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THE TIDES IN THE MIDST OF THE PACIFIC OCEAN.*

A STUDY BY

ALEXANDER BROWNLIE.

3. The Time of High Water in the Midst of the Pacific.

Under our third head we will consider the question of the time of high water in the midst of the Pacific. According to the rules, when the moon is new or full at a small island in the midst of the ocean, then high water ought to take place there at noon and midnight—when the moon is new or full in the meridian of Apia, then precisely at noon and midnight tide ought to rise to its highest level. But what are the facts in the case? The facts are the opposite, for instead of high water taking place at noon and midnight, it is low water at these hours! For example:

APIA, JANUARY, 1900.

MOON'S PHASES.	DAY OF MONTH.	TIME OF HIGH WATER.	
New.....	1	6.20 A.M.	6.35 P.M.
1st Quarter.....	7	11.38 "	
Full.....	15	6.30 "	6.39 "
3d Quarter.....	23	11.42 "	
New.....	30	6.04 "	6.21 "

The table shows that the time of high water at this station, right in the midst of the Pacific, does not take place in conformity with the rules of the science; and were we to consult tables for the years 1898 and 1899 we should find that nature constantly disregards the rules at Apia. That fact is the more significant because promoters Airy and Whewell removed the residence of lunar attraction from the Equator to the Southern Hemisphere. Now, Newton himself had placed its residence at the Equator; therefore the removal was a new and very extraordinary departure in the doctrine.

The reason why they removed it from the centre of the earth to a siding, as it were, was on account of a little discovery made by Capt. Nathaniel Bowditch, the self-taught American mathematician

* Concluded from page 25.

and the translator of the Mécanique Céleste of Laplace. He began to observe the tide through his own eyes as well as through the eyeglass of mathematics. Upon taking observations at the Equator he was surprised to see ebb tide occurring at noon, at time of new moon and full, instead of flood tide. The surprise was the greater because Newton predicted that, when tides were observed at the Equator, his science would be found correct!

When Bowditch discovered that it was all wrong, he said: "It is a remarkable singularity."

But after that remarkable discovery, then, of course, the removal was inevitable, hence the origin of the new departure in the doctrine.

We will next consider the question of the time of high water at Honolulu.

HONOLULU, JANUARY, 1900.

MOON'S PHASES.	DAY OF MONTH.	TIME OF HIGH WATER.	
New.....	1	3.50 A.M.	3.50 P.M.
1st Quarter.....	7	8.04 "	10.06 "
Full.....	15	3.47 "	3 58 "
3d Quarter.....	23	8.02 "	10.55 "
New.....	30	3.30 "	3.42 "

The tables prove that the time of high water right in the midst of the Pacific does not conform to the rules of the science; in short, the facts disclosed at Honolulu and Apia show that nature constantly denies the claims of the science.

4. What is the Rate of Tidal Speed in the Midst of the Pacific?

Under our fourth head we will consider the question of the rate of tidal speed. But, first of all, we must listen to the dictum of the advocates of the science:

> The earth takes 24 hours 50 minutes to turn around with respect to the moon; that is the time which the lunar tide wave takes to complete the circuit of the earth. . . . . The sun completes the circuit of the earth in one day. Therefore, the solar tidal influence travels over the surface of the earth at the rate of 1,042 miles an hour.—*The Tides*, page 165.

Hence, in accordance with the theory, there are independent sets of lunar and solar waves travelling around the globe trying to keep up with sun and moon, but the rate of speed in each set is different; the sun waves more faster than the moon waves.

In his argument for the 1,000 mile an hour rate the author, quoted above, figures on a depth of 13¾ miles. But no such deeps in the ocean are known to science. Many soundings, however, have been taken in the Pacific, Indian, and Atlantic Oceans at a depth of three miles and over. Continuing his argument, he figures again that a three-mile depth will permit a speed of 500 miles an hour. But the reduction of the rate from 1,000 to 500 miles an hour produces a hitch; for then the thing produced can only travel half as fast as that which produces it, and thereby the theory becomes an absolute failure.

In order to test the lower rate of speed at the lesser depth, if such a rate exists, we ought to discover the evidence of it in the midst of the Pacific. The modern advocates affirm that the seat of tidal energy is located in the South Pacific, and that from thence the world is supplied with its tides: that from thence they not only sweep from east to west, but from south to north. If they sweep from south to north, then, since Apia is separated from Honolulu by 35° of latitude, the 500 mile an hour wave ought to travel that distance in less than five hours.

But what are the facts in the case?

On Jan. 1, 1900, Apia had first high water at 6.20 A.M.
" " " Honolulu second " " " 3.50 P.M.

(Of course, we have seen already that the second high water was only an apology for one.) The apparent difference in time is not five hours, but nine and a half hours.

A still clearer case of the absolute failure of the speed of the theory is disclosed at the islands of Tahiti and Tubuai. These islands are situated on the same line of meridian, and have precisely the same moon-time, but there is a difference of about 3½ hours between their times of high water! This fact is all the more striking because the islands are located in the immediate neighbourhood of the supposed tidal energy. In fact, it may be said of them that they lie in the very cradle of the tides.

Another remarkable case occurs at Easter Island, and the island of Sala y Gomez: between this pair the difference in the moon-time is only 15 minutes, but the difference in their times of high water is 3 hours 19 minutes!

Before such geographical evidence the mathematician's argument goes down like a row of bricks set up on end.

If such a speed as 500 miles an hour existed in the midst of the Pacific, the flood tide would visit the islands of that ocean suddenly, and with destructive force.

It is idle for the promoters to talk of a natural *brake* placed upon their great speed by oceanic shoals, because on the east side—the side facing the widest expanse—Japan rises abruptly from one of the deepest depths of the Pacific, from a depth of 3,950 fathoms—about 4½ miles! The shores of Honolulu also rise suddenly from the depths of 2,225 to 2,875 fathoms, yet from such abysmal deeps flood tides, at times, are exceedingly slow and vacillating! It is also useless for Prof. Geikie * to tell us that

its rate in the Atlantic is 500 geographical miles an hour. But as this is merely the passing of an oscillation, the particles of water are gently raised up and let down again.

Such a speed as that in water does not manifest itself by gentleness! If it existed, then it would manifest itself both to the ear and to the eye at the islands in the midst of the Pacific, and also upon our own shores.

Lastly, if we look at the question of speed from a commercial point of view, there would be no commerce; if from a geographical, no land could resist the pounding of such waves; if from an actual point of view, no such speed has been observed by man, for no such speed is possible in water. In fact, we doubt if Niagara itself, in the perpendicular plunge of 150 feet from brink to chasm, comes up to the promoter's rate; yet his rate moves *sideways* to the lifting power, and not directly, like falling water. So enormous a rate as his is non-existent, except in his own mind; but in that region it has been known to exist for two centuries!

This whole question of speed is naught but a "study in contradiction."

5. What the Tides in the Midst of the Pacific Teach Us.

In entering upon the consideration of the question under our fifth head, perhaps the clearest answer can be given by a brief review of that which we have learned, step by step, in our study of the tides in the midst of the Pacific. That study teaches us that

(*a*) The established fact of enormous irregularity in the North Pacific in its time-intervals discredits the assumption of lunar attraction.

(*b*) The established fact of the differences in the daily amount of supply challenges the claim of lunar attraction.

(*c*) The established facts in the daily distribution of supply deny the claim of lunar attraction.

(*d*) The established fact that men ignorant of the science made

* Article Geology, Vol. X. Encyclopædia Britannica, page 283.

"remarkably correct" forecasts proves that a knowledge of the science is not necessary to the forecaster at all, when making a tide almanac.

(*e*) The established fact that tides act in direct opposition to the rules at the Equator, proves that Newton erred as a predictor and based his science upon error.

(*f*) The established fact that tides act in direct opposition to the rules at Apia shows that the promoters unwisely removed the residence of lunar attraction to the neighbourhood of Apia.

(*g*) The established fact of the failure of the second flood tide at Honolulu establishes the failure of the doctrine of equilibrium. "The form of equilibrium is unattainable" (*The Tides*, page 151).

(*h*) The established fact of a gentle tidal speed in the midst of the Pacific proves that the speed of the promoters is merely a delusion.

(*j*) Finally, the science of Newton is as valueless to explain the problem of the tides of nature as the scheme of Ptolemy was valueless to explain the problem of the starry heavens. But we now turn our back upon this lunar tidal anarchy and proceed to discourse about the power which dominates the tides.

6. By what Power is Flood Tide Lifted?

When we were considering our second head we saw that correct forecasts cannot be made by the knowledge of a supposed globe travelling wave. On the contrary, they can only be made from a local knowledge. That fact being established, then we maintain that the force which lifts tide is *local*, that it belongs to the mechanics of the earth and not to the mechanics of the heavens; that the power dwells *within flood tide* itself. It is an established fact that regions of high-water-level in the ocean are contiguous to regions of low water level; hence the region of high-water-level must move towards the region of low water level because of the common law of gravitation which governs the movements of water not only upon the land but in the midst of the sea. The movements of tide are operated by the opposition of high and low level in contiguous regions. The driving-power developed *within* a region of high-water-level, when standing at high, is the driving power that lifts flood tide. The region of high level must move towards the region of low level by gravitation, and the momentum of the movement does not become exhausted until the low level is forced up into the condition of high level. Every time a region of high

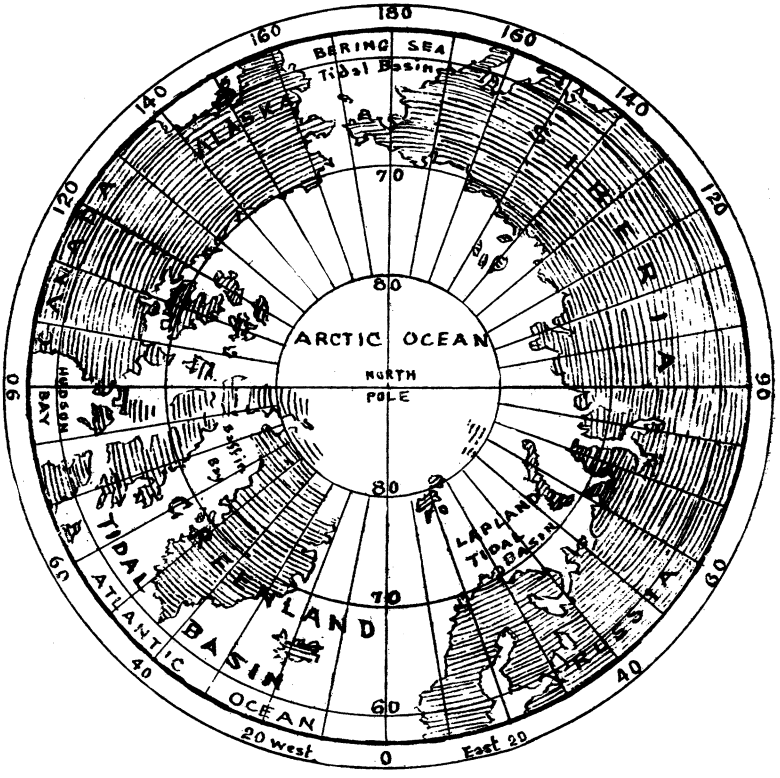
level is attained then the driving power is renewed and developed *within* itself.

But it may be asked, How could such a mechanical system originate? We answer, That question does not come into the present inquiry. This inquiry extends only to the *observed facts* in the tides of nature. But if it did extend to the philosophy of the case, then we in turn would ask our esteemed friends the promoters to explain the origin of their lunar system. How did the moon lift the first tide? And also to furnish a chart of the 1,000-mile-an-hour waves round the earth. They ought to produce the chart to prove that moon-time, and time of flood tide agree around the globe, for that is a first principle of their science. On our part we observe the facts and then try to explain them; observation comes first, not last!

For instance. When we see that the pressure is about evenly balanced between contiguous regions then we say that the time-intervals will be more regular in each, but when unequally balanced, then the time-intervals will be irregular—as irregular, for instance, as those in the North Pacific. That deduction immediately raises the question: Why are the time-intervals so irregular in the North Pacific? The answer is not far to seek provided we make it also a geographical question. Then it will be seen that the cause is both geographical and mechanical combined. Of all the great oceans the North Pacific differs from the rest in one very important aspect, viz., in its *isolation* on the north side. Upon that side it is almost completely landlocked and shut out from communication with the Arctic Ocean. Therefore on its north side the balance of power is absent. On that side there is hardly any tidal pressure at all, and the little there is dribbles in through one small *deep* opening from a deep place of an otherwise comparatively shallow sea—Bering Sea—which in its turn filters through the narrow, shallow Bering Strait on the extreme north, whereas on the south side it has no land boundary whatever; therefore the pressure upon the south side is exceedingly powerful as it moves with majestic force across the open, wide equatorial belt, but the delivery of flood tide there is lopsided because delivered at *different* times from different basins; hence causing the great irregularity in the time-intervals. The mechanical action, however, is a *single-pressure* action, *i. e.*, pressure on one side only—the south side.

That our conclusion is reasonably correct, and our argument logically sound, we will show by a comparison of the land boundaries of the North Atlantic with those of the North Pacific; the former

has no land boundaries on the north shutting it out from communication with the Arctic. On the contrary, it has two large openings, one of which is very wide—over 650 miles wide, and by means of these openings the balance of power is maintained by the mechanical tidal principle of *double pressure.* When the northern region

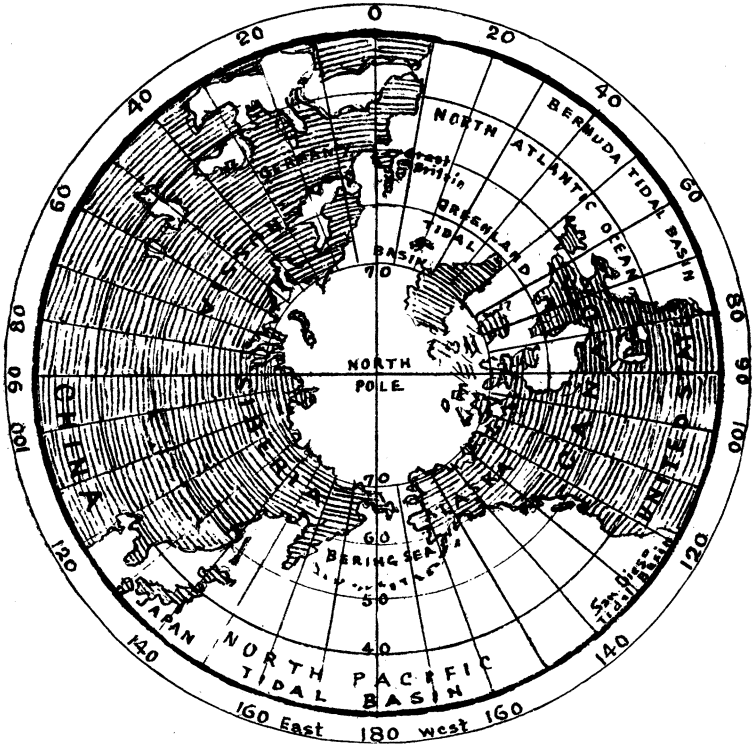


SKETCH MAP SHOWING OPEN COMMUNICATION BETWEEN ARCTIC OCEAN AND NORTH ATLANTIC OCEAN: RESULTING IN REGULAR TIME-INTERVALS FROM ONE HIGH WATER TO THE NEXT.

(Greenland tidal basin) has reached its highest level, then its waters press as strongly to the southern low level as they do to the northern; hence open communication between basins produces regular time-intervals in the North Atlantic. When we look at tidal differences from a geographical point of view, then it is clear that that view gives the clue to the *cause* of the *variation* in time-intervals and establishes the fact that there are *varieties* of tides. For *open* communication in the North Atlantic produces regular time-intervals, whereas *closed* communication and irregular delivery in the North Pacific produce irregular time-intervals and a separate

variety of tide. Therefore the pattern of tide in the North is absolutely separate from that in the South Pacific. Moreover, if our explanation is correct, then the tidal problem is solved.

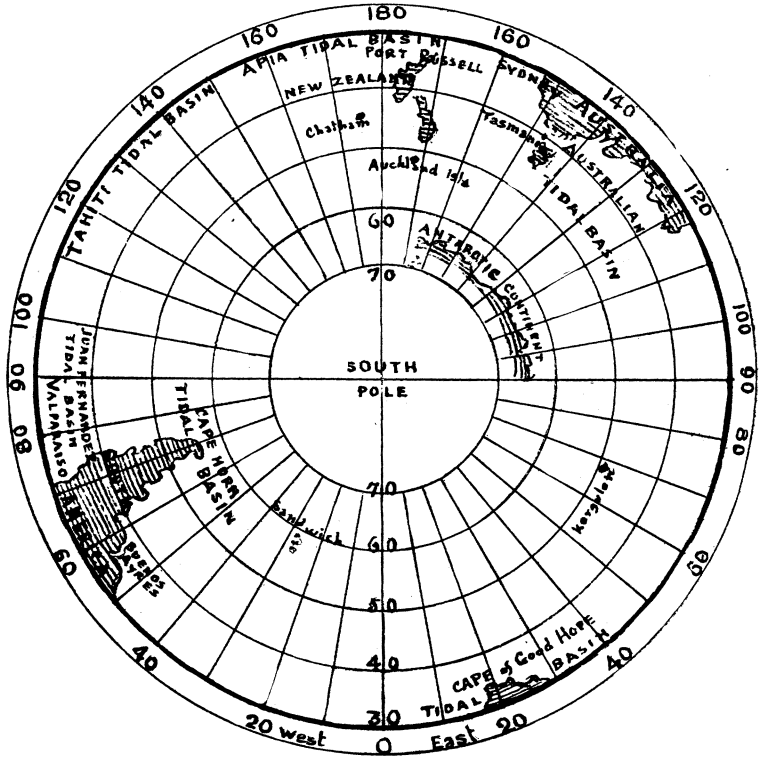
But let us try another test of the principle of geographical boundaries and their effect upon time-intervals. We take the case of the South Pacific. That ocean has no land barrier on the south shutting it out from communication with the Antarctic, and at Apia, Port Russell, New Zealand, and Valparaiso the time-intervals



SKETCH MAP SHOWING CLOSED COMMUNICATION BETWEEN ARCTIC OCEAN AND NORTH PACIFIC OCEAN; RESULTING IN IRREGULAR TIME-INTERVALS FROM ONE HIGH WATER TO THE NEXT.

at all of these stations—one in the midst and one on either shore, east and west—are very regular; making a complete contrast with the irregularity of the North Pacific. The communication is wide open between the South Pacific and the Antarctic; and it in turn is open on the east and on the west. Hence the South Pacific is open at both ends, and it forms part of a system of basins with regular time-intervals; in which system the oscillating potential force is generated within each basin when standing at highest level. The

weight and pressure from one basin is counterbalanced by the weight and pressure of another, but the movement from one to another is immediately due to the opposition of contiguous regions of high and low level. This system of double-pressure basins is linked one with another even as the links of a chain, and that chain encircles the globe in the Southern Hemisphere; but a branch extends through the Atlantic into the Arctic Ocean, and everywhere —in each link—a remarkable *family* resemblance is observed in the time-intervals.



SKETCH MAP SHOWING OPEN COMMUNICATION ALL AROUND THE SOUTHERN HEMISPHERE; RESULTING IN A CHAIN OF DOUBLE-PRESSURE BASINS ENCIRCLING THE GLOBE.

But it is not so with the North Pacific. The family likeness is lost there because the linking is imperfect, for it is linked upon *one* end only; therefore it is a lopsided link, only a pendant to the chain, and produces another variety, or type, of tide—as different from the type of tide at Apia as the Japanese type of face of its kind is different from that of the English-speaking race.

7. Tidal Basins in the Pacific Ocean.

It is too early in the history of the new science of the tides to set forth the number of tidal basins in the Pacific or to describe their boundaries. All that we can do at present is to announce the fact that they do exist and to give the proof of their existence.

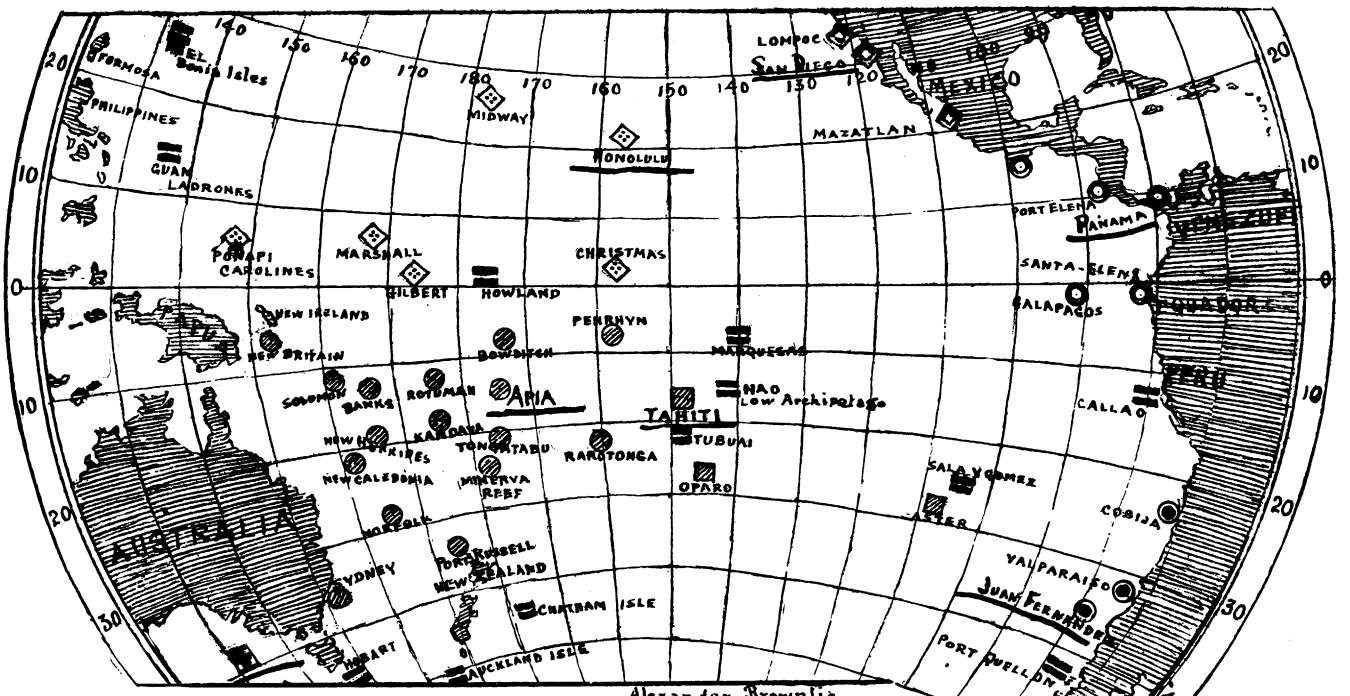
For example, when the tide is high at Apia it is low at Tahiti, and *vice versa.*

Apia is situated in west longitude 171° 44′
Tahiti " " " " " 149° 30′

Tahiti has high water 6 hours 53 minutes local time before Apia; the two stations are separated by 22° 14′ in longitude. That calls for a difference in moon-time of 1 hour 29 minutes; but the difference in their times of high water is very much greater. Now, if the moon can lift the tide, instead of a much greater difference in their times of high water the interval ought to be 1½ hours exactly.

Here, then, is an example of two large contiguous regions in mid-ocean where tide verges towards the condition of high in the one when the condition is quite different in the other; therefore the two places are in separate tidal basins. The case being so, there can be no interference from *friction* by submarine land barriers, because the water is very deep between the island groups to which the two stations belong.

With regard to the extent of Apia basin, we find that Apia is co-tidal with Vavou, and Tongatabu, Friendly Islands; and about co-tidal with Totoya, Vita Levu, Kandara, Fiji Islands; Penrhyn Island; Raratonga, Cook Islands; with the detached islands Rotumah and North Minerva Reef; the basin extends to New Zealand and Norfolk Island; and towards New Caledonia, New Hebrides, and New Britain. But in the latter region a total dislocation occurs, for when it is high water at Blanche Bay, New Britain, it is low at Holtz Haven, New Ireland; yet the two stations are only 1° 15′ apart in longitude. Then, again, a difference of 3½ hours occurs between the time of high water at Tubuai, Austral Islands, and Tahiti; indicating thereby that Tubuai is on the boundary line of Tahiti basin. The two stations are situated in the same meridian, the one almost exactly six degrees due south of the other; yet there is a difference of 3½ hours between their times of high water. Now that fact is contrary to lunar theory; nay, more, it is absolutely destructive of that theory, and the case occurs right in the midst of the ocean, where lunar tides are supposed to have freer sway than anywhere else on the face of the globe.



ORIGINAL MAP of CO-TIDAL BASINS of the PACIFIC OCEAN.

Symbols, ○ APIA. ◎ JUAN FERNANDEZ. ⊙ PANAMA. ▨ TAHITI.
◈ NORTH PACIFIC. ◆ SAN DIEGO. ▣ CAPE HORN. ✚ AUSTRALIAN.
〓 BOUNDARIES of BASINS.

NOTE.—When all the evidence is in, possibly it may be found that Juan Fernandez basin is only the eastern end of Tahiti basin.
= Boundaries of Basins—regions of half tide between regions of ebb and flood.

With regard to Tahiti basin, it extends easterly 40° to Easter Island, but immediately beyond it the time of tide changes suddenly. Sala y Gomez Island is only about 4° beyond Easter Island, but the difference in their times of high water is 3¼ hours—an enormous difference when compared with the difference in moon-time, for it is only 15 minutes. This case and the case of Tubuai and Tahiti clearly prove that moon time and time of tide have no connection with each other; that the two things are absolutely apart and irreconcilable. Then, again, when Tahiti has high water it is only half tide at Marquesas Islands; the difference in moon-time is only about 40 minutes, but their difference in time of tide is about 3 hours.

The detached Oparo Island is about co-tidal with Tahiti. The line of cleavage dividing the basins of Tahiti and Apia seems to run northwesterly from Tubuai towards Penrhyn. These two great basins stretch almost the entire distance across the South Pacific, and they form the southern boundary of the North Pacific basin. But when they attain high-water level they do not deliver their pressure at the same time—the Apia delivers at one time and the Tahiti at quite another. Consequently that fact, taken in conjunction with the other fact of the isolation of the North Pacific, gives us the reason why its time-intervals are so very irregular; that irregularity is due to the lop-sided mechanical action as well as to its geographical isolation.

With regard to the extent of the North Pacific basin, Honolulu, Christmas Island, and Midway Island are about co-tidal; the last two are separated by about 26° in latitude; the basin extends to the Marshall and Gilbert Islands, but the Ladrone and Bonin Islands seem to lie beyond its western boundary. In the northern boundary St. Paul, Alaska, is not co-tidal with Honolulu; although the difference in time between these two is only 22 minutes, the difference in time of tide is about 3 to 4 hours, thus giving another proof of the irreconcilability of nature and the theory.

Nor is Honolulu co-tidal with San Diego, California. For example:

On Jan. 1, 1900, high water was at San Diego 8.35 A.M., 10.01 P.M.,
" " " " " Honolulu 3.50 " 3.50 "

The two places are separated by 40° 16′ in longitude, and if the moon can lift tide the difference in their time of high water ought to be about 2¾ hours instead of 7¼ and 6¼ for the two tides respectively. In fact, these figures clearly show that San Diego forms a tidal basin by itself. Crossing over from San Diego to the Bonin Islands, south of Japan, we find another case of almost

total dislocation; we find that Newport, Hillsboro Island, has high water 5 hours 20 minutes after Port Lloyd, Peel Island; yet they have the same local time! Still further evidence of separate smaller tidal basins is indicated in the seas of China and Japan—not to speak of Okhotsk and Bering Seas, and also in the extreme south, for the difference in the time of high water between Port Russell and Auckland Isles is 3 hours 54 minutes: Port Russell, New Zealand, is 35° 16′ S. L., and Port Ross, Auckland Isles, is 50° 32′ S. L. Port Russell lies in Apia tidal basin, but Port Ross lies on the boundary of that basin. There is also a difference of 3 hours 08 minutes between Port Russell and Port Hutt, Chatham Islands. Port Hutt lies 9° 18′ east of Port Russell, and if the moon can lift tide the difference in time of high water ought to be 37 minutes instead of more than 3 hours! The southern boundary of Apia basin seems to run northeasterly from Port Ross to Port Hutt.

Tidal dislocation is also complete between Melbourne, Victoria, Australia, and Hobart, Tasmania. Another case where nature and theory fail to agree.

Finally, we will examine what evidence there is upon the eastern shore of the Pacific. In that long and almost straight line of coast there are indications of more than one tidal basin.

When high water occurs at Cape Horn, low water occurs at Corral, Port Valdivia: the difference of 6° in longitude between the two stations calls for a difference in time of high water of about 25 minutes, but the difference is 6 hours 19 minutes! What a marvellous moon to work such contradiction against itself—*i. e.*, against its own *imputed* power—and imputed, too, by all the high authorities in Christendom!

We call these two South American basins, just indicated, Cape Horn tidal basin, and Juan Fernandez tidal basin respectively; high water takes place at the island of Juan Fernandez 5 hours 14 minutes after Cape Horn. Juan Fernandez basin makes the third tidal basin stretching across the entire width of the South Pacific, from New Britain to Chili. But, possibly, when all the evidence in the case is in, it may turn out that Juan Fernandez basin is the eastern end of Tahiti basin.

Proceeding still farther north we find another total dislocation at Eten Point, Peru, and we call the region Panama tidal basin. This basin is co-tidal from about Santa Elena Bay, Ecuador, to Panama (Naos Island), and thence to Port Elena, Costa Rica, and includes Galapagos Islands. Proceeding still further north, we

return to San Diego tidal basin, and we find that the south boundary of this basin reaches to the west coast of Mexico, whilst San Diego itself is co-tidal with Mazatlan, Mexico, and Lompoc Landing, California. And now we pause to look at the freakishness of the North Pacific variety. For instance:

Jan. 1, 1900, San Diego had high water at 8.35 A.M. and 10.01 P.M.
" " " San Francisco " " " 12.06 " " 10.23 A.M.

San Francisco is west of San Diego 5° 15′, calling for a difference in time of 21 minutes, but the difference in the early morning tides is 8 hours 29 minutes. Then, again, at San Francisco, from first high water to first low water, on the first day, the time-interval is 4 hours 25 minutes, and from first high water to second high water 10 hours 17 minutes, and from second high water to first high water 14 hours 22 minutes on the second day. Quite a jumble of freaks within so few hours. We also observe that the moon was new on the first day of January, 1900, and the first high water occurred at midnight. That is correct according to the rules of the science. But we also observe that the second high water took place 1 hour 37 minutes ahead of mid-day. That is not correct according to the rules. With regard to this thing, we think that it would not astonish a railway passenger when taking, say, a 6 hours' journey to arrive at his destination 1½ hours *behind* schedule time; but it would be a wonderful thing, indeed, if he should arrive 1½ hours *before* schedule time.

In conclusion. It is an indisputable fact that some changes in the level of the sea are due to causes other than to the opposition of contiguous regions of high and low water level. For instance, meteorological conditions cause changes through atmospheric pressure, and wind pressure, evaporation, etc. Wind pressure and atmospheric pressure cause greater or lesser disturbances very frequently in sea-level, but *not* at regular times, except in the regions of trade winds. And even they could not get up a speed of 17 miles a minute! Evaporation, melted snow and ice, and large rivers discharging volumes of fresh water into the ocean cause changes in the local density of sea water. But none of these active agents can produce the *rhythmic* movements of our daily tides! (or produce the family resemblance in all double-pressure basins.) During the cruise of the *Challenger* 650 observations were taken of the wind, and it was found that on the open sea the average speed was 17½ miles an hour, and near the land the average was 12½ miles an hour. But we have not found that they discovered a speed of 1,040 miles, or even of 500 miles an hour in the water of the sea! How-

ever much the whole world of science is indebted to the truly noble *Challenger* Expedition, the fact that it failed absolutely to find sea water moving at the rate of 8 to 17 miles a minute, in the same sea where we are told that tides have almost uninterrupted sway, is, to say the least, a heavy loss to lunar science. It is to be remembered that the science of mathematics "treats of exact relations existing between quantities or magnitudes, and of the methods by which, in accordance with these relations, quantities sought are deducible from other quantities known." The early fathers of the science had no knowledge of the tides of the world, and the modern masters know so little that the author of *The Tides* humbly confessed and said:

> I do not reproduce the chart of the Pacific Ocean, because it is almost blank from deficiency of data. . . . Thus, in that part of the world where tides are most normal we are compelled to admit an almost total ignorance. (Pages 188, 189.)

It is true that tidal data are still very limited; nevertheless, we hope that this work is only the beginning of a movement which, when once established, will not stop until a radical revision is made of the whole subject. And that work belongs to the Geographical Societies, for it would be quite as reasonable to ask mathematicians to solve the problem of ocean depths still unknown by means of mathematics only as to permit them to remain the tide masters of the world. Tides, like unknown regions—the North Pole, for instance—must be seen by the *eye* if we would understand either aright.