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THE CONSERVATION OF OUR OYSTER SUPPLY.

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"OYSTER culture, properly so called, the production of spat by aid of artificial methods, has never been resorted to in this country." And "as the scarcity of seed is one of the greatest difficulties now encountered by the oyster planter, this subject offers an interesting field for investigation."

These statements occur in the Report of the United States Commissioner of Fish and Fisheries for the year ending June 30, 1889; and as the propagation of spat by artificial means has not been resorted to since that time, it will be interesting to examine the general conditions of our oyster supply, and, from ascertained results in foreign waters, consider whether or not such methods would tend toward restocking our depleted oyster beds, or economically increasing the oyster supply.

In the consideration of this subject it will be well, first, to give a brief, general account of the conditions of the existing, working, and outworked oyster beds; and, having ascertained these conditions, as nearly as possible, and made some necessary comparisons, we can more easily consider the advisability of raising spat by artificial methods. The natural oyster of America can not continue to be produced in such abundance as we have been accustomed to find it. The beds of South Carolina have practically given out; the famous oyster beds of Maryland and Virginia —in the Chesapeake Bay region, which Captain Collins calls "the most important oyster region of the world"—are being so depleted of oysters that the "gravest apprehension" is caused as to their future; and only in Connecticut has there been a marked increase, both in the acreage of oyster beds and oyster production, without hardly knowing what is the matter with them, who would be all the better for trying whether their discomforts spring from too high and rich a diet or from the inability to procure any but inferior meat or fish. In the first case they would soon feel their tired digestions rested and their irritated nerves calming down, while in the latter they would find out that it is easy to get a healthier and an equally satisfying meal for half the cost of what they were in the habit of spending before.

Though these motives are not perhaps the highest which ought to lead us to a result, they are those which exercise a most general influence. The small number who change their mode of life from principle only know how far above bodily health the blessings are which grow out of the sacrifice. Before the eyes of everybody the lines of the Latin poet must conjure up a delightful and attractive picture:

> "Forbear, O mortals, to taint your bodies with forbidden food;
> Corn have we; the boughs bend under a load of fruit;
> Our vines abound in swelling grapes; our fields with wholesome herbs,
> Whereof those of a cruder kind may be softened and mellowed by fire.
> Nor is milk denied us, nor honey smelling of the fragrant thyme;
> Earth is lavish of her riches, and teems with kindly stores,
> Providing without slaughter or bloodshed for all manner of delights."

ORIGIN OF THE MISSISSIPPI VALLEY RAINFALL.

By J. HARRIS PATTON, Ph. D.

It has been assumed that the evaporation off the Gulf of Mexico furnishes the most part of the rainfall of the great valley. Says an authority, when speaking of that of the whole country, "By far the greater portion comes from the gulf and spreads over the central and eastern part of the Mississippi Valley, and even much of the Atlantic slope." Let us examine the data on which this statement is based. The area of the Mississippi Valley is estimated at 1,244,000 square miles, and the annual average rainfall on its surface is forty-two inches—that is, if the rain water did not penetrate the earth, run off, or evaporate, at the end of the year the depth would be three feet and a half.

The area of the Gulf of Mexico is estimated to be one fourth that of the valley. It is easily shown by mathematical calculation that it would require an annual evaporation off this area of fourteen feet to furnish the required rainfall, even if all the water thus raised into the atmosphere were utilized. Again, the area of the gulf is swept by the extreme right flank of the trade winds. These winds must carry toward the west a large portion of the surface vapor rising off the gulf; this is evident because of the unusual distance to which the sea-breeze penetrates into Texas and the adjoining region of Mexico. In addition, the water of the gulf is not as warm as that of the Atlantic equatorial current—to be noticed presently—by an average of *ten* or *twelve* degrees Fahr., and in consequence, in proportion, its evaporation is just so much the smaller. The equatorial current penetrates the gulf about five hundred miles, but does not diffuse itself and thus impart its heat to the adjoining waters, but in a compact body the current turns toward the east and finds its way out through the Florida Strait, and thus becomes the Gulf Stream.

It is estimated that if the "gulf was landlocked and evaporation checked," the volume of water poured into it by the Mississippi alone would "raise the level of this great area one and a quarter feet each year." (Appletons' Physical Geography, p. 130.) The height of the surface of the gulf, however, remains uniformly the same year in and year out. It follows from this that the outflow of water and its evaporation combined amount each year to only one foot and a quarter. This leaves twelve feet and three quarters to be obtained elsewhere, in order to furnish the rainfall for the great valley. The question is, Where can this be obtained?

The Atlantic equatorial current may furnish an answer. This vast stream is about four thousand miles long and about three thousand wide. Taking its rise in the Gulf of Guinea, it flows westwardly, but, dividing on Cape St. Roque, the much greater portion moves along the north shore of South America, and just before entering the Caribbean Sea it unites with the northern counter current. (See Appletons' Physical Geography, pp. 50, 51.) These currents are both under a broiling tropical sun, and their water is heated from 80° to 82°; "the evaporation is rapid in the equatorial regions, and most of all in the warm belts constantly swept by the trade winds." Thus, when the warm, saturated air next the surface rises, it is rapidly carried away by the wind, and cooler air flowing from the north takes its place, to be in turn heated and floated upward. Says Captain Maury, U. S. N. (Geography of the Sea, p. 102), "Off this ocean belt there is, in the form of vapor, annually floated up into the higher air fifteen feet of water." Says Prof. Arnold Guyot, in Earth and Man, p. 85, when speaking of the same, "The sun causes these invisible vapors to rise, which, being lighter than the air itself, increasingly tend to soar into the upper atmosphere, filling it and constituting within it another aqueous atmosphere." This vapor is carried by the trade winds steadily westward at the rate of about thirty or thirty-five miles a day, and meets its first obstruction in the plateau of Mexico, which is five thousand feet above sea-level. On the west coast of Mexico stand the Sierra Madre Mountains, whose altitude is five thousand feet above the plateau (Appletons' Physical Geography, p. 23). The latter furnish the second impediment to the onward progress of these winds, since they run southeast-northwest; but the trades blow directly west, and thus impinge upon them at an angle which deflects the winds themselves toward the north.

The Sierra Madre are more than one thousand miles long, and are an insuperable barrier to the progress of these vapor-loaded winds. This is evident, as there is no indication of their presence on the west side, neither on the land nor on the water, as the Pacific trade winds appear to originate about one hundred and fifty miles west of the coast of Mexico. An analogous case is cited by Prof. Orton, in his Andes and the Amazon, p. 118, who says, when speaking of the Andes, "So effective is that barrier that the trade winds are not felt again on the Pacific till you are one hundred and fifty miles from the coast."

These winds appear to be shoved up, strata upon strata, on the Mexican plateau, and when they finally reach the Sierra Madre Mountains, over which they can not pass, they are rolled back upon themselves. They must have an outlet. The rushing wind from the east prevents their moving in that direction, and the force of the main current forbids their flowing toward the equator, and thus their outlet can only be toward the north. They are now so high that they must be beyond the influence of the rotary motion of the earth, and are governed by the force of gravitation alone. In accordance with the latter law they flow, as on an inclined plane, over the colder and more dense air toward the north, and thus restore the equilibrium of the atmosphere that has been disturbed. This disturbance is caused by a continual flow of the cold and heavy surface air from the extreme north toward the equator, because along the tropical belt a partial vacuum is created by the air becoming heated and lighter and in consequence floating upward, and the cold air rushes in to supply that vacuum.

These comparatively warm strata, though high in the atmosphere, have a tendency to reach the earth, but, being lighter than the surface air, they float above it until their respective densities are about the same. The point of contact with the earth of the *lower* strata of these "return trades" is near 30° north latitude in the summer, but still further north in the winter. This point of contact is near and along the north shore of the gulf, and the blending of the moisture of the "return trades" with that off the gulf may account for the unusually large rainfall of sixty inches near that line; meanwhile the main and higher strata blow on and reach the earth further north.

"The polar winds, seeking the equator, strike obliquely against the Rocky Mountains, and in running along their eastern slopes are deflected to the southeast, and become the northwest winds of the valley of the Mississippi. . . . These cool winds meet the surplusage of the moist return trade winds, and by their coolness condense still more the latter's vapor, which descends in rain-storms that are sometimes quite violent, but furnish water for the head streams of the Missouri and its branches" (Prof. Guyot, Earth and Man, p. 100).

It has been suggested that this warm air, thus saturated with vapor, loses the latter when it floats aloft, because of the cold in the higher regions of the atmosphere, and consequently such air, floating north, could not deposit moisture when it reached the earth. That theory is not consistent with the fact that vapor often becomes visible in the form of clouds, which frequently float higher than the altitude of the Sierra Madre. In this special case it is worthy of notice that the plateau of Mexico is five thousand feet above sea-level, and it is also under a tropical sun, and therefore the incumbent air is so much the more heated. In such circumstances the vapor-loaded winds would not be likely to lose so much of their warmth and moisture as under conditions wherein there was no similar elevation. The great valley being free from mountain barriers at both ends, the winds flowing either way are unobstructed. In consequence, the comparatively warmer and vapor-loaded winds off the equatorial current meeting those coming from the north that are nearer the surface and also cooler and drier, the moisture of the former is condensed into mists and clouds, and finally descends to the earth in copious rains.

One of the most perfectly adapted pieces of machinery for handling heavy weights is the modern "rapid-transit elevated railway traveling crane," which has been found highly useful in manufactories of locomotives and other ponderous machinery. Before it was introduced, heavy weights were moved from one part of the shop to another by means of jib cranes, the arms of which swung in arcs of a circle. A series of them occupied the middle of the floor. The weight to be moved was swung upon one of them and borne round to the next, when it was changed; and so on, till it reached its destination. These machines cumbered the floor, and were otherwise inconvenient. The traveling crane requires no floor room, but is wholly poised above. It consists of four essential parts: (1) the elevated tracks, which are supported by iron columns or built into the walls and run parallel with the walls from one end of the building to the other; (2) the traveling bridge, which is constructed of two parallel plate girders extending from rail to rail, spanning in mid-air the breadth of the building and mounted on wheels; and (3) heavy steel tracks laid between the girders, bearing (4) a trolley car, which runs back and forth, carrying the hoisting mechanism. By the longitudinal motion of the bridge and the cross-motion of the trolley, every square foot of available space in the building can be covered, and the position of a steam boiler or of a locomotive engine changed at will.