THE EFFECT OF WAVES ON THE IMAGE OF THE LOW SUN AND ON A REFLECTION IN WATER

The image that the atmosphere forms of the low sun sometimes looks rather like a reflection in a rippled water surface. This rippled effect can easily be seen near the lower rim of the sun's disc in Fig. 1. The same effect can be observed near the upper rim of the sun's disc. It is interesting to compare the protrusions and isolated segments in Figs. 2 and 3 with parts of the reflection of an object, for instance a mountain-landscape, in a rippled water surface.

Fig. 4 shows a mountain-landscape on the far side of a lake and its reflection in the rippling water of the lake. Note the protrusions that seem to be growing from the sides of the reflection and the isolated segment near the bottom of the figure. The rippling surface of the lake causes the formation of multiple images of points on the mountains and it is this which causes the wavy outline of the reflection of the mountains. Light-rays falling on a portion of a wave or ripple that is tipped away from an observer are deviated more than light-rays falling on surfaces tipped towards an observer. Consequently one point of the mountains will be reflected in the lake in different directions due to the ripples in the water, and multiple images will occur.

The resemblance between the shapes of protrusions and isolated segments seen in connection with the sun's disc and a reflection in the water suggests an analogy in the

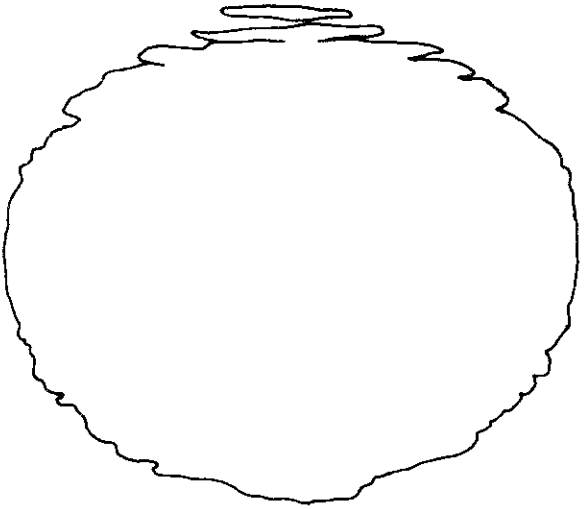

Fig. 1. 'Rippled' disk of the rising sun. Schiermonnikoog, Dutch North Sea Islands, 31 March 1977, drawn from a photograph

way these phenomena are formed. Fraser (1975) in fact showed that the protrusions and isolated segments of the low sun can be attributed to waves: the gravity waves that occur on top of an inversion layer in the atmosphere. Light-rays from the sun falling on a portion of a gravity wave that is tipped towards an observer are refracted very sharply, for the angle of incidence is large. Light-rays falling on a portion of a gravity wave that is tipped away from the observer are refracted only slightly, for the angle of incidence is small. In this way multiple images are formed of points on the sun's disc and protrusions and isolated segments occur, as in the case of a reflection in water.

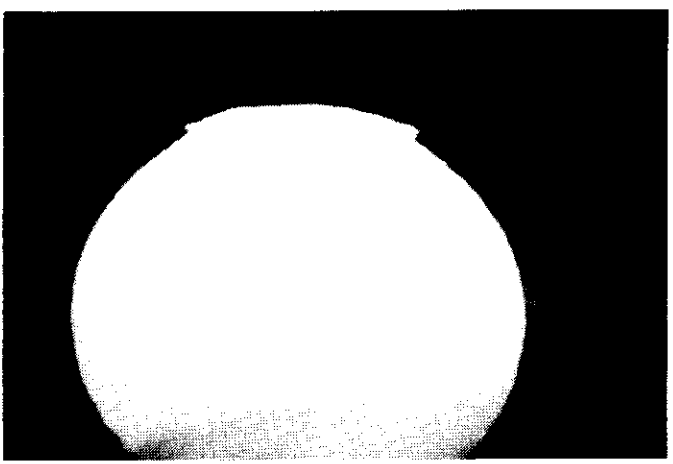

Fig. 2. Setting sun with 'protrusions', Yport, France, 26 July 1978

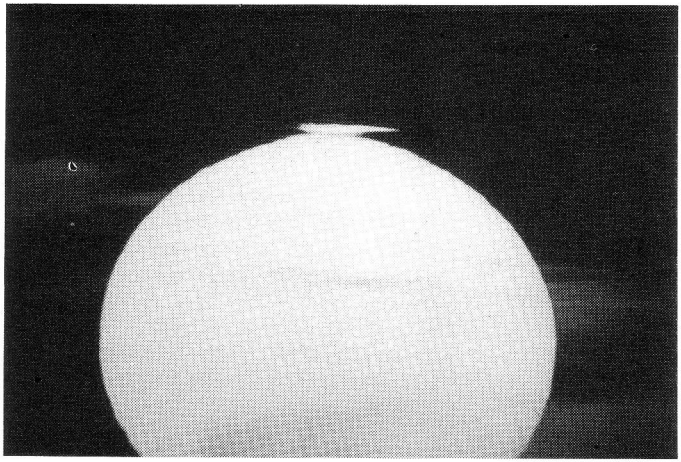

Fig. 3. Isolated segment on top of the setting sun. The isolated segment is at the same elevation above the horizon as the protrusions in Fig. 2

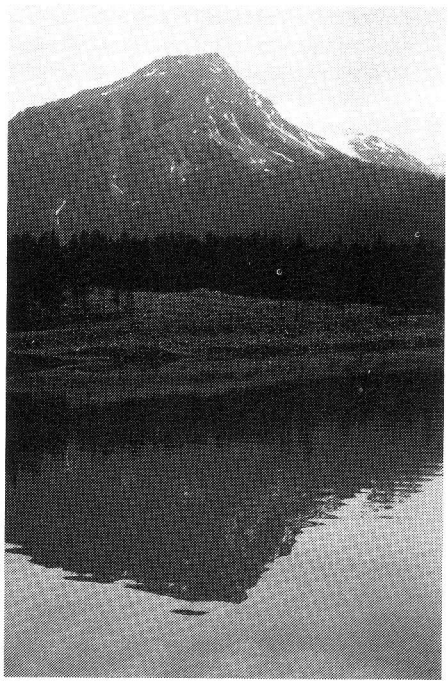

Fig. 4. Reflection of a mountain landscape in the 'Stausee', Arosa, Switzerland. The reflection shows protrusions and an isolated top segment

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Royal Netherlands Meteorological Institute, C. FLOOR
De Bilt, The Netherlands

REFERENCE

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