Air Waves from Experimental Explosions

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IN the article in NATURE of December 31, p. 1008, with regard to the Oldebroek explosions of December 15, it was mentioned that a number of observations had been received at Kew Observatory. The observations have now been scrutinised with the object of arriving at a definite answer to the question whether the waves from the explosions were received in England.

The observations have been put in three classes. Those in Class A were made at such times as were consistent with the passage of the air waves with the normal velocity of sound along the ground or with a delay not exceeding five minutes. The observations placed in Class B were those which were too early or considerably too late, whilst those in Class C were made at such times that there was evidently no connexion with the explosions. There were 12 observations in class A and 10 in Class B.

minutes after 6.0. At Farnham (normal time 24.3 minutes) a door gave a short sharp rattle at approximately 6.30 and again at 7.30, that is, 24 minutes after 6.6 and after 7.6. At Arundel (normal time 24.3 minutes) there was a violent rattle of a sash window but the estimate of the time, 6.30, is very rough. At Lymington (normal time 27.7 minutes) a window gave a clear thud at 28 minutes after 7.6.

Observers at Nuneaton and Maidenhead may possibly have heard sounds with the same trajectory as infra-sonic waves. On the other hand, sounds reported at Maldon, Cleethorpes and Boar's Hill, if coming from Oldebroek, were delayed by at least two minutes. In itself that is not improbable, but in view of the facts that none of the three observers in question heard more than one of the four explosions, that another observer at Boar's Hill reported that he could hear nothing and that noises

FIG. 1. Sketch map showing places where observations were made on the Oldebroek explosions of December 15, 1932.

- + On the Continent, received by undiagraphs; in England, some evidence of reception of infra-sonic waves.
- On the Continent, not received by undiagraphs; in England, not recorded by hot-wire microphones.
- Sounds heard at appropriate times—Cleethorpes, Nuneaton, Oxford, Maldon, Maidenhead and South Croydon.

Six of the twelve observations falling in Class A refer to secondary sounds such as the rattling of windows. The agreement of these observations with the normal time of passage of air waves is very good. The most satisfactory observations are those at Cambridge. The normal time (reckoned at 3 seconds per kilometre) for waves from Oldebroek to Cambridge is 20.2 minutes. The times that elapsed between the explosions at 6.0, 6.6 and 7.6 and the observations at Cambridge were $21\frac{1}{2}$, $20\frac{1}{2}$ and $20\frac{1}{2}$ minutes respectively. As the observer noted the first of these receptions when she was awakened by the vibrating motion of the window, a mistake of a minute is not unlikely.

Confirmation by the observations at Ipswich, Havering-atte-Bower, Farnham, Arundel and Lymington indicates that there was a large area over which the aerial disturbance was appreciable. This area lies between the microphone stations at Hythe and Foulness and those at Nottingham, Birmingham, Cardiff and Bristol. It is known now that at none of these stations could the air waves be detected.

At Ipswich (normal time 16.5 min.) a lady felt her bed quiver and heard a faint rumble $16\frac{1}{2}$ minutes after 6.6. At Havering-atte-Bower (normal time 20.3 minutes) birds were disturbed between 19 and 22

of all sorts are only too common in England, these observations must be regarded as somewhat doubtful.

The reception of the air waves at Cambridge at the time appropriate for normal transmission is remarkable. The condition which favours the passage of air waves westwards close to the ground or sea is the presence of east wind, increasing in strength with increasing height, or alternatively, west wind decreasing with increasing height. On December 15, however, the wind was from south-west and moderately strong. Unfortunately, there was much low cloud and no information is available as to the wind at a greater height than 600 metres; at that height the velocity at Felixstowe was about 15 m./s. It is not impossible that the wind fell off rapidly above the lower cloud and that the air wave was therefore able to travel westwards at a moderate height.

On the other hand, the possibility that air waves travelled very rapidly westwards at a great height, so rapidly that the time lost in ascent and descent was compensated, must not be overlooked.

It has been realised since the War that in this part of the world the sounds of explosions produced at points far to the east at distances of 200 km. or more are likely to be heard in summer but not in

winter. Accordingly, it may be anticipated that if the Oldebroek experiment is repeated at some time during the coming summer, more positive and therefore more interesting results will be obtained.

I should like to take this opportunity to thank all correspondents who kindly communicated their observations and also to express my appreciation of the trouble taken by the observers who manned all the microphone stations which were in operation.

A preliminary report on the observations made on the Continent has been circulated by Prof. H. Hergesell, president of the International Commission for the Investigation of the Free Atmosphere. Of the German stations provided with undographs close to the direct line from Oldebroek towards Lindenberg, those at distances of 105, 136, 155, 161, 170, 183, 190, 198, 201, 213 and 225 km. were successful in obtaining records of the air waves, as were the stations at Aachen, Arnsberg, Jever, Lindenberg, Göttingen and Potsdam. No waves could be recognised on the undograph records in Holland.

Observations of audibility show an abnormal zone which has, in Germany, a mean radius of 145 km. and a maximum of 215 km. This zone extends to eastern Belgium. The inner zone of normal audibility

was narrow; there was some extension to the east, as was to be expected from the prevalence of west wind.

That the air waves were received at places to the east of Oldebroek and not at the principal English stations to the west is in accordance with expectation, as is the fact that there was abnormal audibility in the eastern part of Belgium (south of the source) but not in the western part (south-west of the source). The very small inner radius of the outer zone of reception of air waves, 105 km., is also typical of winter observations. The reception of air waves at Cambridge and other places in England was unexpected and therefore, if the evidence is accepted, all the more interesting.

It is understood that the experimental explosions which were to have taken place in Novaya Zemlya on the same morning as the Oldebroek ones had to be postponed.

Similar experiments, organised by Dr. Bruno Rolf, were to be inaugurated in Sweden on January 11 by the explosion of 300 kgm. of gun-cotton near Boden. Five undographs provided by the International Meteorological Association were to be used for the first time on this occasion.

British Industries Fair

SCIENTIFIC INSTRUMENT SECTION

THE Scientific Instrument Section of the British Industries Fair will again be situated in the Grand Hall at Olympia. Of the 14,500 sq. ft. of space to be occupied by this section of exhibitors, nearly a quarter will be taken up by the composite exhibit of a group of British scientific instrument manufacturers who have co-operated for this purpose. The whole of the exhibits may roughly be divided into two categories, namely, (a) technical instruments and apparatus, such as are used for control and testing in works, for laboratory research or for the teaching of science in colleges and schools; (b) scientific instruments of a more or less domestic character, such as barometers and thermometers. A very wide field of scientific instruments will thus be covered, ranging from a simple pocket magnifying lens to the equipment required for the most refined micro-photographic work.

Among the new, improved, or adapted products of the instrument industry, about which advance information is available, the following may be mentioned. James Swift and Son, Ltd., will exhibit Nicol and other polarising prisms such as are used in the latest apparatus for television and picture transmission. A new model of the tintometer, very light and portable, and enabling rapid measurements to be made, will be shown by The Tintometer Ltd. This instrument enables the specification or definition of colour to be made in terms of reproducible units or standards, in the form of graduated and numbered glass slides. A stereo-prism binocular, with an extra wide field, a magnification of 7 diameters, and a 50 mm. object-glass, having a light-transmitting power very greatly in excess of that of any prism binocular previously made, will be one of the exhibits of Ross Ltd. Among other products, W. Watson and Sons, Ltd., will show a new low-power microscope for the rapid examination of specimens varying in thickness from 1 mm. to 6 in. This firm's exhibits will also include a special microscope 'for crime detection' and a new form of photometer for the

measurement of the comparative densities of photographic plates and for the measurement of reflections from papers and other materials. This last instrument makes use of a photoelectric cell with a suitable magnifying system.

The Foster Instrument Company is exhibiting at the Birmingham Section and, besides a complete range of automatic temperature controllers, will show a 'Blackie Heat-Loss Gauge'. This last named instrument, it is claimed, is the only known instrument of its kind, and, since it is directly calibrated in B.T.U's / sq. ft. / H.R., it can be used even by unskilled operators.

Thermometers reading to an extremely high degree of precision—for example, to the nearest 0.005° C.—for use in research and industrial work will also be among the exhibits at Olympia.

Another noteworthy exhibit will be the projection microscope to be shown by Vickers. It is designed primarily for the purposes of metallography, and will deal with specimens up to 50 lb. in weight and enable magnifications varying from 3 to 5,000 diameters to be obtained. The apparatus will, as desired, provide for visual observations, or take photomicrographs or project the images on to a screen for demonstration purposes. The Cooke optical comparator is designed for the quick and accurate comparison of machine parts produced in quantities. It is intended to supersede the use of high and low limit gauges in works' inspection departments. A total magnification of 1,000 is achieved by means of a system of mechanical and optical levers, and a variation of 0.0001 in. from the standard can be detected. An instrument for observing the precise character of the movement of any rotating or oscillating part of a machine or apparatus is the 'Whidbourne' stroboscope. By means of this instrument—to take one example—gear wheels can be observed in motion without having to stop the machine. The observer, on looking through the