian Diptera".

The Bombyliidæ are poorly represented in cold or cool countries, but they rapidly increase in number of species as we pass southwards. Thus, the author mentions that while there are only nine British species and fourteen Danish forms, some sixty kinds are recorded by Schiner from Austria and 115 from Spain. In 1924, 594 species were known from the Ethiopian region, and that number is only a small proportion of those that probably remain still to be discovered. In 1919, fewer than fifty species of bee flies were known from Egypt, but to-day that number is more than quadrupled. For reasons of economy and convenience, the results of Prof. Efflatoun's study are to appear in two parts. The present, on Section I, deals with the Bombyliidæ Homœophthalmæ or those in which the compound eyes are simple, that is, not indented on the hind margin. Section II, dealing with the Bombyliidæ Tomophthalmæ, or those in which the eyes are evidently indented, will, it is hoped, be published in the near future. A series of beautiful coloured plates have characterized the previous parts of this monograph, and their absence from the present section immediately attracts notice. Prof. Efflatoun mentions that they cannot be published at present owing to difficulties arising out of the War, but it is expected that they will be issued later. On the other hand, the work is very well illustrated by some 38 black-and-white plates comprising more than 550 well-drawn figures of structural details pertaining to the different species.

At the present time nothing is known concerning the early stages of these flies in Egypt, and here a wide field of inquiry awaits a competent investigator.

* A Monograph of Egyptian Diptera. Part VI. Family Bombyliidæ. Section I. By Prof. H. C. Efflatoun Bey. *Bull. Soc. Fouad 1er d'Entomologie*, pp. 482 + 38 pl., 1945.