112. *A Method of Sending Light Signals through Fogs.*

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The principal cause of the disturbances which we experience during the time of communication of light signals are the scattering and absorption of light. Of the two the former effect can be divided into two; one of them is the scattering of the light rays which carries the signals and the other is the scattering of the light rays other than the signal rays. Among the latter, the scattering of the sun's radiation has the most important effects on our communication of the light signals. If we can eliminate this last effect, the day time communication can be safely performed as it is done during the dark night. The present method is to eliminate this sun's effect, though it can hardly be applicable for such a case as running motor car on the street. The author intended to apply the method to the lighthouse system for ships and air-crafts of the foggy lands. The method is roughly represented in the Fig. 1.

Fig. 1.

A is the light source which serves to emit the light ray for communication. B is a lens to converge the light rays from the source on the slit C of the monochromator system CDEFGH. For light source A, we use a lamp giving intense line spectrum which coincides with some of the absorption lines of the sun's radiation, that is with Fraunhofer's lines. Natrium lamps and Kalium lamps fulfill this condition. With monochromator we can easily pick the light rays from the source

out of the confused bundle of light rays of all colours. When the light source stands at sufficiently distant point from the observer, we can see a star on the absorption line in the monochromator. When the field of the monochromator near the absorption line is not very bright we can open wide the slits C and G and then it becomes very easy to find out the object A from a distance by turning the monochromator system as in the case of the ordinary telescope. In this last case, the width of the absorption line becomes broad but the image of the source A remains a point.

Under foggy weather the light signal gives weak images in the monochromator field but the sun's radiation have only a small effects in disturbing the signals when the dispersion of the monochromator is sufficiently large. The dispersion of the monochromator should not be so great as to have important effect on the intensity of the image of the signal.

It is not absolutely necessary to use the emission lines for light source which coincide with the Fraunhofer lines if the emission lines are very strong such as the green line of the mercury arc. For the naked eye observation the D-line communication is better than Green-line communication as the eye's sensation is greatest at the yellow colour. We have not found out red-lines yet which show good results for eye observation. For identification of the sending station we can adopt a proper choice of both the wave-length and the intensity variation with time of the source A. The tests of our method with the artificial fogs such as dense smoke-screens and thick drawing papers all illuminated with strong natural light and glow lamps showed sufficient capacity in eliminating the disturbances. The disadvantage is that we cannot distinguish the form of the station with our method, though the identification can be effected by means of wave length of the signal light not to be mistaken with the ordinary lamps of the streets. For special purposes the magnesium ribbons may also be used for light source.

To remove the drawback that we cannot observe the neighbouring scene of the sending station with the method, the author devised a telescope with his collaborator¹⁾ which can instantly be transformed into a special monochromatic camera. The optical system can be seen in Fig. 2. All the lenses used in the instrument are achromatized ones. Fig. 3 shows one of the photogram obtained with this instrument. The vertical lines in this photo are the Fraunhofer's lines which light rays are absent

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Fig. 2.

Fig. 3.

Distance from the camera.....	1.5 km.
Exposure	5 min.
Weather	cloudy and windy.

in the sun's radiation. The wave-length of light with which the photo was impressed changes from point to point; thus the wave-length becomes longer as the point in the photo approaches to the right end. In the vertical direction the wave-length is the same. The wave-lengths can be determined from the Fraunhofer's lines C, D, E, F..... With the proper direction of the telescope a bright point will appear on the D-line if the sending station have the natrium lamp.

Further details will be reported in the Report of the Aeronautical Research Institute, Tokyo Imperial University and Journal of the Aeronautical Research Institute, Tokyo Imperial University.