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landscape-drawing are among his greatest accomplishments, if, indeed, they are not supreme.

We have also commented on the system of transliteration followed in the English edition of this work, and of the unnecessary trouble caused by it, and by the use of foreign standards of measurement, to English readers. It is comical and a little puzzling to recognize the well-known Zoji La under the disguise of Sodschi-la, and Takht i-pari, the fairies' throne, as Dschinri (Tokta-pärä); but what is to be made of Nesamorsajuschtscheje, or the "Non-freezing," a name given by "Prschevalskij" to a lake?

The out-turn of the volumes, the reproduction of photographs and sketches, and the fewness of the printer's errors, are in the highest degree creditable to the Lithographic Institute of the General Staff of the Swedish Army.

ON THE IMPORTANCE OF AN INTERNATIONAL EXPLORATION OF THE ATLANTIC OCEAN.*

By Prof. OTTO PETTERSSON and Prof. GERHARD SCHOTT.

I. THE INVESTIGATION OF THE ATLANTIC OCEAN IS ONE OF THE MOST IMPORTANT OCEANOGRAPHICAL PROBLEMS TO BE ATTACKED IN THE NEAR FUTURE.

1. IN regard to Oceanography and Climatology. All deep-sea expeditions of later years have started from Europe to the southward, and have occupied themselves principally with the eastern half of the South Atlantic. But about the interesting and complicated conditions of the western half of the North Atlantic ocean, within the boundaries of the Gulf Stream and the Labrador Current, no systematic deep-sea research has been made with modern instruments and by modern methods since the days of the *Challenger* expedition, excepting some observations of the U.S. s.s. *Albatross*. There can hardly be any doubt that what is going on in the western part of the ocean will furnish a key to what is going on in the eastern part, that is to say, on the European side.

We know nearly nothing about the magnitude and laws of the changing variations of the Atlantic currents in regard to strength or temperature. In this respect a foundation ought to be laid for all later investigations. The non-periodic changes in the temperature of these currents, principally those of the Gulf Stream, are of vast importance for western Europe. Their causes must be looked for in the Gulf Stream itself. Hence the necessity of following it up to its origin further westward. By careful investigations of different scientists it appears very probable that these non-periodical changes in the Atlantic temperature have a deep and far-

* At the ninth International Geographical Congress, which met at Geneva from July 27 to August 6, 1908, Section VI. was devoted to oceanography. In the absence of Sir John Murray, of Edinburgh, senior representative of oceanographic research, Prof. Krümmel, of Kiel, presided. Prof. O. Pettersson, of Stockholm, and Prof. Schott, of Hamburg, each of them, read a paper explaining the necessity of commencing as soon as practicable an exploration of the Atlantic on an international basis in respect to its physical and biological conditions. The substance of the two papers is given in this article.

reaching influence, not only upon the weather, but also upon the vegetation and the harvest results of Europe. A study of the primary causes of these changes is thus not only of purely scientific, but also of great practical interest.

2. In regard to Meteorology and Aërology, oceanographical expeditions upon the Atlantic ocean will open up regions hitherto nearly altogether closed, namely, the investigation of the physical conditions of the higher strata of the atmosphere above this ocean. In this respect the forties and fifties of latitude seem specially important for Europe, because the highways of barometric depressions run here about west-east and south-west-north-west. It is mainly the direction and frequency of these great atmospheric whirls which decide the character of the weather in European countries. These oceanographical and meteorological factors are so closely interwoven that it is at present yet impossible to say what is cause and what is effect.

3. In Biology. The young eels of northern Europe, hitherto unknown as to form, have at last been found to the westward of Ireland, in depths of 500 fathoms (1000 metres). This experience shows how far to seaward fish will wander, which in later stages are caught nearer to land. Similarly, Mr. Hjort's investigations have proved that other fish in its young stage is found in great depths of the northern seas of Europe far away from land. Thus there is every reason to expect that if such fishery investigations are extended to the open Atlantic ocean, many surprises are yet in store for us.

As far as the fishery of western Europe is concerned, a careful study of changes in the Atlantic plankton with regard to season and place, is of great importance, because plankton, being the original food of the sea, must influence in some way or other the wanderings of all fish.

4. The international exploration of the sea near western and north-western Europe commenced in 1902, and has done splendid work, but to finish it the adjacent parts of the Atlantic ocean should be investigated in a similar way. The English channel, the North sea and the Baltic are only small dependencies of the Atlantic, and a knowledge of their temperature, currents, etc., must always remain incomplete as long as we are ignorant of the corresponding factors within the Atlantic itself, from which they depend. The international investigations in the seas adjacent to our shores, as carried on at present, find their natural continuation and their necessary completion only in Atlantic researches.

II. THOSE PARTS OF THE ATLANTIC OCEAN WHICH RECOMMEND THEMSELVES FIRST FOR INVESTIGATION.

5. A straight line from Fair Isle or the Pentland firth to Belle Isle strait across the Labrador Current. The Canadian Government ordered during recent years the execution of important oceanographical work within the waters of Newfoundland. It ought to be possible to connect such work in future with an international exploration of the Atlantic ocean.

6. The great highway between the English channel and the east coast of the United States—that is to say, in the forties and fifties of latitude. Although this region is traversed by far more ships than any other part of the seas all the world over, it is scientifically considered one of the most unknown regions of all oceans. It is true that many cable steamers have sounded the bottom everywhere, but with the relief of the bottom our knowledge is nearly at its end. Looking at the importance of the Gulf Stream in connection with the climate of western Europe, one should have expected that the European nations had thoroughly investigated this region of the ocean, because it is so much in their own interest. However, the history of ocean research shows in this case again that so often

things which affect us directly are neglected, while those of less immediate interest to us are cultivated.

7. A line between a point on the coast of Morocco and one on the coast of the United States, say, Cape Hatteras. It appears that on this line very important dynamical factors are at work, influencing greatly the oceanic circulation. This section would cut the "cold wall," the Gulf Stream, the northern part of the Sargasso sea, and the cold water near the coast of Africa, coming up here to the surface from greater depths under the influence of the off-shore winds.

8. Corresponding series of soundings in a north-south direction or north-east-south-west towards Pará, cutting the Guinea current if possible, would complete the picture of the North Atlantic circulation and offer material for representing and calculating quantitatively the hydrodynamic fields existing in this part of the ocean.

9. As to the South Atlantic, it will be sufficient to remind the reader that a strong and active interest for the investigation of the neighbouring seas has been shown by the Argentine Republic and the Cape Colony, which co-operating factors must be taken into account whenever an international combination is formed. Besides this, for 1910 and the following years a renewal of the successful Scottish expedition into the Weddell sea is to be expected.

III. ON WORKING METHODS.

10. In the North sea and in the Baltic, observations, following an international agreement, are made at regular intervals on the same tracks. Similar trips upon the before-mentioned tracks of the Atlantic ocean promise the greatest and a sure success. However, for the first *it is recommended to limit such a synoptic oceanographic survey only to one year*, because it is necessary and safest to make first only a flying survey of the deep-sea layers.

11. As indispensable observations for all who will take part in the international deep-sea research, might be considered—

- (a) Salinity at definite depths.
- (b) Temperature at definite depths.
- (c) Samples of plankton.
- (d) Samples of bottom.

12. The international normal values and constants should be adopted, as metrical measure, Centigrade degrees, standard methods in analyzing.

13. Current observations made from vessels *at anchor*, or from bays in certain districts would be very valuable, for instance, in the Straits of Florida, near the banks of Newfoundland, upon the Wyville-Thomson ridge, in the Straits of Gibraltar, and so on.

14. The following observations might be made or not:—

- (a) Measurement of gases.
- (b) Measurement of alkalinity.
- (c) Measurement of radioactivity.
- (d) Setting adrift bottles or buoys, etc.

15. The observations made by all participants should be worked up at once on board, if at all possible.

16. During the periodical seasonal trips in the Atlantic for deep-sea research, masters of vessels should be requested to make surface observations uninterruptedly, but in greater extent only near the tracks recommended for deep-sea work. Such observations are—

- (a) Samples of surface water for measuring the salinity by chloro-titration.
- (b) Samples of surface plankton.
- (c) Measurement of the surface temperature.

IV. ORGANIZATION IN GENERAL.

17. It does not appear necessary to have a special head office. Every nation participating should be at liberty to investigate certain regions by its own specialists at its own costs. To prevent unnecessary work, a committee chosen by the Geographical Congress might, in co-operation with representatives of the different nations, distribute the different tracks or sections thereof amongst all co-operating parties.

18. The working up and publication of the observations made upon the tracks may also be left to each nation, although uniformity in the way of publishing would be desirable.

19. The working methods must be on all accounts internationally fixed and the same for all to ensure strict comparability (see III. On Working Methods).

20. Of course the interest of the governments of the Atlantic states of Europe, Africa, and America should be first solicited; but besides them also that of private people, of polar expeditions, and of owners of good-sized steam yachts should be awakened. Principally, however, it is necessary to gain the interest and the all-important assistance of the great steamship companies.

V. FIRST STEPS FOR ORGANIZATION TAKEN AT THE NINTH INTERNATIONAL GEOGRAPHICAL CONGRESS.

The Congress has adopted the following resolution: "The Ninth International Geographical Congress at Geneva declares that the physical and biological investigation of the Atlantic ocean is one of the most pressing problems in oceanography. The civilized nations of Europe, Africa, and America should feel themselves engaged to attack this problem. The beginning of this oceanographical work is urgent first in the immediate interest of the Atlantic shipping, and secondly in the great interest of fisheries and meteorology."

Besides this resolution the Congress consented at its last meeting to the following steps: The chairman of the section "Oceanography" has been authorized to ask several oceanographers and persons connected with natural science to become members of a "Committee for exploring the Atlantic Ocean," or, shorter, of an "Atlantic Committee," and to represent the various nations.

It was impossible to elect at once the members of the committee, because a great many of those interested were not present at the Congress. As soon, however, as they have intimated their willingness to become members of the committee, the committee will be considered as constituted, whereupon a meeting will be arranged as soon as convenient. The entry of representatives of special branches of science, as, for instance, meteorology and zoology, is specially provided for. Moreover, the chairman of the oceanographical section has been requested by the Congress to inform the different governments of the resolution.

In connection with this plan it appears important to mention a similar one, proposed by Prof. Vinciguerra, of Rome, with regard to the necessity of a modern investigation of the Mediterranean, in particular the western part. A motion to that effect was also carried by the Congress. Perhaps it may be possible to combine both plans up to a certain extent, the investigation of the open Atlantic ocean and of the Mediterranean, and to work hand-in-hand. The prospects of this combination seem to be favourable, as the next International Geographical Congress in the year 1911 will be held at Rome.