

unrelenting hand of man; others have deteriorated in size and vigour as they have gradually come under the yoke. The horse, however, forms a notable exception, having from obvious reasons improved in physique and gained in strength. Such minor changes, changes of degree rather than of kind, are all that evolution can lay claim to have effected in these stubborn mammalia within the compass of some thousands of years during which Mentone has known the two extremes of climate and temperature.

Another great assistance rendered by the work of M. Boule is that he has enabled us with more certainty than was possible before to reconstruct the milieu of certain of our Palæolithic ancestors; for, from the fauna it is not difficult to realise the nature of the flora or the conditions of the climate. With the in-

#### THE TYPES OF WATER WAVES.<sup>1</sup>

DR. CORNISH has produced an attractive and valuable book. The volume is not the less valuable in that it is primarily descriptive, and in that the author shows great caution and reserve as regards speculative explanations. This caution is indeed amply warranted. The mathematical theory of water waves, successful as it is up to a certain point, is limited in its application by the fact that it contemplates only specially simplified conditions. In particular, owing to the restriction to *small* amplitudes, it can at present offer little in the way of explanation of various important natural phenomena, where what is technically called "turbulent" motion comes into play. Laboratory experiments, on the other hand, require elaborate and costly arrangements, which are only provided with difficulty even when a definite



FIG. 1.—Wave-track of Steamer on Thunersee, showing thwart-ship and diverging waves. From "Waves of the Sea and other Water Waves."

formation thus obtained we can approach the stone and bone implements which the man of that remote date has left, and deduce more confidently what were the purposes they served. A knowledge of the fauna is thus seen to be the key which will most successfully unlock many of the sealed chambers of man's past. Apart, however, from all this, the study of the extinct Pleistocene fauna possesses in itself great and abiding interest, and dull must be the archæologist or anthropologist who does not desire further knowledge concerning these early companions of man whose bones lie commingled with his in river drift and cave floor.

The book is a most valuable contribution to science, and reflects the greatest credit on everyone concerned.

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practical problem is in view; and in some respects the mere question of scale would impair their relevancy. There remain only observations in the open, such as the author has recorded in the present book. The extreme difficulty of these, from a quantitative point of view, is well illustrated by his discussion of storm-waves at sea.

The book is made very readable by the fact that the author's interest in his subject is evidently æsthetic as well as practical or scientific. He is fascinated by the extraordinarily beautiful and varied types of wave motion which are presented by nature, and has recorded a number of these, observed at sea or on land in many parts of the world, in a series of remarkable photographs.

<sup>1</sup> "Waves of the Sea and other Water Waves." By Dr. Vaughan Cornish. Pp. 374. (London: T. Fisher Unwin, 1910.) Price 10s. net.

The book consists of three parts. In the first of these, treating of deep-sea waves, the evidence of various writers as to the dimensions of storm-waves in different ocean basins is collated, and supplemented by the author's own observations. Accurate measurements are from the nature of the case very difficult, but it appears that there is a limit to the height (from crest to trough), which different observers concur in placing at about 40 feet, whilst the limit to the length is somewhere about 600 feet. The waves are longer and higher the longer the "fetch," *i.e.* the extent of water to windward, where the waves are generated. As to the mode in which waves grow under the influence of wind in a storm, we have at present little beyond general indications. Another subject here referred to is that of the much longer and lower waves

with admirable illustrations, of the "bore" or abrupt tidal wave observed in the Severn and other rivers, and of the stationary waves in flowing water due to fixed obstacles. Finally, the remarkable configuration of "ship-waves," first elucidated by Lord Kelvin, is exhibited in some beautiful photographs. These show clearly the system of "transverse" waves, which were (we believe) unnoticed in the earliest tank experiments until their existence had been pointed out by theory.

#### FIVE-HUNDREDTH ANNIVERSARY OF THE UNIVERSITY OF ST. ANDREWS.

FROM September 12-15 next, inclusive, this celebration will be held in the ancient ecclesiastical capital of Scotland, with all the ceremony it is possible to have in the circumstances. Though the university was not founded until 1411, yet St. Andrews for centuries previously had various teaching institutions in connection with the learned religious bodies in the monasteries of the Culdees and other sects concentrated in the ancient city, the preceptors of which had been trained in the English or Continental universities, especially those of France and Italy. Steps, indeed, had been taken before this period to further the interests of the Scottish students by the founding of the Scotch College (Balliol) at Oxford by Lady Devorguill, the wife of John Balliol; whilst the good Bishop of Moray had instituted in 1326 the Scotch College in Paris. No university, however, existed in Scotland, so that her students had to study for degrees elsewhere, and in the unsettled state of the times had not infrequently to encounter difficulties and hardships—even to the occasional capture by their then hostile neighbours, the English—on their way to other countries. Such was the condition of things when Henry Wardlaw was appointed to the bishopric of St. Andrews, and as he was a man distinguished for his wide culture, munificence, and great influence, it was not long before he found an opportunity. Eight years after his appointment to St. Andrews, *viz.*, in 1411, the thoughts which doubtless had been revolving in his mind for a long time took shape and were put in action. A *Studium Generale* was at once commenced with the aid of a staff of able teachers in the faculties of law, divinity, and arts. He drew up a foundation-charter of the university, and forwarded it by envoys to the Pope (Benedict XIII.), who endowed it by means of papal bulls with all the powers of a university in 1413—to teach science, philosophy, and medicine, and this was subsequently confirmed by King James, who was throughout a staunch bene-



FIG. 2.—Stationary waves caused by a weir on the River Aare, Switzerland. From "Waves of the Sea and other Water Waves."

which constitute the "swell" of the ocean. To the eye this is often scarcely perceptible at sea, and the only method of accurate observations consists in timing the waves as they break on the shore, where they are exaggerated by the shoaling of the water. In this way some inferences can be made, as pointed out by Stokes, as to the distance of the seat of the original disturbance to which the swell is due.

The second part of the treatise deals with the action of sea-waves in transporting shingle, sand, and mud. This is of enormous practical importance, and can be dealt with to some extent experimentally. From a theoretical point of view it is very difficult, and we shall not attempt here to discuss the contribution which the author makes to speculation on this subject.

The concluding section gives an interesting account,

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