

# Force of Ocean Waves

Measurements of the size of waves have now been made systematically for many years, but they relate chiefly to the waves of the open sea, where the depth of the water is so great that the friction of the sea bottom exercises no modifying effect.

A few months ago the North German Lloyd liner Brandenburg came into New York harbor with her crew's nest, 50 feet above the water line, stove in, and bearing many other marks of the damage wrought by a monster wave that broke over her bows about 1,000 miles east of Sandy Hook. The officers estimated the height of the wave at 65 feet. This height, according to the Scientific American, is exceptional, but not unprecedented, for it must be remembered that the breaking of a wave against an obstacle throws the water to a far greater height than the unbroken wave could attain.

Unbroken waves due to the wind may in extreme cases reach a height from trough to crest of 40 to 50 feet. Much higher waves occasionally occur as a result of earthquakes or seaquakes. "Solitary" waves of this character have sometimes been encountered in otherwise tranquil weather, taking vessels by surprise and not infrequently sending them to the bottom.

According to Vaughan Cornish, who has probably devoted more attention to this subject than any other contemporary man of science, the average height of the waves encountered in a severe storm at sea is 20 feet, but the ordinary maximum height of the waves in the same storm will attain 30 feet. In a storm of very exceptional violence the average height may reach 30 feet, and the maximum height 45 feet. This is regarded as about the limit of the height of waves due to wind only. Vornish finds that in the open sea the height of a wave in feet is about one-half the velocity of the wind in miles per hour.

So much for the waves on the high seas. These waves, though they may race along at the speed of an express train, do not carry the surface water far with them; each particle of water describes a local circular orbit during the transit of the wave, so that what advances is rather the form than the substance.

The case is quite different when waves break upon a shore, where the shoaling water produces "waves of translation." These waves are relatively short and steep, and break when they enter water the depth of which is equal to or a little exceeds their height from trough to crest. They approach the shore in a direction nearly at right angles to the general shore line, whatever the direction of the wind. This is explained by the fact that if the wave is at first directed at an acute angle to the shore, when it reaches shallow water the side of the wave nearest the shore is first retarded, so that the wave tends to swing around until it faces the shore.

In planning harbor construction and the protection of coasts it is customary to consider the amount of exposure to which the coast is subject, i.e., the extent of open sea in a straight line at right angles to the shore. This is called technically the "fetch." The relation of the fetch to the possible height of the waves was announced by Stevenson in 1852. According to his formula, the height of waves in feet is one and one-half times the square root of the length of the fetch in nautical miles.

The force of a great wave breaking against a sea wall or other construction is so terrific as to tax the strength of the best planned work of the engineer. A marine dynamometer for measuring the force of impact of such waves was devised by Stevenson over half a century ago, and modifications of this instrument have since been introduced by several investigators. According to Stevenson, the maximum force of an Atlantic wave is three tons per square foot. French engineers find that the force of the waves on the breakwater at Cherbourg may attain three and a half tons per square foot.

Some interesting examples of the height to which breaking waves may be thrown and the work they may do in moving heavy objects are given by Wheeler in his "Practical Manual of Tides and Waves."

Stevenson records a case in which water was thrown to a height of 106 feet at the Bell Rock light. At the Alderney breakwater it is said that water has been thrown upward 200 feet. At Peterhead, where the fetch is 300 miles, waves of 300 feet in height and from 500 to 600 feet in length have been recorded; the water has struck the breakwater with such force as to be thrown upward 120 feet and blocks of concrete weighing 40 tons have been displaced at levels of 17 to 36 feet below low water.

At Wick two stones weighing eight and ten tons each were thrown over the parapet of the breakwater, the top of which was 21 feet above high water; while blocks of concrete weighing respectively 1,350 and 2,500 tons were displaced, though there is some doubt whether the latter movement was due entirely to wave action.

At the Bishop Rock lighthouse, which is exposed to the full force of the Atlantic waves, an iron column weighing over three tons was thrown up 20 feet and landed on top of a rock.

At the harbor works at Bilbao in 1894 a solid rock of the breakwater weighing 1,700 tons was overturned from its place and dropped into the water.

At Ymuiden breakwater a block of concrete weighing twenty tons, placed outside the harbor walls, was lifted by a wave to a height of 12 feet vertically and landed on top of the pier, which was 5 feet above high water.

The above cases illustrate the sheer force of the individual wave as an engine of destruc-

tion, but the imagination of mankind is more impressed by the widespread effects wrought by the great storm waves that sometimes inundate low lying coasts. These waves are often misnamed "tidal waves," the only justification of the latter name being the fact that their effects are most pronounced, when the wave propagated outward from a storm area happens to coincide with the occurrence of flood tide on the coast affected.

The precise mode of origin of the storm wave has been the subject of much discussion, and even now is not fully understood. Such waves attend every severe cyclonic storm at sea, and as they travel much faster than the storm (i.e., the storm as a whole, not the wind revolving about the storm centre) they often occur on a coast when the weather is otherwise serene, and thus serve as a valuable prognostic of the storm's approach in case the coast happens to lie in the storm track.

It is well known that the barometric pressure is much lower at the centre than at the periphery of a storm—the difference sometimes amounting to two inches or more—and this difference of pressure must disturb the equilibrium of the water, causing it to become heaped up at the storm centre. This bulging of the water would amount, theoretically, to about one foot for each inch of barometric depression. However, although this process doubtless contributes to the production of the wave the violent winds at the vortex of the storm are probably a much more important factor.

The mechanism of storm waves was studied by a board appointed by the chief of the United States Weather Bureau for this purpose in 1901, and the reader is referred to the report of the board, published in the Monthly Review of October, 1901, for further information on the subject.

We are concerned here chiefly with the effects of storm waves (which the newspapers and the public call "tidal waves" as persistently, and with as much reason, as they call tornadoes "cyclones"). These are most severe when the wave moves toward the low-lying coastal region, having a converging shore line; this convergence producing the same effect as seen in a tidal "bore."

The most disastrous storm waves have occurred along the coast of the Bay of Bengal, on the extensive flats lying about the mouths of the Hugli, the Megna, etc. The storm wave of October 7, 1737, is said to have risen 40 feet in the Hugli, sweeping away 300,000 souls. In May, 1787, at Coringa, near the mouth of the Godavery, such a wave is said to have taken toll of 20,000 lives. The Calcutta cyclone of October 5, 1864, caused the inundation of the flats on both sides of the Hugli estuary, with a loss of about 48,000 human lives and the destruction of 100,000 head of cattle. The greatest disaster of recent times in this much afflicted region was the Backergunge hurricane of the night of October 31-November 1, 1876, which cost the lives of over 100,000 persons. In this storm the water rose from 30 to 40 feet in less than half an hour.

The islands of the Pacific are also subject to visitations of this character on a huge scale in connection with tropical hurricanes. The latest of these was the storm of March, 1910, which was especially remarkable for the vast area that it covered, its track extending some 2,500 miles from Fiji to New Caledonia, Norfolk Island, and the North Island of New Zealand. Statistics of the loss of life and property in this storm are not yet available.

Our own seaboard has repeatedly suffered from the effects of storm waves. In the Galveston hurricane of September, 1900, a series of waves invaded the city; 6,000 lives were lost and the destruction of property amounted to \$30,000,000. The damage was due to wind as well as water, but chiefly to the latter.—New York Sun.

## HOW TO START A FORTUNE

These are the views of Charles E. Warren, who has been president of the New York Bankers' Association:

"The possibilities for a young man founding a fortune today lie almost entirely in his getting away from the city, with a very small percentage of possible success to be achieved in favor of the big city. It is overcrowded. Almost every profession is overdone.

"Of course, I do not mean that a man has no possibilities of making a living in the city, perhaps a good living. But the big fortunes of tomorrow will have begun in the open country. There are the great resources—the untapped reservoirs, developing the country, farming, business opportunities with less competition, easier living, all may be gained there."

"Then you do not think that there is always room at the top, as the optimist will always have us believe?" I asked.

"No, I do not," answered Mr. Warren. "It is all very fine in theory, but another matter in practice. The men who reach the top are few in the city—most of the climbers camp on the hillsides, while others get tired and take the toboggan route."

"There is no doubt but that the city offers more opportunities for the making of an immediate living. For there are workers needed all the time, and when one steps out there is another ready to take his place. But as a rule, if you would admit the truth, the places are so well filled that there is usually a waiting list. A man may make a living, a good one perhaps. But the chances for the fortunes are away from the madding throng."

"What would you suggest as the most plausible place for development?"

"I would say, 'Go South, young man—in-

stead of West.' I have had occasion to study both sections, and the South seems to offer more vast opportunities than anywhere in this country and even outside our own country.

"Take South America—the Argentines. There is a wealth of country that has not been fully developed, the cities of which are advancing at an enormous rate—rich in ore, rich in money and in all products that produce the fortune germ. Our great trouble is that being birds of a feather, we flock together. The individual seems to go with the tide. But the histories of the greatest fortunes prove that the man who struck out on a path of his own making usually came back a winner."

"Then you agree with the poet about 'the crooked path through the wood?'" I suggested.

"Just so," answered Mr. Warren. "There is the city scheme exactly. First a foolish calf came along through the woods and made a path all bent askew, a crooked path, as good calves do. Then a bell-wether sheep followed the path made by the calf. Pretty soon a dog chanced along and followed the same winding way. A horse and rider drove through the road. Then a pedestrian found the place and he, too, traveled the now beaten path—and there you are."

"That is the way of the city. Everybody travels in the footsteps of the fellow who went before."

"While this may lead to bread and butter and a coating of molasses, with perchance an occasional cigar, it does not usually lead to the fortunes made by the few."

"Living in the city is unusually high. And no matter how much you may cry against it, it grows less, slowly. The demands on the man making a living are enormous. And many a worker is kept busy merely keeping his head above water."

"When you narrow down to making a fortune, the seething sea of the city is filled with human flounders. And the high cost of living which we hear so much about is due primarily to there being too many consumers and not enough producers. The salary man of the city who saves a portion of his money in view of the rainy day or the making of the nest egg, presumably for a fortune, is very much like the man running after himself to catch himself. In other words, he does at a comparative snail's pace, so much does the trend of times demand of him."

"Of course, the new country has its inconveniences. But in this era of electricity, telephones, railroads and vast capital ready to be expended on prospective possibilities, these inconveniences are not insurmountable."

"Of course, it may be that the man who strikes out in this direction—or the woman—may have to put up as it were for a time with many disadvantages which are overcome in the thickly populated section. But has there ever been any fortune without obstacles or inconveniences?"

"And it would seem that the struggle in the quiet-close-to-nature condition of things is much more to be desired than the continuous overwhelming competition that presents itself on all sides in the city."

"No one ever obtained anything big without trials and self-denial. For instance, mild in the country may not see the best plays, may not be near a theatre or have her shopping delivered at her door, etc., etc. But the later reward may compensate to a marked degree."

"But suppose circumstances will not permit the young man of the city to leave? Suppose he has people dependent upon him who are already established, and he does not have the rudiments necessary to a successful career outside?" I suggested.

"To such a man I would say if he would be on the way to fortune, he must do whatever he does better than his neighbor. Even if he makes a better mouse trap than the last man who made one, he is in line for the big success."

"Here in the bank we have one system for advancement. That is, as soon as a man knows his work, and a little more, we give him the next place. In other words, the man who gets the big places must not only be competent, unusually so, in his own work, but must also know the work of the man ahead of him before he takes that position."

"And the fellow who looks ahead the farthest with the best clearness of vision, even though he start in an obscure position, is one of the few who reach the top. But the places at the top are few, notwithstanding. The open country has possibilities that will mark epochs or achievements as yet undreamed of."—Sophie Irene Loeb.

## NOT TO BE DISTURBED

Waiter (to night nurse watching patient)—Have some coffee, ma'am?  
Night Nurse—No, I greatly fear that that would keep me awake.—Le Rire.

## MORE TO THE DOLLAR

George Ade, at the recent Lambs' gambol in New York, objected to the extravagance of the modern. "It is true that the married men of today," he ended, "have better halves, but bachelors have better quarters."—The Mirror.

## NEW TO THE "BEAT."

The New Girl—An' may me intended visit me every Sunday afternoon, ma'am?  
Mistress—Who is your intended, Delia?  
The New Girl—I don't know yet, ma'am. I'm a stranger in town.—Harper's Bazar.

## HOLIDAYS

Willie—All the stores closed on the day my uncle died.  
Tommy—That's nothing. All the banks closed for three weeks the day after my pa left town.—Puck.

# In the Days of 1745-46

Through the glamor of the past the mind conceives of the smuggler's trade in the terms of romance. Romance there was, no doubt, but behind it assuredly was the hope of gain. Not many in each successive generation of smugglers or of privateers succeeded in enriching themselves, but at least the opportunity of glimpsing illegal rewards was never so bright as in the year or so after October, 1745, when an illicit import trade flourished on the coasts of Scotland. The privateer himself and his crew were usually Frenchmen or Spaniards, carrying with them a Scotch pilot picked up at some turbulent home port and made a permanent part of the ship's company. The appearance of their ship—snow, lugger, brig, dogger, by whatever name she was known—would be the occasion of some excitement on shore. She would be a vessel of no very great tonnage, carrying a few guns, besides her crew and cargo. What poor man possessed of a boat or of but a part share in one could have watched her movements, with indifference? Where were the terrors of the penalty for touching contraband consignments when the forbidden thing lay out at sea before his eyes? Besides, there was the ardent smack of racy politics to season the coming transaction. But a Jacobite it would make of him! Such a chance was not to be thrown away, and the barer and lonelier the coast thereabouts the better in more ways than one was that chance likely to prove.

## Landing a Cargo

Rates for illicit lighterage must have varied. The ship was sometimes openly laid alongside the quay or docked in a Jacobite harbor, when the boatman or docker worked much as usual, and, under the protection of a Jacobite shore guard, was not only safe in the present, but carried away with him an excellent basis for a plea of duress hereafter, should the need arise. But the case was different when a landing had to be effected in a few hours at some exposed spot.

So long as wind and tide served and no alarm was raised the privateer would lie off the point agreed upon, as close inshore as possible for safety and for the convenience of the boats. Sometimes the unloading would resolve itself into a sharp race between the government spy on shore and the Jacobite receiver. There might be no man-of-war within hail, or the ship at length summoned might be too big to come to close quarters with the delinquents. All this would tell in favor of the privateer's chances of clearing his ship where he was, which he generally seems to have been successful in doing.

## The Privateer's Fate

Suppose, on the other hand, he was sighted at sea by one or others of the ships on the station, the only remedy would be flight to a safer locality, if possible. But should escape by sea be quite cut off, then at last, after first getting as close to the shore as possible or beaching his ship outright, the foreign skipper would go over the side into the boats with his crew and his Scotch pilot, and the whole company make for the shore as hard as they could pull, to be shortly afterwards succeeded in possession of the abandoned ship by a boarding party from the man-of-war.

Without loss of time the deserted vessel was then set on fire and once more abandoned, left, in fact, to burn herself out. It was an easy way of getting rid of her, and an excellent warning to others. There were several ships thus burnt within sight of the shore, one or two near Peterhead, for instance. But the boatmen at Peterhead were not an impressionable race.

About all these encounters between a man-of-war and a privateer there is one fact noticeable. It is that events seem to have succeeded one another with a certain regularity, which suggests at once some sort of routine observed by both parties, under a tacit but definite understanding. Thus the letter of marque did not as a rule scuttle or destroy his own ship, and it was unusual for any lives to be lost at such times. The shipwrecked crew might be taken or they might reach the shore in safety. It was certainly easier and wiser to let them go. Once on shore they were spirited away by friendly hands. In one instance a privateer in a predicament of the kind saved himself and his men by a fresh piece of audacity, and made his way back to France at once. Thither all stranded French seamen must ultimately have gravitated, mingled with the fugitive troops no doubt. But when they land on Scottish soil from their burning ships we lose sight of them, and can only make conjectures.

## Smugglers by Constraint

It is difficult to imagine the English government as at all anxious to secure prisoners of this kind. The jails were full enough already. Captured foreign crews, moreover, were at all events entitled to be treated as prisoners of war. Not so the native longshoreman, who might have the ill-luck to be seized red-handed, as many had. What possible chance could there be for him? An embargo was laid upon the shipping along the northeast coast, and it had scarcely been removed ere a party of boatmen, whose fate partly answers the question, were arrested in the act of assisting the escape of fugitive Jacobites near Peterhead. Lord Ancram, the officer in command of the district, was greatly enraged, especially at the defence set up. For the men appear to have got to windward of him by pleading that they were law-abiding persons after all who had had the misfortune to be pressed much against their will into the service in which they were discovered. Ancram seems to allude to this plea as an old

one. It is easy to believe that it was. If it was, the incident sheds an interesting light upon the men of the '45 and their ways. Was there not sometimes, we may ask, among the English officers one now and then who, without any other than ordinary humane leanings, might be secretly ready to listen to such pretexts or to any sort of plausibility which did not outrage appearances too far? For many of these men had little relish for their task. Albemarle had earnestly begged to be excused from succeeding Hawley in the chief command. Ancram retired on sick leave. What Wolfe thought of his position does not appear. He took his share of the work without comment, though the well-known Colloiden story, whether true or false, remains attached to his name, as a souvenir at any rate of what was thought of his connection with the '45.

The boatmen's story merely as a Jacobite evasion was far older than Ancram suspected, if ninety-five years can be spoken of as an advanced age for such a good excuse. For the master of the small vessel which carried Charles Edward's great-uncle to Fecamp first induced that monarch to make a pretence of leaving himself with the four men of his crew to persuade him to cross to France, so that it should appear that the master only consented to go when he found all on board against him. As little was the embargo a novelty either. It too had been tried in the Commonwealth days, and then included the south coast of England when Charles II. lay in hiding thereabouts. In Scotland boats and wherries were seized and small coasting vessels dismantled, but nothing sufficed to abate the contraband nuisance.

## Return Cargoes

So long as the shore remained Jacobite it seemed to matter little or nothing who ruled at sea, and it was not till Charles Edward finally left Scotland that the King's troops became fully masters of the coast. As late as July, though Colloiden was fought in April, the landing of foreign supplies still went on, the only difference now being that since April the contraband trader might look for a return cargo. Fugitive officers crowded the shores, on the lookout for his white sail and French rig. Provided they had their passage money, these outcasts might be sure of such accommodation as the ship offered. But the passenger's peril did not pay his fare, and passage money was required.

No reason exists why it should be taken for granted that at any period of these troubles motives common to us all obtruded themselves less than usual. In a chronicle of small events, however, deeply interesting, there cannot always be room for historical perspective. We must look on, not at a distance, but at close quarters, and be prepared to catch sight of some part of comedy's share of frail human nature, especially when the turn of events lays motives bare.

The articles imported by privateers at various times included meal, brandy, beef, ammunition, saddlery, big guns (only five in number, so far as is known). Horses came with the cavalry, and, if horses, fodder also. Shiploads of troops came, and tubs of French livres, which were worth a pound sterling in Scotland. The most famous consignment of money reached Scotland, but never reached the Prince. Yet had he where he then was been in a position to spend it all, he could not have bought greater security than was his for next to nothing. The money came too late. From this alone it partly follows that the campaign of 1745 could not have been a costly affair on the Scottish side. Charles himself was the source of confidence and the rallying point to all. He was Jacobitism when Jacobitism was formidable. It fell to nothing when he went, as for thirty years before he came it had been as good as dead.—G. A. P. in the Glasgow Herald.

## PUNS IN THE BIBLE

An interesting article in the August "Treasury" by the Rev. Malcolm Peart, M.A., points out that the pun is one of the oldest forms of humor in the East. "The Old Testament writers, especially the prophets, are true ornaments in this respect, for they use this ornament of speech most effectively."

"Amos, the desert prophet, the first of the writing prophets, uses puns more successfully than any of the prophets. Unfortunately in our translations the play of words is lost to us, and we fail to see the delicate shade or meaning or the mocking or scornful irony of many a phrase. A most notable pun of this prophet is that of the vision of summer fruit.—And he said Amos, what seest thou? And I said a basket of summer fruit. Then said the Lord unto me—The end is come upon my people Israel." (Amos viii. 2.)

"In this verse the translation fails to bring out the play upon the words 'summer fruit' and 'end,' consequently the joint is lost to us. The Hebrew word for 'summer fruit' is kaitz, and the word for 'end' ketz. The parable is made far more expressive by the pun and much more liable to stick in people's memories. Just read the verse, substituting the original words, 'And he said, What seest thou? And I said a basket of kaitz. Then said the Lord unto me, 'The ketz is come upon my people Israel'—and we at once see how sight and sound must have combined to arrest the attention and impress the mind of the unthinking Israelite. The beauty of this punning parable lies in the fact that (as Pusey says) 'the symbol and the word expressing it coincide.' Mr. Peart gives many other examples.