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THE GREAT ICE SHEET.

In the heat of summer nothing is more refreshing than a generous quantity of ice. And it may be refreshing to the mind, at least, to contemplate, in these sultry summer days, the great sheet of ice that once enveloped all the northern part of our continent, and of the globe as well.

All have seen the immense boulders, called "lost rock" in some sections, scattered over the northern part of the United States, which have little or no resemblance to any mass of rock in place anywhere in their vicinity, and have perhaps asked the question: Where did they come from? also the heaps of sand, gravel, and cobble stones of various sizes, which form many of our ridges, knolls, and hills, and which are totally unlike any fixed rock near them. Some of these have coarse and fine pebbles promiscuously mixed together, and others show beds of stratification in which the coarse and fine seem to be sorted and arranged by themselves. Some, too, have doubtless seen the parallel scratches on the surface of rocks, and noticed, as the Indians did before them, that they all have one direction, and that is usually north and south. Now all these phenomena are attributed to a single cause, and that is the great sheet of ice which Nature stored up ages ago without the necessity of protecting it in an ice-house. The transported boulders, of all sizes down to pebbles and even fine sand, and the scratches upon the rocks, are clear indications of a movement on a very large scale. And if one takes the trouble to search for the place whence these erratic boulders came, he will invariably find that it is north of the position in which they now rest, and varying in distance from a few miles to several hundreds. It will very frequently be found that these masses of stone could not have reached their present resting place without crossing intervening mountains, valleys, lakes, and sometimes parts of the ocean. They are often perched in very singular and almost inaccessible places. There is a very large one on the summit of West Rock, New Haven, under which the regicides are said to have taken refuge after the restoration. Some are so nicely poised in their position that they can be easily rocked by a child, though they weigh tens of tuns. One of the most noted of these erratic blocks is called Pierre à Bot, of fine granite, which now rests on the Jura, 800 feet above Lake Neufchatel, near the early home of Professor Agassiz. This has a solid content of 40,000 cubic feet, and was transported from Mont Blanc across Switzerland, a distance of sixty or seventy miles. Through the influence of their world-renowned fellow townsman, the city authorities of Neufchatel have constructed a promenade to it.

To explain the transportation of these wanderers from their homes, various theories have been advanced, as the effects of floods, or of powerful mud currents, gas explosions of great violence, hurling rocks in all directions, and drifting ice, carrying boulders on its mass and depositing them wherever the ice melted. But these and many others fail to satisfy the observed conditions, and utterly fail to the ground in presence of the facts. To our lamented Agassiz belongs the credit of first attributing the cause of all our drift phenomena to glacial action. But he was not the first to observe that boulders were carried long distances by land ice. More than twenty years before Agassiz announced his conclusions, a chamois hunter of Valais said to M. Charpentier: "Our glaciers had formerly a much longer extent than at present. Our whole valley was occupied by a vast glacier extending as far as Martigny, as is proved by the boulders found in the vicinity of this town, and which are far too large for the water to have carried them thither." Charpentier adds that he afterwards received similar explanations from mountaineers in other parts of Switzerland: once, in 1834, from a woodman, when he had at the very time in his pocket a paper advancing the same theory, which he was then going to Lucerne to submit to a convention of Swiss naturalists.

In 1836, Agassiz became acquainted with Charpentier and was made familiar with his investigations. Soon after, he (Agassiz) carried the theory beyond the limits of the Swiss Alps, and made it embrace a sheet of snow and ice extended enough to cover a continent. Having noticed that the markings in the region of the Alps below the glaciers were the same as those found beneath the ice mass, he compared these with similar appearances in Northern Europe and Asia, which were generally attributed to the great flood, and made the bold generalization that all were due to the very same cause, and that one vast sheet of ice must have covered all the northern regions of the globe. While these theories at first met with great opposition, they are now universally accepted.

According to Agassiz, the sheet of ice extended in this country as far south as South Carolina or Alabama, and was thick enough to cover all the mountains of the eastern part of North America with the exception of Mount Washington. This peak projected, a lone sentinel on that vast waste of ice, two or three hundred feet. In the latitude of northern Massachusetts, he conceives the ice to have been between two and three miles thick; and it held its direct southerly course in spite of the mountains and ridges over which it moved, as is indicated by the direction of the parallel grooves it made, and the trains of boulders which it left. The boulders were all torn off, by the advancing ice sheet, from the projecting rocks over which it moved, and carried or pushed as "bottom drift," scratching and plowing the surface over which they passed, and being scratched and polished themselves in return, till they were finally brought to rest by the melting of the ice. They were not carried as far south as the ice sheet extended, seldom beyond the parallel of 40° N. The native copper of Lake Superior was drifted four or five hundred miles south; and the pudding stones of Roxbury, Mass., were carried as far south as the Island of Penikese.

The tough, elastic, compact clay, called in this country "hard pan" and in Scotland "till," is described as the oldest deposit of ice agency. It was formed under the great ice sheet as it ground along on the earth's surface. This was often plowed and forced forward in a confused mass, was thickest in the valleys and on the lee side of crags and other obstructions, and thins out towards the mountain tops, where it appears only in protected places.

During the existence of this ice sheet over the earth's surface, geologists tell us there was a great depression of the crust, which of course resulted in an equally great encroachment of the sea upon the land. Various reasons have been assigned as the cause of this. Adhémar, and later Croll, attribute it to a displacement of the earth's center of gravity, due to an increased weight of ice at the north pole, while at the same time there is a diminution of ice at the south pole. The latter authority estimates that the melting of two miles of ice from the antartic regions would raise the ocean level one foot; and the simultaneous abstraction of heat from the arctic regions would add a mile to the thickness of the ice at the north pole; and that these results would so change the earth's center of gravity as to cause a submergence of nearly 500 feet in the northern polar regions, and a gradual diminution of this amount towards the equator. But, unfortunately for this theory, the facts show that the amount of submersion does not diminish with uniformity as we recede from the pole, but with much greater rapidity than the theory requires.

Another theory, advanced by Professor Shaler, attributes this depression to the weight of ice accumulated on the continents during the glacial period. This theory assumes that a cap of ice, a mile or more in thickness, would, by its gravity, depress the earth's crust at least 500 feet from the Great Lakes to the Arctic Ocean. That this weight would tend to produce a depression cannot be denied; but it is hardly probable that it would be sufficient to produce so great an effect upon the earth's crust, which is probably not less than 100 miles thick, and so shaped as to offer a resistance to pressure very similar to that of a monstrous arched bridge. It would seem more natural and reasonable to attribute this depression to the commonly accepted cause of all the elevations and depressions on the earth's surface: the contraction of its crust due to constant cooling.

After the disappearance of the ice sheet, there were local glaciers which conformed to the larger valleys, like those now seen in the Alps. They carried down boulders torn from the rocks along their sides and deposited them, with other *débris*, as terminal and lateral moraines, which often dammed up rivers and formed many of the lakes which now beautify our landscapes. Other lakes were formed in the solid rock by the gouging action of the boulders frozen into the ice. At perhaps about the same time there was again an upheaval or elevation of the land, or, more strictly, successions of elevations. These caused a rapid drainage, from the land, of the water previously making up the ice sheet, by which the drift was stratified and its pebbles assorted and rounded; hills and ridges were formed by a deposition of material suspended in the water, just as drifts of various shapes and sizes are formed by the snow suspended in the air; and the beautiful terraces which ornament so richly our river valleys were formed. These elevations were also due to shrinkage of the earth's crust, for a depression in one place must necessarily make an elevation in another.

SALICYLIC ACID.

Disinfectants and antiseptics may be divided into two classes, those which have a destructive action by the dominant power of their chemical affinities, of which chlorine is the type, and those which have a preservative action, causing them to prevent decay and putrefaction, of which class carbolic acid is the type.

The first class destroy the infectious materials. Chlorine does so by its great affinity for hydrogen, which breaks down all hydrogen compounds; while at the same time, if oxygen is set free, the latter will, by the power of its nascent condition, finish the work and utterly destroy the compound. As all organic infectious substances are hydrogen compounds, the special action upon them of chlorine or its equivalent is evident.

Of the second class of disinfectants, preventing the decay of organic compounds, there are several. Carbolic acid and its nearly equivalent creosote, chloride of zinc, arsenic, bichloride of mercury, and others are well known. Notwithstanding that many of them may be used as disinfectants, they are rather preservatives, protecting as they do the organic substance against the destructive agency of zymotic principles, and against the action of fermentation, eremacausis, or other modes of decay.

Till recently, all the known disinfectants and preservatives had the grave defect of possessing a bad odor or flavor, or of being poisonous, and sometimes these disadvantages were combined in one body; and the discovery of a preservative and disinfectant having neither taste nor smell when diluted, and an agreeable odor when concentrated, is of great importance. Such a substance is salicylic acid, and it may be well, therefore, to give an outline of the history of the discovery of this compound, which promises to come widely into use.

The starting point was the study of salicin, a crystalline bitter substance contained in the leaves and young bark of willow, poplar, and some other trees. It is simply obtained by exhausting the bark with boiling water, filtering, concentrating by evaporation, and subsequently crystallizing, when pure white, silky needles are formed, of which analysis has shown the formula to be $C_{13} H_{18} O_7$.

When this substance is boiled with a diluted acid, it will absorb one atom of water and be split up into two other substances, glucose or grape sugar and a new compound which has been called saligenin. The chemical action may be simply represented by the formula:

$$\underset{\text{salicin}}{C_{13} H_{18} O_7} + \underset{\text{water}}{H_2 O} = \underset{\text{glucose}}{C_6 H_{12} O_6} + \underset{\text{saligenin}}{C_7 H_8 O_2}.$$

The splitting up of the salicin atom has caused some chemists to consider salicin as a glucosite of saligenin. The latter has little bitter taste, if any.

When saligenin, $C_7 H_8 O_2$, is submitted to the action of chromate of potash and sulphuric acid (a powerful water-forming mixture), two atoms of hydrogen are oxydized out of it and become water, and $C_7 H_8 O_2$ becomes $C_7 H_6 O_2$, a thin, colorless, and very fragrant oil, heavier than water, but soluble in it. This has been called salicylol. When salicylol is oxydized by chromic acid, it takes up an atom of oxygen, and $C_7 H_6 O_2$ becomes $C_7 H_6 O_3$; this is the salicylic acid, the subject of our remarks. It crystalizes in prismatic form, and is very soluble in hot water and alcohol. When heated, it melts; and by further heating to distillation, it gives off carbonic acid and becomes carbolic acid, the same as is obtained from coal tar, thus:

$$\underset{\text{salicylic acid}}{C_7 H_6 O_3} - \underset{\text{carbonic acid}}{C O_2} = \underset{\text{carbolic acid}}{C_6 H_6 O}.$$

This gave a hint to the chemists investigating this substance, and they tried to obtain it by a shorter route by combining carbolic acid with carbonic acid, and they succeeded. Carbonic acid gas is simply passed through the liquid carbolic acid; but in order to loosen the elements in its atoms, pieces of sodium are introduced, which, by their affinity for oxygen, loosen the bands between the C, H, and O, and so predispose them to a new combination; so we have

$$\underset{\text{carbolic acid}}{C_6 H_6 O} + \underset{\text{carbonic acid}}{C O_2} = \underset{\text{salicylic acid}}{C_7 H_6 O_3}.$$

And this close relationship between the two substances gave rise to a suspicion that the salicylic acid was, in a certain sense, a deodorized carbolic acid, and would have the antiseptic properties of the latter without possessing its intense tarry flavor and odor, which make it totally unfit for the preservation of food. This was verified, and it was found that, when three grains of this salicylic acid are placed in a pint of fresh milk, it will keep 40 hours longer than without it. Its presence cannot be detected by odor or taste, and it is claimed that it does not impair the wholesomeness. It also prevents fermentation, and arrests it when begun, in cider, beer, wine, sugar solutions, etc.

We repeat that the discovery of a substance of this class, the presence of which is not revealed by taste or smell, is of the utmost practical importance.

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