self-culture in an almost new sense, so far as the majority of people are concerned. They have shown that there is a practicable method by which the average intelligence and self-reliant character of the people outside of the schoolroom, as well as in it, can be effectively increased, and have taught thousands how to work with whatever means were at hand, not only for their own intellectual improvement, but for that of their children and neighbors. This must eventually affect the curriculum of the public schools through the creation of a demand for better and more natural methods of instruction. Indeed, if Mr. Ballard were to do nothing for the remainder of his life but carry on and perfect the system he has originated, and so extend the influence of his society, he could do nothing more desirable for the interests of science in this country, or more likely to secure future happiness and personal satisfaction for himself.

There is, however, in the path of this new organization, a certain danger arising from its necessarily intimate association with a publishing enterprise like that of *St. Nicholas*. Publishers and editors must do what will be profitable, and cannot afford too much philanthropy in their business. This spirit appears in the title, 'St. Nicholas Agassiz association,' as it stands upon the titlepage of the 'Handbook.' The incongruity of names offends good taste, and does not accord with the purely unselfish nature of the whole enterprise. There is also a real cause for apprehension in one clause of the constitution, which places the appointment of his successor in the hands of the president and the editors of the *St. Nicholas*. Most persons will translate it as having but one object, — that of securing to the publishers and editors, in the future, whatever advantages may flow from the prosperity of the society. However pardonable and strictly honorable this may be from a business point of view, it is not consistent with the scheme of the association, and will finally excite comment and dissatisfaction. It might have been necessary to confine the power of appointment and election in a society of children; but this association is no longer composed wholly of young persons, and has admitted large numbers of adults. The proprietors of *St. Nicholas* have a chance to lay the whole society under obligations of a kind which such bodies of people, in our experience, have never failed to recognize with gratitude and appropriate acknowledgments. We should earnestly advise them to take advantage of their opportunity.

THE 'POROROCA,' OR BORE, OF THE AMAZON.

While travelling upon the Amazon in 1881, I was fortunate in having an opportunity to observe some of the effects of a remarkable phenomenon which occurs at the northern *embouchure* of that river, in connection with the spring-tides. It is known to the Indians and Brazilians as the *pororóca*,[1] and is, I believe, generally supposed to be identical with the 'bore' of the Hugli branch of the Ganges, of the Brahmapootra, and of the Indus. I regret very much, that like Condamine,[2] who passed through this part of the country about 1740, I could not observe this phenomenon in actual operation; but the gentleman whose guest I was at the time, and upon whose boat I was a passenger, was fairly horrified at my suggesting such a thing, while his boatmen united in a fervent 'God forbid that we should ever see the *pororóca!*' and ever afterwards doubted my sanity. I venture, however, to give some of the results of my own observations, in order that those who in the future visit this region, concerning which so little is known, may be able to see, and establish as far as possible, the rate of destruction and building-up here being carried on.

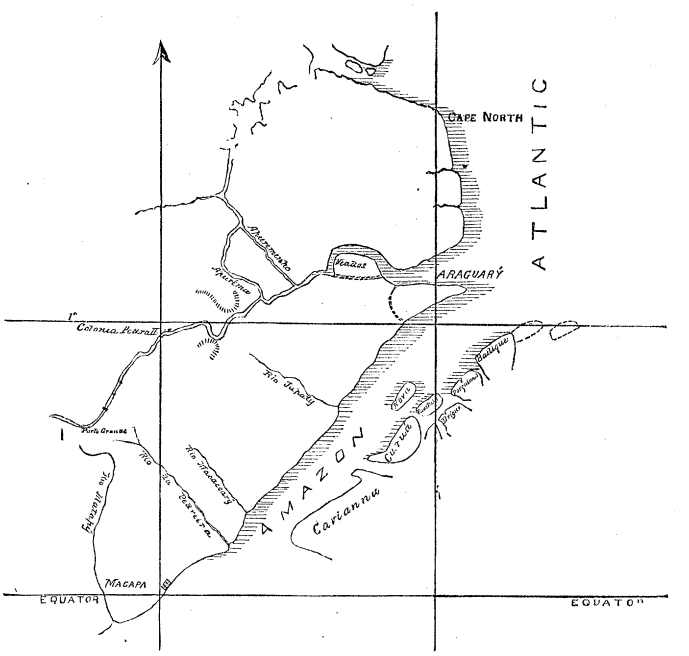
I was upon a trip from Macapa, — a small town on the northern bank of the Amazon, and about a hundred miles from its mouth, — down the river to the ocean, and thence up the Rio Araguarý as far as the last might be found navigable. The one inhabited place on the Araguarý is a military colony, called the Colonia Militar Pedro Segundo. At Macapá I became acquainted with the then director, Lieut. Pedro Alexandrino Tavares, and was invited by him to visit the Araguarý.

[1] This word, which is of Tupý or native Brazilian origin, is the one invariably used by the Brazilians. Father João Tavares says it is probably a frequentative form derived from the Tupý word *opoe*, which means 'to break with a noise.'

[2] Condamine was sent by the Royal academy of sciences, of France, to make astronomical observations in South America in 1735. His description of the *pororóca* is the one from which all references to it have been taken until now.

The trip from Macapá was by a small sail-boat down the Amazon to the ocean, and thence up the Araguarý. Our departure was so arranged that we could reach that part of the region disturbed by the *pororóca* exactly at the time when there would be the least probability of its being met with; that is, at the time of the neap-tides. The voyage down the river was in the face of the wind, and it was only five days after leaving Macapá that we put into an *igarapé* on the Island of Porquinhos to wait for the turning of the tide. I had already seen islands said to have been half washed away, and others built up, by the *pororóca;* and I had seen upon the shores the evidences of its destructive power in carrying away forests, and cutting away banks: but it was on this island that I was first able to see some of its effects near at hand, and at my leisure. After having seen so much, I was only the more anxious to see the *pororóca* itself; but my suggestions in regard to it were answered by an ominous silence on the part of the director, and my requests by additional expressions of horror.

As I shortly afterwards met and conversed with a man who had seen the *pororóca*, I shall first give his description of it, and then speak of its effects as observed by myself. This man was a soldier in the Brazilian army, and, on the occasion referred to, was going with a few other soldiers from the colony to Macapá in a small open boat. Arriving at the mouth of the Araguarý, they went down with the tide, and anchored just inside the bar which crosses the mouth of this stream, to await the turning of the tide, which would enable them to pass the shallows, and then carry them up the Amazon. Shortly after the tide had stopped running out, they saw something coming toward them from the ocean in a long white line, which grew bigger and whiter as it approached. Then there was a sound like the rumbling of distant thunder, which grew louder and louder as the white line came nearer, until it seemed as if the whole ocean had risen up, and was coming, charging and thundering down on them, boiling over the edge of this pile of water like an endless cataract, from four to seven metres high, that spread out across the whole eastern horizon. This was the *pororóca!* When they saw it coming, the crew became utterly demoralized, and fell to crying and praying in the bottom of the boat, expecting that it would certainly be dashed to pieces, and they themselves drowned. The pilot, however, had the presence of mind to heave anchor before the wall of waters struck them; and, when it did strike, they were first pitched violently forward, and then lifted, and left rolling and tossing like a cork on the sea it left behind, the boat nearly filled with water. But

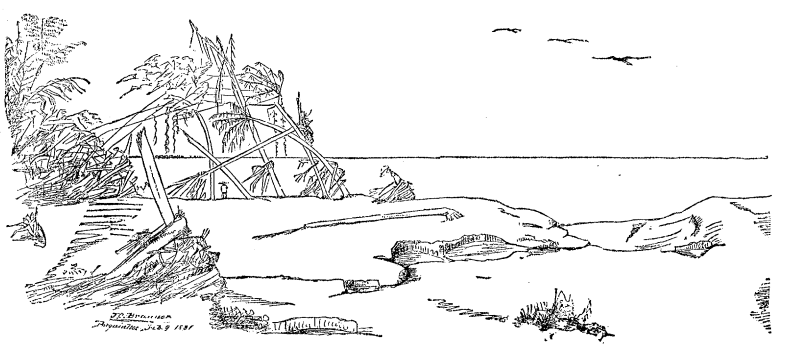


MOUTH OF THE AMAZON. SKETCH-MAP OF THE PART PRINCIPALLY AFFECTED BY THE POROROCA, BY J. C. BRANNER.

their trouble was not yet ended; for, before they had emptied the boat, two other such seas came down on them at short intervals, tossing them in the same manner, and finally leaving them within a stone's throw of the river-bank, where another such wave would have dashed them upon the shore. They had been anchored near the middle of the stream before the waves struck them, and the stream at this place is several miles wide.

But no description of this disturbance of the water can impress one so vividly as the signs of devastation seen upon the land. The silent story of the uprooted trees that lie matted and tangled and twisted together upon the shore, sometimes half buried in the sand, as

if they had been nothing more than so many strings or bits of paper, is deeply impressive. Forests so dense that I do not know how to convey an adequate idea of their density and gloom, are uprooted, torn, and swept away like chaff; and, after the full force of the waves is broken, they sweep on inland, leaving the *débris* with which they are loaded, heaped and strewn through the forests. The most powerful roots of the largest trees cannot withstand

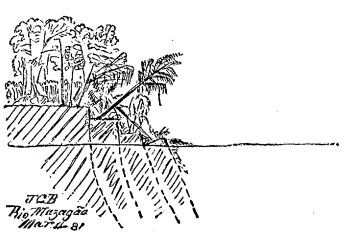


SKETCH ON THE ILHA DOS PORQUINHOS, SHOWING THE UPROOTED TREES.

the *pororóca*, for the ground itself is torn up to great depths in many places, and carried away by the flood to make bars, add to old islands, or build up new ones. Before seeing these evidences of its devastation, I had heard what I considered very extravagant stories of the destructive power of the *pororóca;* but, after seeing them, doubt was no longer possible. The lower or northern ends of the islands of Bailique and Porquinhos seemed to feel the force of the waves at the time of my visit more than any of the other islands on the south-east side of the river; while on the northern side the forest was wrecked, and the banks washed out far above Ilha Nova.

The explanation of this phenomenon, as given by Condamine, appears to be the correct one; that is, that it is due to the incoming tides meeting resistance, in the form of immense sand-bars in some places, and narrow channels in others.

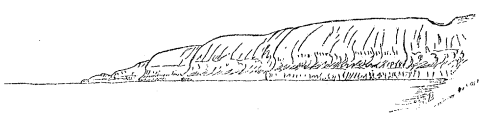
Most persons who mention the *pororóca*, say that it breaks as far up the Amazon as Macapá; and, indeed, the people of Macapá themselves often refer to the rapid cutting-away of the river-banks near their city as the work of the *pororóca*. It is true that these banks are being rapidly cut down; and it is even a common thing to see, in this part of the country, the stilted houses — the floors being nearly two metres from the ground — that were originally built one, two, or three hundred feet from the water, gradually encroached upon until they fall into the stream. A portion of the old fort at Macapá was, at the time of my visit, about to fall, on account of the land upon which it was built being washed away; but all this is the work of a rapid current, for the surf of the *pororóca* does not reach Macapá, though it may reach a little farther west than I have represented on the map. Moreover, there is a marked difference in character between the washing done by the *pororóca* and that done by the ordinary river or tide current. The latter works from below, and, by undermining and softening the bank, causes what is known through the Amazon valley as *terras cahidas*, or fallen banks. The land falls into the stream in sections of various widths, and not infrequently these form temporary terraces miles in length. These *terras cahidas* are most common and most extensive on the upper Amazon during high water, but they may be seen on a small scale at various places through the valley. The accompanying diagram and sketch were made near Mazagão, on the lower Amazon. From this it is clear that the work of destruction goes on entirely below the surface. With the *pororóca*, on the contrary, the water is dashed fairly against the banks, and the earth is washed away from above as well as from below, and the shore is left perfectly clean. The depth to



SECTION OF A FALLING BANK ON THE AMAZON.

which the banks are cut shows that this disturbance is also a profound one; so much so, indeed, that on the north-west side of Porquinhos the deepest place in the channel of the river was, in 1881, close to this island, where the action of the *pororóca* was most violent.

All through this region the *pororóca* is largely instrumental in the rapid and marked changes that are constantly going on. The water of the Amazon is notoriously muddy; and, as would naturally be expected, these disturbances in comparatively shallow places make it much more so, and fill it with all the sediment it can possibly carry. Even when I entered the Araguarý, a time when there was the least possible tidal disturbance, the water near the mouth of this stream was so muddy, that a thick sediment would settle in the bottom of a vessel of it left standing a single minute; though the water of the Araguarý proper, as far down as the Veados, is of a clear,



SHORE 2 M. HIGH, WASHED BY THE POROROCA, FORMERLY COVERED WITH FOREST.

dark color. But the work of tearing down and that of building up are equally rapid, and the vegetable world takes quick possession of what the sea offers it; and, while some islands are being torn away, others are being built up, old channels being filled, islands joined to the mainland, and promontories built out. To the northwest of Faustinho is an island known as the Ilha Nova ('new island'), about ten miles long by about three wide, when I saw it, and which, I was assured by several trustworthy persons, did not exist six years before. In 1881 it was covered by a dense forest. The young plants were sprouting at the water's edge, those behind a little taller, and so on; so that the vegetation sloped upward and back to a forest from twenty to thirty metres high in the middle of the island.[1] Again: on the southern side of the mouth of the Araguarý was a point of land nearly or quite six miles in length, and covered with vegetation, from young shoots to bushes six metres high. I was told, that, one year before, this was nothing more than a sandbar, without a sign of vegetation on it. The western end of the Island of Porquinhos was once known as Ilha Franco; but the channel that separated it from the Porquinhos has been filled up gradually, and the two islands are now one, though the upper end of it is still known as Franco. The point in the mouth of the Araguarý known as the Ilha dos Veados ('deer island') was, at the time of my visit, fast being joined to the mainland. A couple of years before, boats navigating the Araguarý passed through the channel on the south side of the island. In 1881 it was no longer navigable, and the Veados was rapidly being made part of the right bank of the river.

Owing to this shifting of material, the pilots never know where to find the entrance to the Araguarý River. One week the channel may be two fathoms deep on the north side, and the next it may be in the middle; or it may have disappeared altogether, leaving the river-bed perfectly flat, with only one fathom of water across the whole mouth. The bar was in this last-mentioned condition when I passed over it in 1881. At this time another bar extended eastward from the eastern end of Bailique; while a little farther out was another just south of the same line, as I have indicated on the map. The shifting nature of the sandbars about the mouth of the Araguarý renders it unsafe for vessels drawing more than one fathom to enter this river, except at high tides. But, as high tides and the *pororóca* come at the same time, only light-draught steamers can enter by waiting well outside the bar until the force of the *pororóca* is spent.

With the few canoes or small sailing-vessels that enter this stream (probably less than half a dozen a year), it is the custom to come down past Bailique with the outgoing tide, and to anchor north of the bar that projects from the southern side of the Araguarý, and there to await the turn of the tide to ascend the latter river. Care is always taken to pass this point when the tides are least perceptible.

Although the *pororóca* breaks as far up the Araguarý as midway between the Veados and the entrance to the Apureminho, its violence seems to be checked by the narrowing of the stream below the Veados, by the turns in the river, and by the vegetation along the banks.

This vegetation is of the kind against which it seems to be least effective, namely, bamboos. They grow next the stream from near the mouth to the foot of the falls above the colony, and form a fringe to the heavy, majestic forest behind them, than which nothing could be more strikingly beautiful. The clusters next the stream droop over till their graceful plumes touch the surface of the water; and, as the plants grow older, they droop lower, until the stream is filled with a yielding mesh of canes. I measured a number of these bamboos; and the longer ones, taken at random, were from twenty to twenty-five metres in length, and from seven to ten centimetres in diameter. A more effectual protection against the *pororóca* could hardly be devised.

[1] The plants growing upon this newly formed land are all of one kind. They are called *Ciriúba*, or *Xiriúba*, by the inhabitants, and belong to the family Verbenaceae, genus Avicennia.

On Bailique and Brigue I found the forests very different from any I had hitherto seen in the tropics. These islands, like all the others in this part of the country, are flooded at high tide during part of the year; and, as a consequence, they are very like great banks of mud covered with the rankest kind of vegetation. This vegetation varies with the locality. All around the borders, Brigue is fringed with tall assai palms, bamboos, and various kinds of tall trees, all of which are hung with a dense drapery of sipós (lianes) and vines, which form an almost impenetrable covering. Inside of this are several palms, the most common being the ubussú (Manicaria saccifera). The next in order are the murumurú (Astrocaryum murumurú), urucurý (Attelea excelsa, the nut of which is used for smoking rubber), and ubim (Geonoma). But, unlike most tropical forests, this one has very little or no undergrowth, except upon the borders. Most of the ground was under from one to six inches of water, while the exposed places were covered with fine sediment deposited by the standing muddy waters of the Amazon. I walked several miles through this forest without finding any palms except the ones mentioned. The little ground above water was covered with the tracks of deer, pácas, cutías, and of many kinds of birds, mostly waders; but the deathlike stillness was unbroken, save for the little crabs that climbed vacantly about the fallen palm-leaves, or fished idly in the mud for a living.

This vast expanse of muddy water, bearing out into the ocean immense quantities of sediment; the *pororóca*, breaking so violently on the shores, and carrying away the coarser material to the open sea, and burying uprooted forests beneath newly formed land; the rank vegetation of islands and *varzea* rapidly growing and as rapidly decaying in this most humid of climates; the whole country, submerged for a considerable part of the year by the floods of the Amazon, — impress one with the probability of such phenomena having been in past ages, and still being, geological agents worthy of study and consideration. Across the mouth of the Amazon, a distance of two hundred miles, and for four hundred miles out at sea, and swept northward by ocean-currents, beds of sandstone and shale are being rapidly deposited from material, some of which is transported all the way from the Andes, while in many places dense tropical forests are being slowly buried beneath the fine sediment thrown down by the muddy waters of the great river.

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HISTORY OF ALMANACS.

THE derivation of our English word 'almanac' seems doubtful. The word possibly came from *almonaght*, Saxon words meaning 'the observation of all the moons.' In Roman times the priests announced once a month to the people what days should be observed as holidays, basing their calculation upon the movements of the moon. In this way almanacs arose to give information of church feasts. Then superstition entered, and caused an interest to be taken in the movements of the planets. As the earth was held to be the centre around which moved the moon, the planets, and the stars, and as the moon was seen to have an influence upon the tides, the inference was drawn that human affairs could but be affected by these outside bodies which were supposed to have been created for the benefit of the world alone.

The earliest calendars known were cut upon rods of wood or metal, some of the Roman calendars on blocks of stone. The earliest written almanacs were of two classes, — the first containing astronomical computations; and the other, lists of saints' days, and other matters pertaining to the church. Both are sometimes found united; although the latter claimed greater antiquity, being prefixed to most ancient Latin manuscripts of the Scriptures. We reproduce from the 'Glossaire archéologique' of Victor Gay a church calendar of the fourteenth century, in which the leaves are made of box-wood, the pages reproduced giving the calendars of January and December. The first printed calendar was issued in 1472, by Johannes de Monte-Regio; and before the end of that century they became common on the continent. In England they were not in general use until the middle of the sixteenth century; and the making of calendars interested the best mathematicians of the time, which was not the case a little later.

From the earliest times, calendars were filled with advice to physicians and the farmer: the farmer is told when to plant, and the sick man when to take physic. We quote here from an almanac published in 1628, in London, by Daniel Brown, — "Willer to the Mathematickes, and teacher of Arithmeticke, and Geometry," — the titlepage of which bears the inscription, 'Astra regunt homines et regit astra deus,' the paragraphs on

"*Judiciall Astronomy.*

"It hath beene an order and a custome (amongst the most excellentest and wisest Physitions, to choose the Moone for the principall. Significatrix of the sicke Person, and according unto her motion, situation, and configuration (with other Planets) haue giuen judgement on the increasing, mittigation and alteration of the disease; which of the Physition is called Crisis, that is a swift and vehement motion of a disease, either to life or death, and it hapneth about the supreame intention of a disease. And Galen (in commento de diebus Criticis) sayth. A Physition must take heed and advise himselfe of a certaine thing that faileth not neither deceiveth,