instances, royalties may be claimed and a modus will have to be found which is fair to all parties concerned. Obviously, the subject will need the co-operation of authors, publishers, learned societies and the legal profession in all countries[3].

Another point on which there is much difference of opinion is the question of payment. The alternatives under discussion are: (1) free service; (2) annual subscription; (3) payment for the job. An authority on microfilm and related subjects, Dr. Atherton Seidell, secretary of the Executive Committee of the Friends of the Army Medical Library, Washington, D.C., wrote in *Special Libraries* (October 1944): ". . . the final complete acceptance of microfilm copying as a legitimate function of library operation is at hand. Since no part of library operation is ever conducted as a business enterprise, it is very unfortunate that microfilm copying should have been so considered. There is no more justification for charging for limited microfilm copying than there is for charging for any of the other services by which the resources of libraries are placed at the disposal of those capable of using them for the advancement of learning". The stress is on the "limited copying"—but it is exactly here where opinions—and practices—vary considerably. It would be helpful if general agreement could be reached on the question as soon as possible. With regard to the more extensive programme now awaiting attention, different categories of documentary reproduction will require different treatment from the costing point of view; but any such details of financial policy should be worked out in close co-operation between all the interests concerned and any decisions on these matters should be adopted by universal agreement.

There can be no doubt that developments in matters of documentary reproduction—in particular so far as planning and policy for the future are concerned—have reached a stage when nothing short of co-ordinated effort can produce practical results.

When documentary services were in their early stages, it was essential for those who recognized their growing importance to keep in touch and exchange experiences. The annual conferences and publications of the International Federation of Documentation (frequently referred to by the initials of its French title as F.I.D.) were great and important events. The last of these international conferences before the War took place in Zurich in the summer of 1939. (The first post-war conference is planned for the spring or summer, 1946.) Since then, documentary reproduction has made itself indispensable, and questions of practical organization have become pressing. Exchange of experiences through international conferences is more important than ever; but beyond this we need machinery for permanent co-operation in day-to-day matters, effective co-ordination of policy, and general agreement on a scheme of international planning in documentary reproduction.

It will take some hard thinking to work out a procedure which will make international co-operation in these fields practicable. As a first contribution to further discussion, the following is a tentative suggestion:

1. Permanent offices should be set up in each and every country to act as centres of organized national systems of co-operating institutions in the field of documentary reproduction.

2. Permanent co-operation should be maintained between national offices of different countries with the view of setting up an international system of reproduction services and co-operating institutions agreed on questions of policy, procedure and economy.

3. An international system of co-operating institutions in the field of documentary reproduction would be in line with similar systems in other fields already functioning, or outlined for consideration and discussion, such as an International Science Co-operation Service[4]; an International Information Council[5]; an International System of Library Loans[6].

4. A permanent universal office should co-ordinate—under one central administration and guided by one agreed policy—the activities of all national and international centres, offices and systems of co-operating institutions in the field of documentary reproduction for purposes of study and research, science and learning, education and re-education in the post-war world.

[1] *Nature*, **155**, 26 (1945); *J. Documentation*, **1**, No. 1, 31 (1945).
[2] cf. Item 5, Preliminary Programme in Ref. 1.
[3] *Photographic J.*, **85B**, 92 (1945).
[4] *Nature*, **154**, 657 (1944); **156**, 401 (1945); **156**, 558 (1945).
[5] *Daily Sketch* (February 12 and 15, 1945).
[6] *The Times* (May 3, 1944).

THE SOLAR ECLIPSE OF 1945 AND RADIO WAVE PROPAGATION

By Dr. R. L. SMITH-ROSE
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IT has long been appreciated that an eclipse of the sun represents a unique opportunity of examining the effects of a temporary reduction or cessation of solar radiation on the ionosphere and the consequent effects on the propagation of radio waves. Observations of the influence of a solar eclipse on the reception of wireless signals have been made for more than thirty years past; and particular attention has been given to the use of radio wave-sounding technique to examine the changes brought about in the ionosphere by solar eclipses from 1927 onwards. The results of such previous investigations have shown quite definitely that ultra-violet radiation is the main cause of ionization of the lower layers of the ionosphere; but in the case of the upper region or F_1 layer, the results have usually been somewhat inconclusive. It has always been realized that swiftly moving neutral particles or corpuscles emitted by the sun could cause ionization in the upper regions of the atmosphere: because such particles travel much slower than light, there is an important difference in times of occurrence of what may be termed the 'optical eclipse' and 'particle eclipse' respectively. In consequence of the motions of the moon and the earth, the particle eclipse can occur from one to two hours in advance of the optical eclipse, the actual difference in time depending upon the velocity of the particles.

An additional series of measurements of the conditions affecting the transmission of radio waves through the ionosphere was carried out on the occasion of the solar eclipse of July 9, 1945, by the staff of the Radio Division of the National Physical Laboratory, working under the auspices of the Radio Research Board of the Department of Scientific and Industrial Research. These measurements were supplemented by a variety of other observations made by British Service establishments and other

organizations working to a general co-operative programme suggested and arranged by Sir Edward Appleton, secretary of the Department. The detailed analysis and study of the results obtained is in progress, but a preliminary and very brief account of the major effects observed can be given at this stage.

Ionospheric Soundings in Great Britain

The National Physical Laboratory scientific team on this occasion comprised Mr. R. Naismith and Dr. W. G. Beynon, who carried out ionospheric soundings at Burghead and Loth in Scotland; Mr. W. R. Piggott, who made similar measurements at Slough, England, where also some radio direction-finding observations were made by Mr. W. Ross; and Mr. L. H. Ford and Dr. B. G. Pressey, who conducted some ultra-short-wave field measurements at Teddington and Slough respectively.

The path of totality of the solar eclipse on this occasion was considerably to the north of the British Isles, and at the time of maximum phase, which was about 1400 G.M.T., the magnitude of the partial eclipse was 76 per cent at Loth and 61 per cent at Slough. At these stations the density of ionization in all three regions, E, F_1 and F_2, of the ionosphere was reduced by amounts of 30–45 per cent during the optical eclipse, the reduction being greater in the F_2 than in the E region. A decrease in ionization which occurred during the morning on the day of the eclipse may be associated with a corpuscular eclipse.

Absorption of Radio Waves in the Ionosphere

Observations were also made at the above stations of the amount of absorption to which the radio waves were subject at vertical incidence reflexion. These were carried out on a number of selected frequencies and, as in the case of all the other measurements, over a period of seven days centred on July 9. The observations of most interest are those made on frequencies less than the minimum value reached by the critical frequency of the normal E region during the eclipse period; for on these frequencies the absorption measurements are not complicated by the marked changes in signal intensity associated with the critical frequency phenomena, and any variations which may occur can be attributed to changes in the absorbing layer of the ionosphere.

The changes in absorption observed at Slough during the eclipse period were less marked and of shorter duration than those at Loth, a result to be expected from the greater obscuration of the solar disk at the latter place. Thus on a frequency of 2 Mc./s. the ionospheric absorption at Slough decreased by about 1 neper (8·7 db.) for a period of about forty minutes near the time of maximum totality. At Loth, on the same frequency, the decrease amounted to 1·3 nepers (11·3 db.); in this case, the absorption reached its minimum value at about the period of maximum phase, and remained below the average midday value throughout the period of the optical eclipse. Similar results were observed on other frequencies.

The measurements at Loth on all frequencies showed that the period of maximum absorption coincided reasonably well with the time of maximum optical eclipse. The magnitude of the decrease in absorption was also of the order to be expected from theoretical considerations on the assumption that the ionization of the absorbing D region is produced by ultra-violet radiation from the sun.

Effect of Eclipse on Communication

The above measurements made under vertical incidence conditions were supplemented by observations of the received signal strength of ordinary communication and broadcasting transmissions carried out by the staff of the Post Office and British Broadcasting Corporation. Full reports of these will be available later, but a few typical results may be quoted here.

During the eclipse period, observations on trans-Atlantic transmissions on a frequency of 18 kc./s. and 58·5 kc./s. showed no appreciable change; but on a frequency of 216 kc./s. transmitted over a 1,260 km. path, a slight increase in field-strength was noted. In the medium wave-length broadcasting band, the field-strength in the north of Scotland on transmissions from Droitwich on a frequency of 1·15 Mc./s. showed a sharp increase of some 5 db. at about forty-five minutes after the commencement of the optical eclipse. The intensity of the received signal reached a maximum near the time of maximum phase of the eclipse, after which conditions gradually returned to normal. These results, obtained during transmissions through the ionosphere at oblique incidence, show that during the optical eclipse there was a small, but definite, decrease in ionospheric absorption for various frequencies in the band 60 kc./s. to 1 Mc./s.

Direction Finding

An extensive series of radio direction-finding observations was carried out at the Radio Research Station, Slough, during the eclipse, on transmissions from stations in America, U.S.S.R., India, China and Spain, using frequencies between 10 and 15 Mc./s. A rotating spaced-loop direction-finder of high accuracy was used, but the results obtained on the day of the eclipse did not differ significantly from those observed on other days before and afterwards. In most cases the deviations in bearings were less than 1°, the highest being 1·6°; and the results in general illustrate the very high accuracy which is obtainable in radio direction finding over long distances—1,300–8,500 km.—in favourable circumstances.

Transmissions on Ultra-Short Waves

In addition to the above work, the opportunity was also taken to examine any effects produced by the eclipse on the transmission of waves of much higher frequencies than those referred to above. By arrangement with the British Broadcasting Corporation, a programme of transmissions was provided from Alexandra Palace station on a frequency of 46·3 Mc./s., and the field received at both Teddington and Slough, some twenty-five miles distant, was recorded continuously for more than thirty hours including the eclipse period. No significant effects due to the obscuration of the sun were observed, and the received signal was sensibly constant to better than 1 db. for the whole period of the measurements. Similar results were obtained on a frequency of 92 Mc./s. during measurements of the field strength received at Slough from a transmitter at Teddington, eleven miles away.

Observations Received from the U.S.S.R.

A brief summary has been received by telegram of some of the results obtained during the eclipse by workers at the Mandelstamm Laboratory of Oscillations as part of the Physical Institute of the

Academy of Science of the U.S.S.R. This Laboratory is under the direction of Dr. Papalexi, a member of the Academy, and the results have been communicated by Mr. J. N. Alpert, who made the measurements in co-operation with Mr. N. Gorozhankin.

The radio observations were carried out in the vicinity of Moscow, where the optical eclipse in the ionosphere was total; and the results confirmed the hypothesis that the ionization in the *E* region is mainly caused by ultra-violet radiation from the sun, and thus supported previous conclusions that in medium latitudes, the emission of particles from the sun is not the chief cause of ionization in the ionosphere. The communication from Moscow states, however, that some characteristic variations in ionization occurred several hours before the optical eclipse, and at about the time that a particle eclipse would take place if the particles from the sun were travelling with speeds of 450–600 km. per sec. These variations were not observed on the days before and after July 9, the day of the solar eclipse.

OBITUARIES

Dr. J. F. Tocher

JAMES FOWLER TOCHER, born in 1864 at Fyvie in Aberdeenshire, was a man of many interests: by profession a pharmaceutical and analytical chemist, he found time in a busy life to make numerous contributions to the history, antiquities and anthropology of his native country, and he was most successful in stimulating popular regard for all branches of local knowledge.

His story indicates something of the drive and resolution that lay behind his genial presence. He left school early and, having served an apprenticeship in a country chemist and druggist's shop, he set up on his own account a similar business in Peterhead. But his energies were bent on finding a scientific outlet beyond the dispensing room, and in 1887 he founded the Buchan Field Club, which became a focus for local lore, and the *Transactions* of which, with two elaborate volumes "The Book of Buchan" (1910 and 1943) both of which Tocher edited, form an invaluable compendium of the history and natural history of the north-east of Scotland.

Later Tocher's interest in statistical analysis, encouraged by Karl Pearson, led him to plan and carry out with Dr. John Gray an extensive survey of the physical characteristics of Scottish school children and adults. More than half a million individuals were examined, and the results, published in the *Journal of the Anthropological Institute* and *Biometrika* from 1908 onwards, brought out many new facts about the distribution of ethnological groups. Thus the north-east of Scotland was found to be the home of a population characterized by a higher proportion of red-haired and a lower proportion of dark-eyed individuals than any other part of the country; and the centres of population were shown to have relatively more dark-eyed and dark-haired people than the country districts.

While the survey was in progress, Tocher determined to study for a B.Sc. degree at the University of Aberdeen, and this enthusiast of forty years, under great handicaps, completed the course and graduated in 1908. A few years later his investigations won him the degree of D.Sc.

In 1911 he was appointed lecturer in statistics in the University of Aberdeen, and thereupon transferred his home to that city and took up appointments as agricultural analyst for Aberdeenshire and other counties in the north of Scotland, and consulting chemist to the Highland and Agricultural Society. He served on the governing bodies of most of the teaching and research institutes in Aberdeen, and in 1909 was president of the British Pharmaceutical Conference. Recently he received from his University its LL.D.

Dr. Tocher had a great gift of friendship, and his overflowing spirits expressed themselves in goodwill and effervescent humour, whether on the more formal occasions of a Burns' Club address, or in the anecdotes of a casual gathering. He died in Aberdeen on November 8, aged eighty-one. JAMES RITCHIE.

Mr. B. B. Bancroft

B. B. BANCROFT, who was killed while serving as a 'seaborne aircraft identifier' during the invasion of Normandy on June 24, 1944, will long be remembered for his work on the trinucleids and brachiopods of the Shropshire Ordovician, upon which four of his papers appeared in the *Memoirs* of the Manchester Literary and Philosophical Society for the years 1928 and 1929. He was the first geologist to recognize the unconformity at the base of the Ashgillian near Bala, and made many advances in the stratigraphical correlation of English and Welsh Ordovician sections. One of his greatest successes lay in his discrimination between *Heterorthis retrorsistria* and *H. alternata* and his assignment of them to their correct stratigraphical horizons. Some of his best work was privately printed in "Correlation Tables of the Stages Costonian–Onnian in England and Wales" (1933), and his "Brachiopod Zonal Indices of the Stages Costonian to Onnian in Britain" has recently appeared posthumously in the *Journal of Paleontology* in the United States. It is hoped other papers will follow.

Bancroft served also in the War of 1914–18, in the Royal Garrison Artillery, and was recommended for the Croix de Guerre. It was typical of his fearless spirit that in the recent War, though well advanced into middle age and a member of a reserved profession, he should again be a volunteer. One who was with him in the attack on the "West Wall" writes:

"It was a very great experience and lesson to me to live for a time with a man of such age and experience as he, to whom anything but complete truth was abhorrent. He had the mind and outlook of a true scientist." ARCHIE LAMONT.

WE regret to announce the following deaths:

Mr. R. H. Briggs, M.B.E., editor of the *Overseas Engineer* and recently assistant director of the Technical Press Censorship, Ministry of Information, on January 3, aged fifty-eight.

Prof. Charles Fabry, For.Mem.R.S., until recently president of the International Council of Scientific Unions, on December 11, aged seventy-eight.

Prof. E. S. Goodrich, emeritus professor of zoology and comparative anatomy in the University of Oxford, on January 6, aged seventy-seven.

Prof. T. H. Morgan, For.Mem.R.S., professor of biology and director of the Wm. G. Kerchhoff Laboratories, California Institute of Technology, since 1928, on December 4, aged seventy-nine.