Growth of Waves.

THERE has always been some difficulty in accounting for the growth of waves under the action of wind. Do the individual waves grow in length, or does the wind raise waves of all lengths which separate in virtue of the dependence of wave-velocity on wave-length? The late Lord Rayleigh was in favour of the latter hypothesis, but I believe that the true explanation is that the waves do not increase in length unless they are breaking.

The excess of energy supplied by the wind to the water beyond that which can be carried in an unbroken wave is expended partly in causing local turbulence (ultimately converted into heat) and partly in producing a surface current in the direction of the travel of the wave. In effect, this surface current increases the wave-velocity; and since the addition to the current by each wave depends on the time for which that wave has been in existence, the waves first formed will, after the lapse of time, be travelling faster than the more recently formed waves which follow. Thus if waves are set up by wind on a previously calm water-surface, the wave-length will continuously increase from windward to leeward.

I have made some rough observations on a pond something like 1000 ft. in length, and found that in a brisk breeze the waves formed at the windward end showed as ripples of a few inches from crest to crest, while at or near the leeward margin the wave-length was about 2 ft. If it is assumed that the wave-length increases regularly, there would be about a thousand crests in the length of the pond, and the gain in length from wave to wave would be about 1/1000th of the mean wave-length. All the waves from the least to the greatest were in a breaking condition. The ripples did not show any foam at their crests, but it was clear from their shape that they were actually breaking.

There is no satisfactory theory of the shapes assumed by breaking waves. Stokes, in one of his earlier papers, showed that the irrotational form of wave cannot have an angle of less than 120° at the crest (the corresponding limit for the trochoidal wave, *i.e.* for the cycloid, is 0°), but he considers that the wave will break before the 120° limit is reached.

In the problem presented by breaking waves—as, indeed, in most problems relating to the actual phenomena exhibited by fluids in motion—the simple assumptions on which the hydrodynamical theory of text-books rests are insufficient, and experiments are required.

It would be quite possible to try (say at the Froude tank at the National Physical Laboratory) the effect of a steady artificial wind on a length of several hundred feet of water, and to observe and record the form, length, and velocity of the waves throughout the length of the channel. It would probably be found that the waves were started by the instability due to the discontinuous motion at the boundary of two fluids, and that these waves increased in amplitude only until they began to break, but that after the breaking state was reached the wave-length, as well as the amplitude, increased until there was some approach to equality between the velocity of the wind and the wave.

I have worked out the results for various assumptions as to the rate at which the wind can transfer energy to the water, but in the absence of experimental data the conclusions are scarcely worth publication.

A. MALLOCK.

9 Baring Crescent, Exeter, August 10.

The Antarctic Anticyclone.

IN his letter entitled "The Mechanics of the Glacial Anticyclone Illustrated by Experiment" published in NATURE for July 22, Prof. Hobbs remarks: "In all my writings upon the glacial anticyclone I have been at much pains to explain that the domed surface of the ice is essential to the development both of the anticyclone and of the alternating calms and blizzards which record its strophic action." As, however, one goes on to read the letter one finds that Prof. Hobbs's explanation demands another "essential," namely, that the domed surface must be cooler than the air in contact with it. Remove this defect of temperature, and the mechanism ceases to act; reverse it, and the mechanism works in the reverse direction, producing a cyclone instead of an anticyclone.

Assuming that the Antarctic continent has the domed form postulated by Prof. Hobbs, one might be led to accept his conclusions so far as the winter months are concerned, but what about the summer months? During the summer, with its continuous insolation, the surface of the dome must be at a higher temperature than the adjacent air, for there is plenty of evidence that the temperature of a snow surface is very susceptible to solar radiation. The mean amplitude of the daily variation of air-temperature over the Barrier during November, December, and January was found by Scott's Expedition to be 11·5° F., while between November 17–22, 1911, the average amplitude was 20° F., and this with the sun oscillating only between 10° and 35° above the horizon! If Prof. Hobbs's theory were correct the Antarctic would have a pronounced monsoon climate, while we know from observations that anticyclonic conditions last throughout the year.

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Trichodynamics.

THE present writer has had interesting associations since 1915 in various ways with projects for industrial research in the cotton industry and with its actual conduct. In all these the need for a word which would define and describe the field of research peculiar to the textile industries has been intermittently obvious, especially with respect to the processes of spinning and weaving.

In consequence of this I proposed, in the course of the discussion on industrial research at the tenth International Conference held in Zurich in June last, that the word "trichodynamics" should be adopted in order to effect this generalisation, together with the related term "trichostatics." The analogy with aerodynamics is obvious, and hence also my justification for suggesting the word. The word itself is open to question, since, if used in the literal sense, it includes only the hair textiles, *e.g.* wool and cotton, but the significance intended is akin to that of the word "capillary," which now conveys a definite meaning independently of actual hairs.

The chemical and colloidal constitution of textile raw materials, their biology, and the engineering aspects of their utilisation are fields of study not strictly peculiar to the textile industry. On the other hand, the movements and mutual contacts of attenuated filaments and the changes which take place in their arrangement as they pass from the tangle of the raw material to their orderly sequence in yarn or cloth, which the proposed names would cover, form a well-defined field of a peculiar kind which awaits physical investigation.

W. LAWRENCE BALLS.

Edale, Derbyshire, August 11.