No. 2. — *Reports on the Results of Dredging, under the Supervision of* ALEXANDER AGASSIZ, *along the Atlantic Coast of the United States, during the Summer of* 1880, *by the U. S. Coast Survey Steamer "Blake,"* COMMANDER J. R. BARTLETT, U. S. N., Commanding.

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XXII.

A Chapter in the History of the Gulf Stream. By ALEXANDER AGASSIZ.

THE soundings of the "Blake" during the dredging season of 1880 developed some striking features in the profile of the slope extending eastward from the shore along the Atlantic coast, south of Cape Hatteras to the northern extremity of Florida. The soundings previously taken in deep water between the northern extremity of the Bahamas and Cape Hatteras varied greatly, and but little reliance could be placed upon them. The few lines run in 1880 normal to the coast, and the line run parallel to the so-called axis of the Gulf Stream, showed the probable existence of an immense submarine plateau extending eastward from the Atlantic shores. Either the eastern edge of this plateau was not reached in 1880, or else the soundings indicated a very gradual slope from the shore to deep water along the whole coast line south of Cape Hatteras as far as the northern part of Florida.

Everywhere else along the Atlantic coast of the United States, north of Cape Hatteras and in the Gulf of Mexico, the continental line of one hundred fathoms is most plainly marked, forming the upper edge of the more or less abrupt descent leading into deep water with a regular inclination. Owing to the absence of this hundred-fathom line south of Cape Hatteras, it became an interesting problem to trace the exact profile of that part of the coast, and to extend it into deep water. The season of 1881 was spent by Commander Bartlett in the "Blake," under the direction of the Hon. Carlile P. Patterson, the late Superin-

tendent of the Coast Survey, in running a number of lines normal to the coast, south of Cape Hatteras and north of the Bahamas, and extending them into deep water. Commander Bartlett has sent his Report to Professor Hilgard, the Superintendent of the Coast Survey, who has kindly allowed me to make use of these results in connection with my present work on a general report of the dredging expeditions of the "Blake." The accompanying map has kindly been prepared for my use by the Superintendent of the Coast Survey.*

As was to a certain extent anticipated, the lines show the existence of an extensive plateau, of a triangular shape, reaching from the Bahamas to immediately south of Cape Hatteras, where this plateau gradually passes into the continental plateau, extending northward, which is limited by the 100 fathom line, and has a steep slope extending to deep water.

The eastern edge of this plateau is from 300 to 350 miles from the coast, and forms a gigantic submarine plateau, with an abrupt slope passing into deep water. For the sake of brevity I shall call this plateau the "Blake plateau." The eastern edge of the slope of the Blake plateau commences at an average depth of at least 400 fathoms, so that the general profile of the lines extending normally across the Blake plateau show a gradual incline from the shore to a depth of about 50 fathoms, then a somewhat abrupt slope to a depth of about 400 fathoms, then a very gradual descent to the edge of the sharp, steep slope forming the outer eastern edge of the Blake plateau, at a depth of nearly 600 fathoms.

It is interesting to speculate how this peculiar profile, so different from that of any other part of our coast, was formed. The explanation to my mind is comparatively simple. The present outer eastern edge of the Blake plateau, which is now at a depth of 600 fathoms, was at one time at a much higher level. In fact, I assume that this slope

* These lines have, during the season of 1882–83, been extended south of the Bahamas as far as Porto Rico. Under the direction of Professor Hilgard, the "Blake," in command of Lieutenant-Commander Browson, U. S. N., ran normals into deep water, showing that the great submarine Bahama plateau developed by Commander Bartlett commences slightly to the westward of Great Abaco, and extends thence northward, as is shown on the accompanying map. Lieutenant-Commander Browson showed further that to the south the eastern edge of the Bahama Bank extended but a short distance seaward parallel to the general line of the outer row of islands of the group, till it united with the great plateau upon which Porto Rico and the Caribbean Islands crop out, leaving probably one or two deep passages extending towards the old Bahama Channel north of San Domingo and Cuba, leading to the Windward Passage.

probably represents the remnant of the slope formed at the time when it began at the 100 fathom line, and that this trough with unequal sides has been worn away by the action of the Gulf Stream, wearing away the Blake plateau from a geological time which we can trace with a considerable degree of accuracy.

In other words, the old continental line extended at least 250 to 300 miles farther to the eastward, forming a huge plateau, the 100 fathom line of which extended to where the 600 fathom line now runs, and probably stretched so far south as to include the Bahamas and Cuba in this great submarine plateau. The elevation of the Blake plateau probably dates back to the end of the cretaceous period, the time when the plateau of Mexico was raised, thus cutting off whatever communication may have existed between the waters of the Atlantic and those of the Pacific, forming at the same time a number of islands, more or less extensive, in the range of the Larger and Lesser Antilles.

At that time, the Gulf Stream passing between Yucatan, then a submarine plateau of comparatively moderate depth, and Cuba, furrowed the deep channel, 1,000 fathoms or more, which now separates Yucatan from Cuba. The Gulf Stream then lost itself northward in the great Mississippi Bay, and extended fan-shaped in part over the submarine plateau of Florida. It brought, however, an accession of materials by the deposition of which the plateaus of Yucatan and of Florida were gradually built up, and which also supplied food to the innumerable marine animals whose existence is proved by the geological structure of the very plateau upon which they must have lived. The Gulf Stream thus contracted its own boundaries, and was forced into the narrower channel it had constructed between Yucatan and Cuba. As a consequence, it cut an ever deepening trough, and in proportion as Florida rose from the sea it was also compelled to find an outlet for the mass of water by which the Florida peninsula had been covered. It naturally followed the track of least resistance, and forced its way up hill over the lowest part of the plateau, the southern point of Florida, through the then comparatively shallow passage of the Straits of Bemini, which the Gulf Stream must have deepened by degrees as Florida was rising.

The mass of water which in the early part of the tertiary period forced its way north partly up the Mississippi, and east over the peninsula of Florida, was little by little confined to the single channel of the Straits of Bemini, and the whole mass of the Gulf Stream then flowed

northward over the shallow plateau (the Blake plateau) extending north of the Bahamas to Cape Hatteras. It is this part of the Blake plateau which, if I am right in tracing its past history, has been worn away by the unceasing flow of the Gulf Stream.

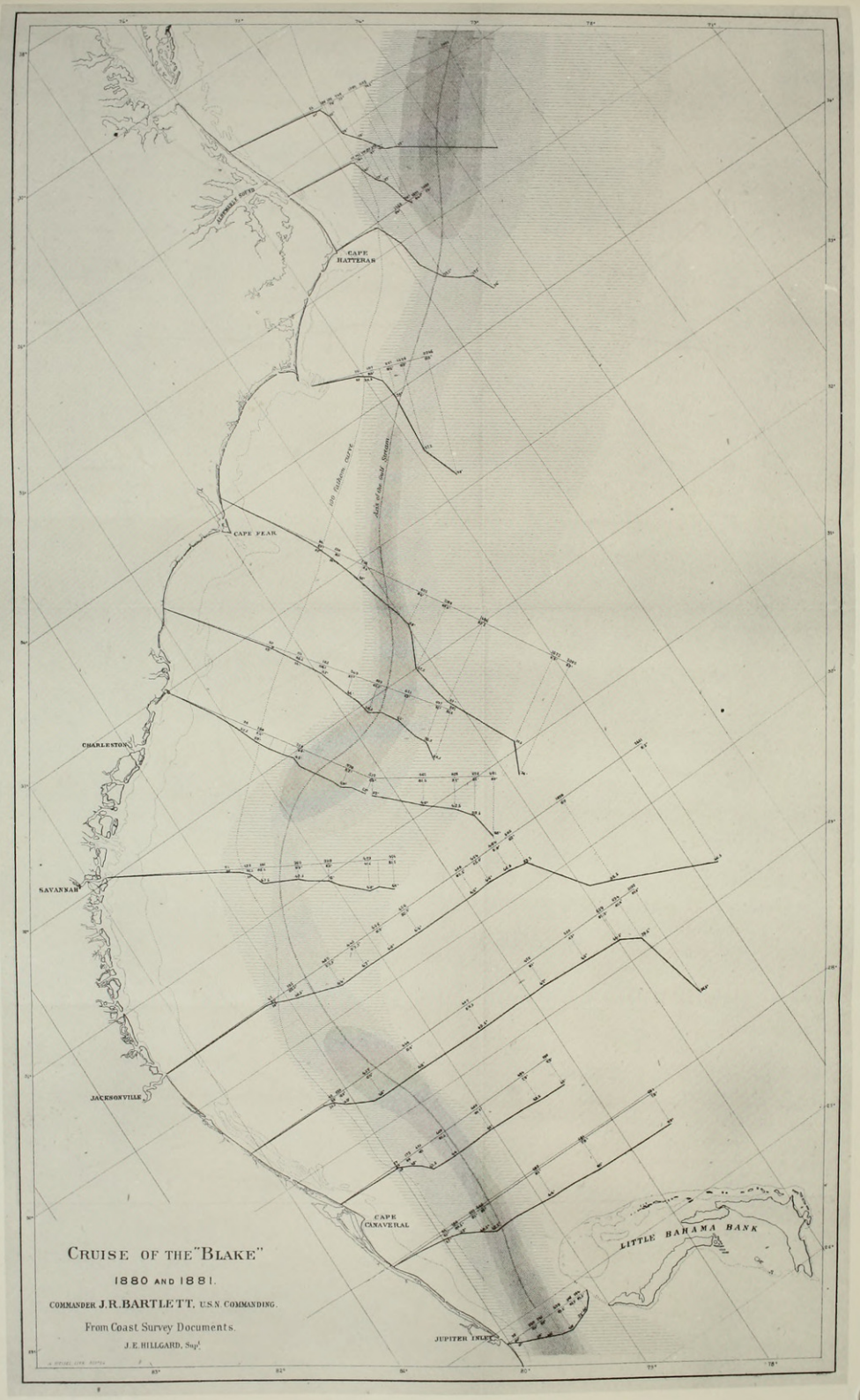
Thus the Gulf Stream now flows north of the Straits of Bemini upon this comparatively shallow submarine Blake plateau,* of an average depth of about 450 fathoms, and finally pours into the deep water of the Atlantic over the edge of the steep slope south of Cape Hatteras. At the same time it precipitates on this slope all the silt it has carried along on its bottom, and which represents for the greater part the wearing action of the Gulf Stream in its course northward. A similar action, but on a smaller scale, also takes place on the steep western and northeastern slopes of the Yucatan Bank. The shallow surface waters of a part of the Stream pour over this bank, and deposit along the above-named slopes all the silt held in suspense, and whatever materials are picked up along its course due to its action upon the shallow banks and reefs of the great Bank itself.

We have, unfortunately, no very definite data regarding the wearing action of water charged with silt to the degree indicated by the immense quantity of it deposited by the Gulf Stream on the northeastern edge of the Blake plateau, just south of Cape Hatteras. The Mississippi, with a depth of say five fathoms, and a velocity not much greater than that of the Gulf Stream, has in a couple of years dug out a depth of at least eighty feet a short distance back of its bar. Now what may be the wearing action of a mighty river like the Gulf Stream, having perhaps an average depth of three hundred and fifty fathoms, and a breadth of some fifty to seventy-five miles, with a velocity of five miles, it is difficult to say. Supposing, however, that this wearing action is no greater than aerial denudation over the area of the Mississippi drainage basin, — that is, at the rate of one foot in six thousand years (it certainly is not too much to assume the same amount for the grinding action of the Gulf Stream), — this would give us a period of about ten millions of years since the termination of the cretaceous period. This estimate is probably far too high, judging by what we know of the wearing action of water in hydraulic sluices ; we probably have a safer estimate in a period of five millions of years as indicating the time which has elapsed since the beginning of the Tertiary. If we assume with Ramsay that this represents about one tenth of the time which has probably elapsed since

* The different shades on the map correspond with the respective velocities of 1, 2, 3, 4, and 5 knots per hour.

life appeared on the earth, this would give us a total of not more than fifty million of years since the first appearance of life upon this globe. To this must be added as the age of the globe whatever time mathematicians think necessary to reduce the globe to a condition fit for animal life from its primitive state.

CAMBRIDGE, May 23, 1883.


CAPE HATTERAS
CAPE FEAR
CHARLESTON
SAVANNAH
JACKSONVILLE
CAPE CANAVERAL
JUPITER INLET
LITTLE BAHAMA BANK
CRUISE OF THE "BLAKE"
1880 AND 1881.
COMMANDER J.R. BARTLETT, U.S.N. COMMANDING.
From Coast Survey Documents.
J.E. HILLGARD, Sup.t