

comprehend that although there may be no apparent money value in the investigation, still it has a scientific value. The scientist in an investigation rarely thinks of its practical application, yet some of the greatest godsend to the human race have resulted from these theoretical researches. For example, medicine would have no knowledge of chloroform, ether, acetanilide, antipyrin, potassium bromide, and countless other equally valuable preparations, were it not that these substances were discovered during theoretical investigations. Again, when Faraday was working on the bad-smelling, dirty-looking coal-tar, who ordinarily would have supposed that his isolating from this unpromising substance benzene and some of its derivatives would revolutionize many industries and inaugurate others that now have a capitalization of millions and millions of dollars? Faraday's researches rendered possible the coal-tar color industry.

Numberless instances of the practical value of theoretical investigations might be given, but the above will suffice.

There is, perhaps, a popular prejudice against the scientific man. This prejudice was formerly directed against mathematicians only, but is now being extended to other scientists. There is no outcry against them, but their advice and conclusions are often thought inferior to those of the so-called practical man. Unfortunately for the pockets of these people confiding in the judgment of the practical or rule-of-thumb man, their ventures nearly always come to grief. I believe that the amount of money lost in this way, even during the last twenty years, amounts to more than the national debt. This popular idea is due entirely to ignorance and to unfamiliarity with science and scientific men and methods. It is hoped that this Academy of Science will be able, both directly and indirectly, to help educate the people to put their confidence in those that are worthy of it. When this is brought about we will no longer have companies organized to make a Keely motor, nor to refine sugar by electricity, nor will we have men digging for gold in every rock, or looking for bituminous coal in alluvial formations.

I believe that with these aims before us we can make the academy a success and a benefit to science. Texas has ample and first-class material in her young men for the making of future scientists, both pure and practical. We should encourage by every means in our power the study and prosecution of the exact and natural sciences, because, no matter what may be said to the contrary, on them rest our comfort, our welfare, our progress, physically, mentally, morally.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

Causes which Produce Cold, and Mild Periods.

IN *Science* for Aug. 21 and Feb. 19, I pointed out what I conceived to be the cause of the frigid and warm periods. Still, in order to make my views more plain, further explanation, and repeating, may be necessary.

The tropical surface-waters of the ocean when moved into the high latitudes in large volumes, thus adding their warmth to the heat imparted by the sun, are undoubtedly able to cause a mild climate. This is the opinion of most writers on climatic changes. Still, it seems to me, while viewing the subject from a marine standpoint, that they have only partly comprehended the manner in which the ocean waters are moved in a latitudinal direction. Consequently, their explanations have never proved satisfactory to

those who have considered the subject. The only way in which tropical waters are moved into the high latitudes, in quantities sufficient to cause a mild climate, is through the force of the great prevailing winds of the globe. These winds, as is well known, blow mostly from the east towards the west in the tropics, and from the west towards the east in the high latitudes. This counter-movement of the winds, in connection with land of great latitudinal extent, like the western continent, is able to move the tropical waters far into the northern and southern seas. But in order to do such work perfectly, the land should extend unbroken from the Arctic to the Antarctic circles; because, under such conditions, the westerly winds would blow the surface-waters of the ocean away from the eastern shores in the high latitudes, and so cause extensive low sea-levels, while the easterly winds of the torrid zone would heap the ocean waters against the tropical shores of the continent. Consequently, the warm waters of the tropical high sea-level would be moved by gravitation to the low sea-levels of the high latitudes, even to the Arctic and Antarctic regions, and thus afford them a mild climate. In this way we account for the mild climates enjoyed by the temperate and polar regions during early ages. For it is probable that during such times the wide channel of comparatively shoal water, which now separates the western continent from the Antarctic shores, was a region of low land, and the channels leading into Baffins Bay and Davis Strait were also closed. But since the Tertiary period the low land that connected Cape Horn with the southern continent has been flowed by the sea; which may have been caused through a tendency of the ocean waters southward, or a comparatively small movement in the earth's crust. This flowed region as now represented increases in depth from its northern and southern shores to 1,000 fathoms in its middle portion. The channel has probably been greatly deepened since its first flowage, through the scouring of ice-sheets for thousands of years of successive ice-periods; and it is owing to its waters separating the Antarctic shores from South America that prevents the strong westerly winds of that region from creating a low sea-level in the high southern latitudes. Therefore, the waters of the torrid zone heaped against the South American coast by the trade-winds are not at this date attracted far into the southern seas. It is true they flow along the coast of Brazil to an inferior low sea-level, caused by the westerly winds blowing the surface-waters away from the coasts of Argentine and Patagonia, but on gaining that region they are met by the cold currents which pass through the channels opening into the Pacific, and so turned away from the more southern latitudes. The westerly winds further south, owing to the Cape Horn channel being open, cause, as I have before explained, a drift current to extend around the southern portion of the globe, which largely turns away all tropical currents setting southward. And it is through this exclusion of tropical waters from the high southern latitudes, ice-sheets have been able to gather and will continue to gather on the southern continent and extend into its shallow seas, until the channel separating the western continent from the Antarctic lands is closed. The closing of this channel with ice is only a question of time should the snowfall of that region continue to be as great as it is now.

The Antarctic ice-sheet may have been over ten thousand years in gaining its present extent and thickness, and it may require as much, or more, time to perfect it. Yet it is probable that the larger portion of its coast-line cannot be extended seaward, on account of the great depth of the ocean bordering its shores. But where the water is comparatively shoal the ice-sheet must advance until all the neighboring shallow seas and channels are filled, and a broad isthmus of ice connects the Antarctic lands with the western continent. This being perfected, the strong westerly winds of the southern latitudes will blow the surface-waters away from the Atlantic side of the isthmus, and so cause an extensive low sea-level sufficient to attract the tropical waters from the high sea levels abreast Brazil and the east coast of Africa well into the southern ocean, and thus cause in time a mild climate in the Antarctic regions, as I have before pointed out.

In the northern latitudes we see the Arctic channels severing the western continent from the more northern lands; and it is

through these passages the Arctic currents flow and largely occupy the low sea-level, caused by the westerly winds along the American coast from Greenland to Florida. We also see the tropical waters heaped against Mexico, attracted to the same low sea-level, thus causing the Gulf Stream. But the waters of this stream, while on their northern passage, are so obstructed by the opposing Arctic currents, they fail to reach the higher northern latitudes; consequently heavy glaciers have gathered and still are gathering on Greenland and other Arctic shores, and this increase of cold will continue in unison with the growing cold of the Antarctic regions until the Arctic channels are closed with ice, and a northern ice-age completed. But when the Arctic channels are closed, the Gulf Stream will be able to reach a much higher latitude than now, as it would meet with no obstruction except the return current of its own waters, which would probably flow down the east coast of Greenland, where the Arctic waters now flow. Thus, with less obstruction, the movement of tropical waters into the Arctic regions, which, in connection with increasing warmth in the southern hemisphere, would be able to bring about a warm period in the northern latitudes of considerable duration, on account of the glaciers filling the Arctic straits being situated to the windward of the tropical currents, and, in consequence of their cold location, would be the last ice to melt in the northern regions.

It has been the opinion of several writers that should the whole of the warm Gulf Stream water flow into the Arctic Ocean it would probably remove the ice of Greenland, and it is reasonable to suppose that such would be the case. But, as far as I know, such theorists always fail to explain how tropical waters are ever made to flow into the high latitudes. They have nothing to say of the low sea-level trough, caused by the westerly winds, extending from Georgia to Greenland, and thus attracting both the Arctic and Gulf-stream waters in opposite directions over fifteen hundred miles along the American Coast. For were it not for this low sea-level the Gulf Stream would not be able to move so far northward as it now flows, but would spread out, were the Atlantic a level plain, and become a drift current much further southward; especially with the Arctic currents opposing it from the north.

Professor Geikie asserts that there can be no doubt whatever that periods succeeding the Tertiary have been characterized by great oscillations of climate—extremely cold and very genial conditions alternating; and that during the frigid period, where we now have the greatest rainfall, the greatest snowfall took place. He also says, that during such times changes in the relative level of the land and sea had taken place. But he did not believe that there had been any great movement in the earth's crust. For while giving his views on the earth-movement hypothesis he declared that there was not the least evidence of great continental elevations in the northern hemisphere, and even if such improbable earth-movements were admitted they would not account for the glacial period. The assertions of Professor Geikie, that where we now have the greatest rainfall, in glacial times the greatest snowfall took place, shows that the prevailing winds during the cold period must have blown in the same direction they now blow. Consequently, the great ocean currents, being governed by the prevailing winds, were during the glacial period moving in the same direction they now move. But the great Southern Ocean drift current lost its independent movement when the Cape Horn channel was closed with ice; which, according to the common course of nature must again be brought about. Thus, in the future, as in past glacial periods, the strong westerly winds that sweep the Southern Ocean would blow the surface waters away from the leeward side of the ice isthmus and so cause a low ocean-level; and it appears that the only water that could be attracted to this low sea-level would be the tropical water heaped against Brazil by the trade-winds. This tropical water on gaining the low ocean-level would spread over its wide depression, where the westerly winds would cause it to become a drift current, and in this way it would be moved along the shores of the Antarctic continent past the South Indian and South Pacific oceans and eventually be forced against the Pacific side of the ice isthmus and Patagonian coast, and so cause a high ocean-

level. This high level would vastly increase the volume of the Humboldt current, which would flow, as it now flows, down the South American coast to the equatorial latitudes, where it would become the main source of the great equatorial current. The latter current with an increased volume would also move as it moves to-day, across the Pacific, and through the East India passages into the Indian Ocean, where it would flow on partly as a drift current until it joined the great Mozambique current, which would flow southward along the east coast of Africa, the same as it now flows. At this age, when this continuation of the great equatorial stream gains the latitude of the Cape of Good Hope, its waters are largely turned eastward by the great drift current of the Southern Ocean; but a considerable portion of its waters turn towards the west forming the Agulhas current, which flows around the Cape of Good Hope into the Atlantic, where it mingles with the cooler currents, which branch off from the great southern drift current; and so in connection with the latter waters is moved by the south-east trade-winds towards the equatorial Atlantic and coast of Brazil. Thus it will be seen that the Agulhas current, while giving additional warmth to the Atlantic, serves to retard somewhat the advance of the coming cold period.

The Agulhas current also partly serves to replenish the water which at this date is forced from the South Atlantic by the strong westerly winds into the southern Indian and Pacific oceans. For it appears that more water is now removed by such winds from the South Atlantic than enters it from the Cape Horn channel. This channel being less than half of the breadth of the westerly wind-belt of the Southern Ocean, the drift currents do not all pass through it from the Pacific into the Atlantic. Consequently, a considerable portion of the drifting water turns northward west of Cape Horn, and so forms the Humboldt current. Therefore, the Agulhas stream, which even now assists in replenishing the Atlantic, would be a much stronger current with the Cape Horn channel closed; because the South Atlantic waters would continue as now to be forced eastward by the strong westerly winds, yet they could not be replenished as they are to-day directly from the Pacific; therefore, the waters of the whole Atlantic Ocean would be correspondingly reduced. Such conditions alone would greatly swell the warm Agulhas stream at the culmination of a frigid period, and thus greatly assist the Atlantic in its operations while bringing about a warm period. Dr. Croll, in his astronomical theory, declares the ice periods of the northern and southern hemispheres to be consecutive. But when we consider the wide connection and circulation of the tropical seas it seems impossible for a glacial epoch to be perfected in one of the hemispheres with a mild climate extending over the opposite portion of the globe. And it appears to me that the tropical lands I have visited show indications of having at times experienced a temperature sufficiently cold for snow and ice to have gathered on their highlands, and in some locations glaciers may have extended to the sea. Besides it is well known that Alpine plants exist on the high mountains of the tropics; and it also appears that during some ancient period the climate has been favorable for their crossing the lower lands of the torrid zone, which tends to show that the frigid periods of the two hemispheres were concurrent.

C. A. M. TABER.

Wakefield, Mass., June 13.

European Origin of the White Race.

I HAVE received so many letters questioning my statement in *Science*, March 25, that Omalius d'Halloy, and not Dr. Latham, was the first to maintain the European origin of the white race, that it seems due to the former scientist, as well as to myself, to quote his words. Even such a thorough-paced archæologist as M. Salomon Reinach, of the National Museum, St. Germain-en-Laye, writes: "Where did you hear that Omalius had presented the European theory before Latham? I am sure that it is not so."

Now if these inquirers will turn to the *Bulletins de l'Academie Royale de Belgique*, Tome XV., No. 5, May, 1848, they will find an article of 16 pages, entitled "Observations sur la Distribution ancienne des Peuples de la Race blanche," par M. J. J. Omalius