After preliminary tests, the observations were made at 240 m. The diameter of the dinghy being 2·5 m. the angular size at the limiting ranges was, as the report points out, of the order of 0·05°. Actually the size is about one minute of arc for the greatest range (7·4 km.), nearly two minutes for the red range (4·6 km.) and nearly seven minutes for the British waters range (3·15 km.). Now Helmholtz has shown that the minimum perceptible brightness difference increases from about 2 per cent for an angular size 3° ; from his curve one finds (by extrapolation) that the minimum perceptible brightness difference has increased to about 40 per cent for the 7-km. range, about 35 per cent for the 5·5-km. range, and for the 3-km. range to about 27 per cent. As the effect of the atmosphere is to introduce a greyness into the colours, it is clear that the high values of the minimum perceptible brightness differences are the real limits to vision. Put simply, the objects become too small to see, quite irrespective of their colour.

It should be possible to increase the 'size' of the object by liberating oil. In the past, use has been made of fluorescein powder, which should the "multitudinous seas incarnadine", and this has been given off by airmen's suits (namely, packet on life-jacket). But the colour is obviously soon diluted, and in any event a volume effect is produced as against a surface effect for oil. The action of the latter is, according to N. K. Adam, "to damp out the small ripples which are constantly being formed by the action of wind". The water surface at a distance makes, therefore, a smaller average angle with the eye, and so its reflexion is greater. This reflexion amounts to 40 per cent for 5°, and is increasing rapidly as the angle between sea and line of sight diminishes. There is, in addition, the difference due to the refractive indices of oil and water; but a trial on calm water showed this to be negligible. I am indebted to Prof. Adam for the guess that a fuel oil will spread to a thickness of at most one micron on a clean sea; at this one should have the higher orders of interference colours, which are surely observed. One kilogram of oil would, therefore, cover at least 1,000 sq. metres, giving a patch 30–40 m. in diameter. At the farthest range observed, namely, 7·4 km., such a patch would subtend an angle of about 15′, corresponding to a minimum perceptible brightness difference of about 17 per cent, as against 40 per cent for the dinghy; for British waters, 3·15 km., the angle would be 35′, corresponding to a 7 per cent minimum brightness discrimination. Thus increase in size should considerably extend the visual range, for dinghies plus oil, as against dinghies alone.

An obvious method of increasing the angular dimensions of an object is, of course, to use field-glasses; but it appears that the limitation of the field of view renders them valueless in ocean search —at least, no mention was made of them in the report.

The rate of spreading of oil on water may be about 12 m. a minute[1], so were a dinghy to liberate oil on sighting an aeroplane, a good-sized patch should rapidly be produced. So many factors are concerned in trials of this sort that direct observation seems the only way to reach a conclusion.

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[1] Adam, N. K., "Physics and Chemistry of Surfaces", 213 (1941).

Chemical Effects of Moonlight

The article by Dr. C. F. C. Beeson in *Nature* of October 26, p. 572, is a welcome attempt to sort out the many conflicting references to a subject of much importance and of wide interest. Numerous factors go to the growth of a plant, and I felt many years ago that it was necessary first to find out the chemical and physical effects of moonlight under simple controlled conditions. The research was carried out chiefly under the bright moonlight of South Africa. Moonlight is partially polarized, the maximum effect being with the oblique reflexion of half-moon, or somewhat later for the waxing and earlier for the waning moon.

The experiments were as follows:

(*a*) Exposure of seeds to the night sky at periods of half-moon and of no moon. There was marked increase of germination in those seeds in which the testa was thin and transparent. These experiments were simply exploratory but led to the inquiry as to the effect of moonlight on reserve food material.

(*b*) Exposure of starch grains, washed and mounted on a microscope slide, *without* a cover glass. No diastase was added, but the water contained 0·05 per cent sodium chloride as co-enzyme. After about three hours the slide was covered and left to dry. Crystals were seen forming within the grains and exuding from them, also in the surrounding film of liquid.

(*c*) Exposure of a film of *boiled* starch. On drying, crystals were seen forming stars and rosettes, and on treating with Fehling solution the change to a sugar was indicated by countless specks of cuprous oxide.

(*d*) In the living plant (chiefly in South Africa). Young leaves of *Tropœolum* and of spinach were partially covered by tinfoil, leaving a small portion exposed to the moonlight. In the exposed region the starch disappeared, while the covered portion still gave the blue colour with iodine. This effect was also shown in a shaded vine-leaf[1]. A similar effect can be produced on films of boiled starch on filter paper. A penny placed on top of a sheet of *thin* glass, with a film of starch on the under side, after exposure to moonlight, gave a distinct image of the shadow on staining the film with iodine.

(*e*) At the request of a consulting timber engineer, determinations of the sap content at different phases of the moon were commenced. Equal weights of vine stems were boiled and the solutions were tested for sugar after (i) a period of half-moon, (ii) after an equal period of minimum light. The result showed nearly twice as much reduction in the first case as in the second: (i) required 16·5 c.c., (ii) required 29·9 c.c. of the solution to reduce equal quantities of Benedict solution.

From these experiments, the results of which are similar to those obtained with artificially polarized light[2], it appears that moonlight, being polarized, has a hydrolysing effect on reserve food, that is, it acts as a digestive tonic. Now to live on digestive tonics, especially without extra food, may be disastrous— hence the conflicting results which have been recorded.

Most of the experiments referred to above are quite simple, and can easily be reproduced. They should help to dispel the idea of 'superstition' and 'old wives' fables'.

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[1] *Nature*, **130**, 243 (1932).

[2] *Bot. Gaz.* (Dec. 1930). *Nature*, **144**, 379 (1939). Baly and Semmens, *Proc. Roy. Soc.*, B, **97** (1924).