Letters to the Editor

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NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 784.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Cause of 'Oil Patches' on Water Surfaces

WHEN water moving in a channel at constant velocity encounters an obstacle, say, a weir, retarding its motion, a stationary wave is formed called Bidone's wave after its first observer. The more gradual the change in velocity, the less conspicuous becomes the wave. I have found no reference in literature to the fact that at very low velocities the gravity wave is reduced to a capillary wave appearing like a very fine thread or hair floating on the surface. The phenomenon is strikingly revealed as a moving reflection or refraction image when bright sunshine falls on to the bottom of the channel (see Fig. 1, taken in 1932, at a point where a brook discharges into the Lake of Lunz, Lower Austria).

Minute floating particles crossing the thread are abruptly retarded and thus accumulate. With larger particles the effect is less conspicuous, indicating that only a very thin surface-layer (say, 1 mm. or less) is involved, at least close to the 'thread' on its down-stream side, where coloured water if gently poured over the surface tends to remain. That capillary forces are largely responsible for the phenomenon is proved by pouring a liquid of lower surface tension like liquid paraffin over the surface, when the thread is at once displaced upstream by several metres.

The same phenomenon is observed along the lee-ward shore of a lake when a gentle wind is blowing (Fig. 2). Here the boundary (indicating a line of convergence) is formed 10–30 metres from the shore where the wind-driven surface-water dives below a thin layer of slowly moving water. Generally the thread itself is easily observed. Scattering aluminium powder over the surface brings out the circulation still more clearly. Where the convergence is bilateral, as is generally the case farther off from the shore, the 'oil patch' will assume the form of an oblong streak limited on each side by a 'thread'.

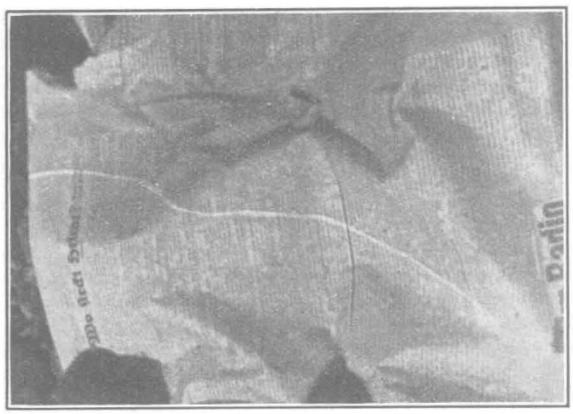

FIG. 1. The 'thread' image on the bottom of a stream, showing as a white line across the sheet of paper.

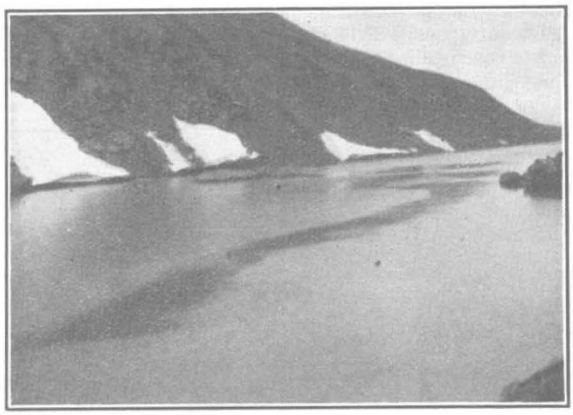

FIG. 2. 'Oil patches' on the Oberalp Lake, Switzerland, 1935.

These regions of retarded motion in a well-defined surface layer have mechanical effects analogous to those of real oil patches, that is, they have a damping effect on waves, especially those of short wave-lengths, smoothing out their crests. When viewed obliquely, the surface is apparently quieter inside than outside the boundary, an effect which is most marked when capillary waves are generated by rain-drops. It is, however, also quite distinct with the wavelets due to a rising wind. With stronger winds and increased eddies the thread becomes less continuous, but is still visible from time to time. The layer itself is not broken up very easily, the 'oil patch' and its effect on waves remaining visible.

This explanation seems to agree well with other observations on 'oil patches', which are known to contain more pollution, surface plankton and sometimes fatty substances than the rest of the water, obviously a *consequence* of the formation of the layer and not its *cause*.

'Oil patches' in the form of long streaks left behind a boat crossing the lake persist as long as there is any descending motion in the surface. I have never found the position of similar streaks incompatible with the explanation here advanced. They seem to afford important clues to the general circulation in the water. A detailed study may help to explain various surface phenomena, like the great differences in velocity often manifest between the surface itself and the water some centimetres below.

The conditions of the formation of these 'threads' and their associated phenomena will be a subject of further study.

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