Auroral Radiation in the 3,000-Megacycle Region

DURING the auroral display of January 24, short pulses of radiation were observed on the indicator of a radar set operating at a frequency of 3,000 megacycles. Since these pulses were observed even when the radar transmitter was off, it seemed probable that they were associated with the auroral display. Observations on twenty auroral displays since January 24 seem to confirm the auroral origin of these pulses.

The radar receiver had been equipped previously with an antenna designed to pick up radiation from an angle of about $6{\cdot}3 \times 10^{-3}$ spheradians. During the course of the investigation of the pulses, the following additions were made to the equipment. An electronic discriminating circuit was added to the receiver to indicate the presence of the pulses and to count the rate at which they were received. An auroral camera, modified so as to use 35-mm. film and to operate by remote control, was mounted beside the receiving antenna so that it moved with the antenna. With this equipment, the observer could detect the presence of pulses on the cathode ray tube, count the rate at which the pulses were being received, and photograph the region of the sky towards which the antenna was directed.

The pulses arrive in a random manner, occurring in bursts lasting only a small fraction of a second. Each pulse appears to be of one to five microseconds duration. Bursts of radiation in which the individual pulses appear to be separated by as little as ten milliseconds are observed; but the very short duration of the bursts makes difficult the accurate determination of this interval. The rate at which the bursts occur is variable between wide limits and seems to depend both on the intensity of the display and on the type of aurora. The pulses are more numerous with bright, active displays, exhibiting a definite structure. The types of aurora, arranged in order of increasing pulse activity, are as follow : glow, corona, homogeneous arc, flaming aurora, homogeneous band, ray arc, ray band and isolated ray. The auroral designations correspond to the ones used in the Photographic Atlas of Auroral Forms, International Geodetic and Geophysical Union, 1930.

The investigation is continuing with the view of determining quantitatively the pulse frequencies for different types and intensities of aurora, and also the possible mechanisms responsible for the observed pulses of radiation.

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A High-Intensity Light Source for High-speed Cinematography

HIGH-SPEED cinematography, that is, a camera operating at speeds up to 3,000 pictures per second, presents special lighting problems as compared with the more conventional speed of 24 frames per second normally used for ciné-film photography. The light intensity for a satisfactory exposure to be made at these high speeds is approximately proportional to the ratio of frames per second, and with an average object having a reflectivity of 10 per cent, the illumination required is about 10,000 foot-candles for a lens aperture of f 2·7. However, at higher speeds the total exposure-time seldom exceeds 3 seconds, and it is therefore possible to consider other means of obtaining these very high intensities than by ordinary methods.

One method that has been used is to fire off in rapid sequence a series of photo-flash bulbs of the chemical reaction type mounted on a rotating disk, so arranged that each bulb is fired at the focus of the reflector to produce a relatively long flash of light from a series of short high-intensity flashes.

It is not possible to increase the light output of a photo-flood lamp which has a high-temperature filament with a life of about 2 hr., as the tungsten filament is already running very close to the fusing point of the metal, and where heavy filaments are used there is an appreciable lag in reaching maximum brightness if they are subjected to short overload periods. Small carbon arcs do not respond to large variations in current, the arc becoming unstable in operation.

We have recently obtained very successful results by operating high-pressure mercury vapour lamps at considerable overloads for periods up to several seconds ; for example, a lamp having a normal rating of 1 kW. and designed for D.C. operation may (with special electrodes) be overloaded to 10 kW. for a duration of 1 second, or 4 kW. for 3 sec. giving in a reflector 18 in. in diameter an average illumination of 500,000 foot-candles over a 10-in. diameter circle at a distance of 3 ft. A prototype model being designed will use a smaller mirror, and it is estimated that a maximum intensity of 250,000 foot-candles covering an area of 12 in. diameter at a distance of 3 ft. will be adequate for most purposes. Where higher intensities or modelling is required, two or more units may be synchronized.

When the lamp is operating at its steady continuous rating of 1 kW., sufficient illumination is provided for modelling purposes. During the exposure of a film, the lamp is triggered by the camera at the desired moment to its full power for a predetermined period, or at lower powers for longer durations. In this way the object being photographed is only subjected to the maximum light intensity and therefore heat radiation for a minimum of time.

Apart from the economical and simple method in which the required light intensity is obtained, the small 'modelling' light, the short period of flash and high efficiency of the mercury source, means that problems associated with the heating of the subject normally experienced under high light intensities is considerably reduced.

The mercury lamp may be colour-modified by the addition of cadmium metal, and the colour rendering at these high-pulse currents has enabled satisfactory high-speed films to be taken in colour. In the past, the use of colour film with its lower emulsion speed has not been considered readily practical due to the very high light intensities required. The colour-modified high-intensity compact source lamp thus furthers the use of high-speed cinematography in colour, and in monochrome a greater depth of focus is possible with smaller apertures. This method of obtaining high light intensities may be of importance apart from high-speed cinematography lighting.