

Proposed Co-operation Between United States and Germany in Study of Atmosphere About Tropics.

Boston, Jan. 10.—One of the greatest of the unsolved problems of meteorology is concerned with the permanent circulation of the atmosphere, especially in the higher reaches in altitudes greater than 15,000 feet. The surface currents, including the steady trade winds of the tropics, have been pretty thoroughly studied; but just what takes place in the upper air has still been rather guessed at than discovered. In the tropics on either side of the equator there are supposed to be great anti-trade currents flowing above the trade winds and in an opposite direction, while in the north temperate zone peculiar conditions of temperature and directions of air currents have been discovered that have led many scientists to conjecture that great masses of warm air rise about the equator and roll off in constantly descending and cooling streams toward the two poles.

In support of such a hypothesis the scientists bring forward the well established fact that the air does not grow steadily colder at the rate of one degree Fahrenheit for every 183 feet of vertical ascent, as was taught in our physical geographies at school, but that there are warm strata even up in the region of eternal cold. This phenomenon has been noted frequently in the kite-flying experiments at the Blue Hill observatory, the meteorological station of Harvard university, situated a mile south of Boston. In the opinion of most authorities, however, the problem of such seeming irregularities can be settled only in a manner proposed by Mr. A. Lawrence Roth, the director at Blue Hill, who was able, moreover, at the recent meeting in Washington of the American Association for the Advancement of Science to present a definite proposition from the German government for international cooperation in study of meteoric conditions in the middle Atlantic about the equator.

The Germans, Mr. Roth then announced, have agreed to furnish a ship equipped for a three months cruise in the tropics on condition that American scientific men provide the necessary apparatus and pay certain of the incidental expenses. The total cost to the people on this side of the water would not exceed \$10,000. At the time Mr. Roth admitted frankly that no one can foretell with assurance that the results of the expedition would be of commercial, or even scientific value—since it is a matter of venturing into an entirely unexplored field—but he is fully confident that great benefit will come to the weather service of the whole world if it can be discovered accurately just what goes on above the tropical trade winds.

It is a theory of Mr. Roth's that between the trade winds and the anti-trade intervenes an interval of comparatively still air. This is by no means absolutely certain, but it is accordance with conditions discovered in the kite-flying experiments at Blue Hill observatory; and, if found, it will justify Mr. Roth's contention that the most feasible means of exploring the higher atmospheric levels about the tropics is through use of kites flown from a movable base.

It is indeed upon the kite that the American scientists will chiefly rely if the proposed expedition takes place; though the rubber balloon employed for similar research by Dr. Assmann of Berlin will also undoubtedly be used. The limitations of the balloon, however, are so manifest that it will scarcely supplant the "Hargrave" and "Lansom" high fliers. It can be sent to great heights but it cannot be maintained there for purposes of continuous observation. Furthermore, the kite for the meteorological instruments which are released from it by parachutes—over a circle of 30 miles radius—is an annoying feature of the experiment on land, and will be likely to constitute a very serious objection by sea. As for the paper balloons which the French meteorologists still use, their case is even worse; they do not burst, like the German balloon, on attaining certain altitude, but drop slowly, drifting sometimes 100 miles before they reach earth.

Over both these methods, therefore, the kite has decided advantages. Kites have been sent to the height of three miles at the Blue Hill observatory, and by working from a movable base Mr. Roth is confident that he can go higher yet, for the most serious drawback in flights from the land is that above the surface winds one ordinarily encounters deep strata of stagnant air through which the kite will not rise. By utilizing the upward pull of a moving vessel it has been shown that the kite can be drawn through this quietest layer into the next windy tract. A further advantage is that if the direction of this upper current proves to be opposite to that of the surface wind the ship can make a turn to accommodate itself to the changed conditions, and that if any breeze proves too stiff for the kite the vessel can be steered slowly in the direction of the air current, thus virtually modifying its velocity.

This use of kites on shipboard is not a matter of mere theory, however. It has already been pretty thoroughly tested on the sea from Boston to Liverpool, on one of the Dominion Line steamships. The methods adopted and the results secured have been described in a paper by Mr. Roth published in the recently issued report of the Smithsonian Institution. The facts are certainly interesting enough to bear summarizing.

Mr. Roth and his assistant, Mr. Sweetland, installed a huge kite reel on the stern of the steamer Commonweath on August 23, 1901, and made the first recorded exploration of the mid-Atlantic atmosphere. On the five of the eight days occupied by the voyage they were able to raise the kites, though the breezes were so light that the ship's speed of 16 knots an hour had to be utilized to create an east wind sufficient to lift the kites to the height of 2,000 feet. With larger kites and stronger wire this could easily have been exceeded. Automatic records were taken of harmonic pressure, air temperature, relative humidity and the wind velocity. No especially noteworthy discoveries resulted nor was this expected, for the flights were not high enough to explore the upper currents and the region traversed is not especially interesting to the meteorologist. The most remarkable fact noticed was that in the flights the temperature decreased far more rapidly as one ascended than the normal rate would have led to suppose, suggesting possibly that great streams of cold air drift down the Atlantic from the pole; and it was found actually that the air was "warmer" at the maximum height attained by the kite than at the surface of the water. These phenomena are at present inexplicable. They will be explained, it is expected, by Mr. Roth's study of the great equatorial air currents.

The apparatus which was used on the earlier trial trip, and which will undoubtedly be the mainstay of the new expedition, has been brought to a high degree of perfection in the nine years that it has passed since the Blue Hill observers first learned scientific kite-flying from Mr. Wm. A. Eddy of Bayonne, N. J. Their kites are of the well known "box" type, of two distinct types, one the Hargrave, an Australian invention modified by Mr. Clayton of the Blue Hill observatory; the other the Lansom, invented by Mr. C. H. Lansom of England, Mr. Eddy has his peculiar uses, and both are frequently used in tandem, the more powerful Lansom



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The kite string employed in steel piano wire, which was long ago found in deep sea soundings to be of great strength and very slight liability to sagging. A steam winch, a modification of Lord Kelvin's steam power windlass for sea use, is placed on the stern of the vessel. This works almost automatically, for the pull of the kite suffices to unwind the drum; only when drawing the kite in does the observer have to resort to steam power. An automatic register keeps account of the length of the wire paid out and the pressure exerted, facts necessary to be known in order that the tandem may not break loose.

The self-recording instruments are all included in a so-called meteorograph, a compact lantern-shaped carrier which contains an anemometer that records continuously the velocity of the wind; an alcohol thermometer, the liquid of which as it contracts or expands constantly alters the curvature of the tube itself, and thus furnishes a second continuous record; a hygroscope, consisting in essence of a bunch of human hairs which lengthen in moist air and shorten in dry, thus revealing the relative humidity of the atmosphere; and a barometer which records the heights reached and substantiates the calculations made trigonometrically at the sea level station. These last are, of course, performed with great accuracy, the error caused by sagging of the line having been calculated to a nicety. All changes in direction of the wind are also minutely recorded by the shift of the wire at the windlass. The deck of a vessel it should be noted, offers especially good vantage ground for sea level observations contemporaneous with those of the instruments aloft in the air.

This joint American and German expedition of the tropics, atmospheric depths should not be made, it is pretty clear that somebody is going to undertake it before very long, for Mr. Roth's idea of flying kites from a moving vessel has already caught on in Europe. Thus past summer Count von Zeppelin, the Swiss scientist of airship fame, has been towing kites up and down Lake Constance from the stern of a small steamer, while two German meteorologists, Messrs. Peterson and Elms, who by the way have been appointed to attend Mr. Roth on his prospective tour, have already taken records from shipboard in the Arctic regions about Spitzbergen. Furthermore, the German Antarctic exploring vessel Gauss and the English ship Discovery both set sail more than a year ago equipped with meteorological kites; and they will undoubtedly bring back interesting reports from the South Seas. Off the coast of Scotland Mr. Dines of the British Royal Meteorological Society has been cruising with kites and declares himself very enthusiastic regarding their possibilities. It appears, therefore, that this plan of oceanic kite flying has abundantly justified itself, and it is only a question whether the country where it was evolved will have the credit of making notable scientific discoveries or will leave it to the ambitious Germans.

The route to be chosen for the trip has not been definitely settled, nor the time. In a general way, however, Mr. Roth approves of July, 1903, as the date for setting forth, and would be inclined to follow the itinerary suggested by Prof. H. H. Hildebrandson of Upsala, who would have him start from the Azores Islands, after landing a party at San Miguel for brief observations of the clouds and for kite soundings. The party would proceed thence to Tenerife by way of Madeira, through an ocean tract where the anti-trade is always in evidence, since it dips in some places as low as 6,000 feet. After a stay in the neighborhood of Tenerife they will go south past the Cape Verde Islands to the doldrums, and thence westward to the South American coast, running at right angles to the southeast and southwest monsoons. As they turn again toward Africa some curious phenomena will demand their attention at Mauritius, where the upper winds are regularly from the northwest against the southeast trade. On Ascension Island they will send up a balloon without instruments to the greatest possible height, in order that its drift may be accurately observed. Thence return will be made past the Azores, avoiding proximity to the coast of Africa, where the atmosphere is frequently disturbed by hot blasts from the Sahara. Following the coast of the Azores, the party will make past the Azores, avoiding proximity to the coast of Africa, where the atmosphere is frequently disturbed by hot blasts from the Sahara. Following the coast of the Azores, the party will make past the Azores, avoiding proximity to the coast of Africa, where the atmosphere is frequently disturbed by hot blasts from the Sahara.

Guesses at the world's age differ widely. Sir Edward Fry points out that the physicist, reasoning from the dissipation of the earth's heat, the contraction of the sun, and the action of the tides, finds that the earth consolidated at a time nearer 20 than 40 million years ago; while the geologist, from the present rate at which sand, chalk, etc., are being deposited by river and sea, infers that 450 million years must have elapsed since life began on the globe. The biologist thinks the time must be still more vast since the beginning of life, on the assumption that species have multiplied by very slow variation, the estimate being 2,700 million years. Sir Edward contends that the simple phenomenon of "pelosism," a sudden transmissible variation among plants, sufficiently shows that the biological estimate is unnecessary. This abnormal development was first observed more than 150 years ago in the yellow toad-flax of a Baltic island, and has since been traced by one observer in 110 varieties of plants.

An attempt to fix the velocity of light with greater accuracy, using the toothed-wheel method of Fizeau under improved conditions, has been described by M. Petrotin. In previous experiments, the beam of light was made to travel a distance of 12 kilometers (7,452 miles) and back, but in the recent trials it was reflected from a mirror placed at a distance of 45 kilometers (28,566 miles) from its source. From 1,109 observations the velocity has been found to be 299,880 kilometers (about 185,225 miles) per second, with a probable error less than 50 kilometers.

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