THE TRANSIT OF MERCURY AND THE INTER-MERCURIAL BODY.

The observations of the transit of Mercury across the sun which were conducted at the various astronomical observatories throughout the country on May 6 yield varying results, the planet in some instances being apparently found to be ahead and in others behind predicted time. A large number of excellent photographs were, however, obtained and by the aid of these and a comparison of the data determined in various localities reliable results will probably be reached. At the Naval Observatory in Washington, Professor Newcomb found that the planet came into view twenty seconds ahead of the time predicted by Leverrier and more than a minute ahead of the American table. The statistics are as follows: Internal contact at ingress, from Leverrier's tables, 10h. 4m. 53sec.; observation, 10h. 4m. 38sec. Internal contact at egress, from Leverrier's tables, 5h. 34m. 17sec.; observation, 5h. 33m. 51sec.

The object of observing the transit of Mercury is altogether different from that sought in observing the transit of Venus. In the latter case the aim was to determine the sun's distance from the parallax, and to this end the observations were made from localities on the earth's surface where the latter was greatest. Mercury is situated at a much greater distance from the earth than Venus, and its orbit is smaller, while it is so difficult of observation that the position of its orbit is very imperfectly known, a fact indicated by the difference above noted between Leverrier's and the American tables. Now, if accurate data relative to this orbit can be obtained, in such lies the determination of the question of the existence of the alleged Vulcan or inter-Mercurial planet. It will be remembered that by observing the perturbations of Uranus, Leverrier reached the conclusion that the same could not be produced save by the influence of some undiscovered planet, and assuming the existence of this body he calculated its position, and on pointing his telescope to the point in the heavens where his calculations led him to believe it would be found he made the magnificent discovery of Neptune. Reasoning analogous to this induced him always to believe in the existence of some body which causes the perturbations of Mercury. He found that the perihelion of that planet advances much more rapidly than can be accounted for by any definitely known disturbing cause. In other words, as the planet sweeps around the sun in its nearly circular path and reaches the point nearest the sun (the latter being eccentrically placed as regards the orbit), it advances about 246 miles, or one thirteenth of its diameter, at each recurring revolution. As the planet approaches its aphelion the effect of a large motion of the perihelion would be to cause the planet to be further advanced in its orbit, and hence the time of transit would be hastened, and this would point to the existence, or rather tend to confirm Leverrier's hypothesis, of some unknown attracting matter exerting an influence.

That this result has been realized by the observations of Professor Newcomb is evident from the foregoing figures, and the same appears to be true from most of the uncorrected data telegraphed by other observers throughout the country to the daily journals.

Of course, admitting the probable presence of an undiscovered attracting body to be substantiated, it by no means follows that that body may be the imaginary Vulcan. It may simply be an aggregation of meteoric masses, or matter existing in the corona and protuberances of the sun itself.

The observations of the total solar eclipse of July 29 next will perhaps shed some light on this last possibility, and may even be the means of revealing Vulcan, if it exists, as one of our correspondents, who has made that supposititious planet the object of much study, published the fact some time ago that Vulcan ought to be quite near the sun at the time mentioned. Meantime, in order to know exactly how far the results of the recent observations tend to substantiate the conclusion indicated, it will be necessary to wait until the astronomers at the different observatories make their comparisons and final corrections, which will probably occupy considerable time.

OUR NAVAL NECESSITIES.

The New York *Tribune*, in an editorial on a "new navy," points out the inefficiency of our present marine, and advocates its rehabilitation in a general way singularly free from practical suggestions. Speaking of our numerous small vessels our cotemporary says: "Let us have a well considered system of replacing them by the best men-of-war that can be built, on patterns suited to our peculiar needs." If the *Tribune* will kindly indicate what manner of system it knows of that will afford the "best men-of-war," it will do the country a genuine service, and possibly settle a problem on which millions have been expended by foreign nations, and which seems no nearer solution than at the outset.

Out of 150 vessels borne on our Navy Register it appears that but 29 are suited for general cruising purposes. To these last the *Tribune* urges the objections that they are not iron clad, not heavily armored, and are merely thin "iron pots," besides being contemptible in the eyes of third rate European powers. All this is true enough, and it might be added that we have spent enough money in tinkering these inefficient hulks to have purchased a powerful ironclad fleet; but then it by no means follows that such a fleet should have been organized, or that the same is now necessary. We do not defend the waste of national funds which might much better have been left in the pockets of the taxpayers, but supposing we had constructed an iron fleet in answer to the demands that have been renewed by the *Tribune* and those who share its opinions about every year since the war, how much better off would we be? We built one ironclad fleet of monitors. Most of them are in the scrap heap, and the rest are rapidly gravitating thither. Their laminated armor is as pregnable to heavy modern projectiles as so much wood. We launched several very expensive and presumably swift cruisers, and in our anxiety to make them fast we gave them so much machinery that it was scarcely practicable to stow their coal, berth their crew, or accommodate their guns. Several of them were speedily consigned to the limbos of Navy Yard Rotten Rows.

Fortunately we proceeded no further, for had we followed England's example the outlay might well have been enormous. We should have had a fleet of Warriors, another of Minotaurs, of Captains, of Glattons, of Inflexibles—each in turn as one type of vessel superseded the other, and each probably in answer to such demands as that of the *Tribune* for the "best men-of-war that can be built." Each also in turn would have been discarded, and now, instead of complacently profiting by her immensely expensive experiments, at no cost to ourselves, we should be sharing with England the unenviable possession of a vast fleet and the annoying consciousness of its inefficiency.

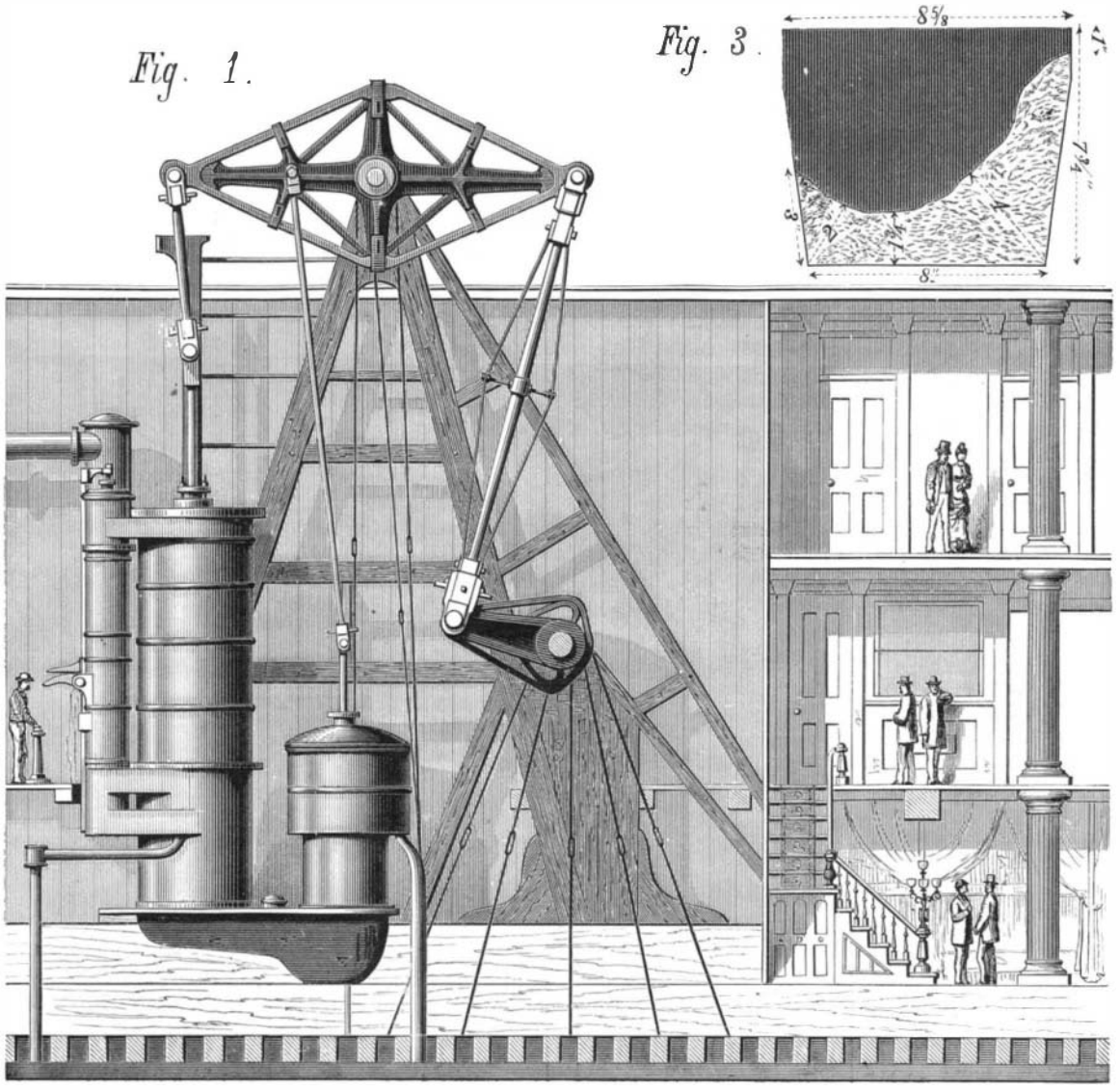
The *Tribune* greatly underrates the productive ability of our people when it asserts that a "navy cannot be improvised in time of danger," and at the same time shuts its eyes to already demonstrated fact. With an improvised navy we maintained and compelled respect for the most extensive blockade ever known, despite the utter negation of its possibility by foreign military authorities. The improvised Confederate rams and our own hastily built gun boats alike did splendid service. We improvised the revolving monitor turret, the only really efficient system of ironclad ever contrived, and so revolutionized the naval armaments of the world. We improvised fixed and movable torpedoes, and for the first time demonstrated the enormous capabilities of the weapon which is chiefly to decide all future conflicts. This was done with the genius of the country divided against itself.

In our present navy, though it is small and inefficient, we have a reliable nucleus for as great a one as we choose to organize; and we possess the best and most skillful torpedo service in the world. A few staunch cruisers might, perhaps, profitably supplant some of our older vessels, but we see no present necessity for any further change in our naval status. The necessities of future wars may safely be left to the inventors.

THE ACCIDENT TO THE MACHINERY OF THE STEAMER OLD COLONY.

Since last summer, three New York steamboats have been disabled by the breakage of their engines—the Harlem, the Dean Richmond, and the Old Colony. When the Providence, one of the very largest and finest steamers plying on the Sound, was "laid up" for the winter, a flaw was discovered in one of the main journals of the paddle shaft to be so serious as to make a new shaft necessary before recommencing the coming summer trips between this city and Fall River. In every one of these cases flaws in the wrought iron were indisputably apparent, undoubtedly the cause of fracture, and in the three first mentioned were attended by a marked crystallization of the iron. We referred to the breakage of the working beam of the Harlem at the time of the occurrence, and spoke of the flaw and crystallization at the point of fracture in the lower strap, and of the good fibrous iron in the upper strap. When the accident occurred to the Dean Richmond, the connecting rod broke first, afterwards the beam and other parts; it was then that a very extensive flaw appeared in the center of the connecting rod, which extended to within a few inches of the circumferential surface.

From the accompanying illustrations and description it will be seen that exact information has been obtained respecting the accident to the engine of the Old Colony, and, classifying this with the others already mentioned, a subject presents itself for the attention and investigation of constructing engineers. That subject embraces the forging of iron, the most suitable iron for heavy forgings, the manner and place of welding, and the reduction of strength by crystallization. The strains that require wrought iron shafts to be 24 inches, and connecting rods 12 inches in diameter, can only be withstood by sound castings and forgings of the best quality of iron, and to secure these practical science and skilled workmanship are indispensable.



MACHINERY OF THE OLD COLONY—BEFORE THE ACCIDENT.

The steamer Old Colony, one of the older boats on the New York and Fall River line, was built by John Englis & Son, at Greenpoint, L. I., in 1865. Her length between perpendiculars is 322 feet; beam, 42 feet; depth, 14 feet. The engine of the Old Bay State was constructed at the Allaire Works in 1847, and this engine was taken out and put in the Old Colony. Since that time many parts have been renewed and little is left of the original engine. Fig. 1 is a general view of the engine in working condition. The cylinder is 81 inches in diameter; stroke, 12 feet; has the Stevens cut-off; length of beam (center to center), 22 feet; length of connecting rod, 23 feet; diameter at middle, 11 inches; diameter at ends, 9 inches; diameter of paddle wheel shaft, 18 inches. The crank is of cast iron hooped with wrought iron bands. The condenser is a jet and not a surface one. The boilers are placed on deck by the starboard and port guards. The diameter of the paddle wheels is 38 feet; width of bucket, 2 feet 2 inches.

The center keelson is made of live oak, 14 inches by 30 inches deep, resting on frames 17 inches deep; the frames are of chestnut, hackmatack, and oak.

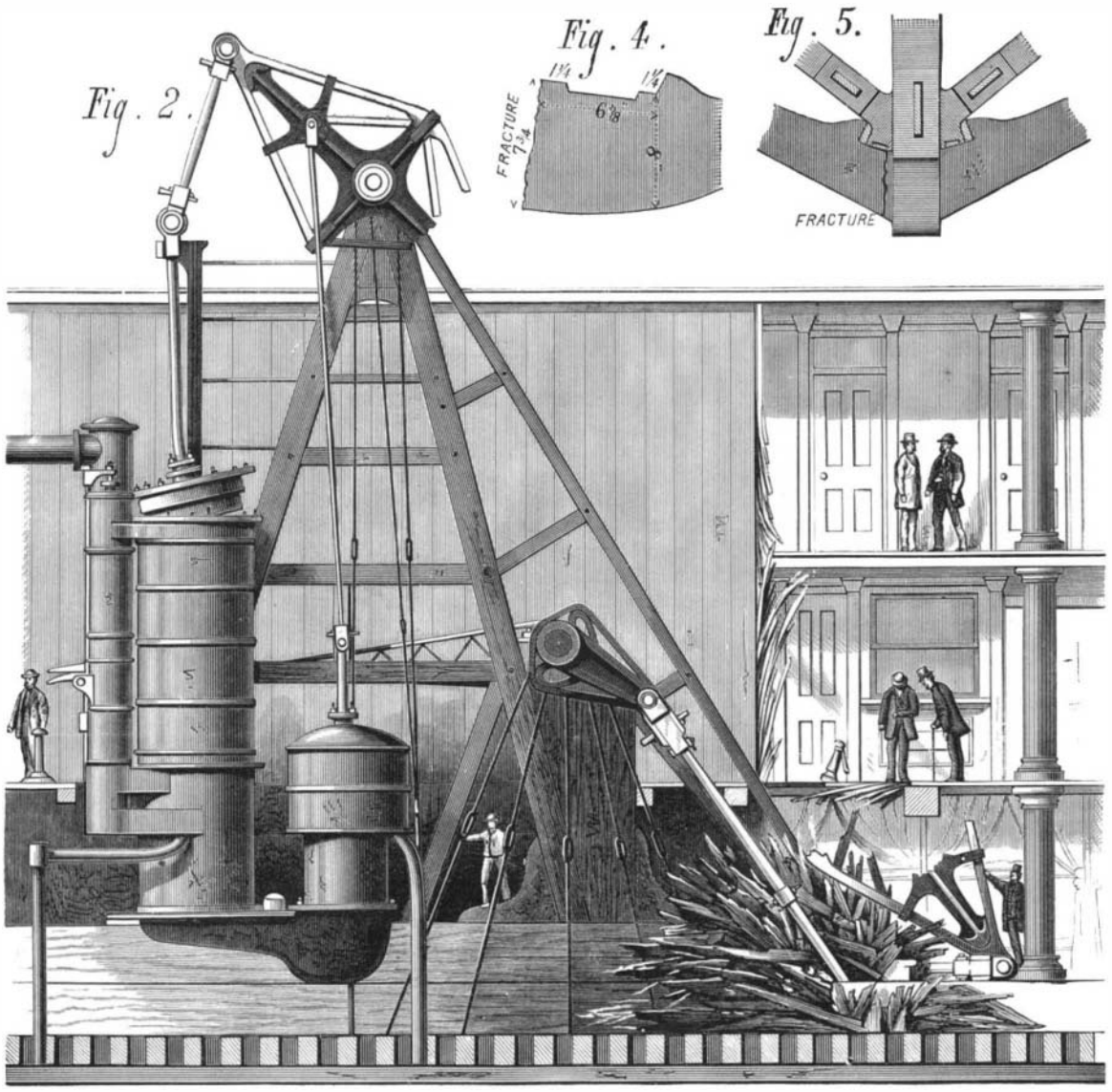
The accident occurred between Point Judith and Gull

Light, or about two hours' run from Newport, to which place the Old Colony was being steered. The weather at the time was fine, the sea smooth, and the engine working remarkably well. The steam pressure was 27 pounds, cut-off at a little more than half stroke, and the engine making 16½ revolutions per minute. Without warning the lower strap of the beam broke near and aft the center strap, when the piston was taking steam for an upward stroke. The position of the engine after the accident is indicated by Fig. 2. The breakage of the strap was immediately followed by that of the cast iron skeleton frame and upper strap. The aftward half of the beam fell, carrying with it the connecting rod, which in its fall struck a wooden transverse beam, and broke off at a short distance from the forked end.

The detached half of the working beam with the forked end of the connecting rod fell directly on the center keelson, and fetched up against the mast, as represented in Fig. 2. Of course the fall of the beam with the heavy piece of connecting rod was somewhat broken by striking the partition, cabin stairs, and the transverse wooden beam, which were all shattered to pieces. The keelson and frames are strong, but had the beam fallen at either side of the keelson there might have been still more serious damage. The motion of the vessel caused the crank to make four or five revolutions after the beam broke, and the greater length of the connecting rod being attached to the crank pin, the broken end of the rod moved backwards and forwards on the top of the center keelson. The piston struck the cylinder head, forcing it off the cylinder flanges and causing other damage. The engine, like all others in the N. Y. & Fall River steamboats owned by the Old Colony Steamboat Company, is provided with an automatic arrangement that shuts off the steam instantaneously if the piston either in its ascent or descent should through any cause exceed the regular stroke. As the clearance between the piston and the cylinder head was about ⅜ or ½ inch in the Old Colony's engine, the advantage of this automatic mechanism was realized, for the steam valve closed just as soon as the piston exceeded the stroke, and prevented steam entering the saloons. Singular was it that no person was hurt or scalded, and still more remarkable that one of the oilers who was oiling the crosshead guides at the time of the break escaped unhurt. Fig. 3, p. 322, represents the flaw and break in the wrought iron strap as it appears when viewed endways, or as a transverse section. The flaw at the time of observation was black and smooth. Looking at it through a magnifying glass, very small bright spots were seen, indicating crystallization and attrition. The portion of the strap that broke at the time of the accident, and which is indicated in the lower part of Fig. 3, shows crystallization. The broken wrought iron connecting rod also exhibits crystallization. The breaks are short and indicate brittleness rather than fibrous toughness. Fig. 4 represents a side view of the wrought iron strap at the point of fracture, and Fig. 5 shows the strap with its connections. The figures indicate the exact dimensions of the flaw and iron.

The question naturally arises: Was this a flaw in the forging that was always there? or was it a flaw that had gradually increased in size as the iron gradually increased in crystallization? About this there are different opinions. Our own opinion coincides with that of the master mechanic of the company's extensive repair works at Newport. He says: "My theory regarding the breaking of the beam is, that the strap was fractured slightly while being forged, and that it gradually increased as the fibers of the iron became crystallized. Concussions, strains, friction, etc., will undoubtedly produce crystals in iron. After a critical examination of the working beam of the Old Colony, and a microscopic inspection of the fracture, I am convinced that it was absolutely impossible to have foreseen, by the closest scrutiny or observation, the fracture or defect in the wrought strap of the beam before the iron separated, which I believe in this case was instantaneous."

PÉLIGOT has found in the skin of silk worms a substance, tunicin, which has the composition and properties of cellulose.



MACHINERY OF THE OLD COLONY—AFTER THE ACCIDENT.

WHAT ARE THE CAUSES THAT AFFECT THE TASTE OF DRINKING WATERS?

An examination of the annual reports of the water boards of most of our larger cities, extending back over a period of some years, reveals the fact that water stored in reservoirs, both natural and artificial—no matter from whence the source of supply—is subject to an occasional phenomenal occurrence that manifests itself in the sudden appearance of an exceedingly unpalatable taste, accompanied quite often with a peculiar odor. The cause of this taste, which has everywhere been likened to that of cucumbers, has been for many years a prominent subject of inquiry among scientists; and, although some advances have been made towards a solution of the mystery, the ultimate "wherefore" remains nearly as deeply hidden as ever.

It is very clear that a complete and satisfactory answer as to the cause of the evil cannot be founded on chemical analysis alone. We can ascertain by this means the amount of inorganic matter very accurately; but it is rarely that the presence of these, in water, do any further harm than that of causing an unnecessary waste of soap—a matter of household economy not connected with our present inquiry. As to the organic constituents, to which we must look, as a source of anything that may render water disagreeable to the taste or smell, or deleterious to the health, chemistry can aid us but little. The best the chemist can do in the premises is to tell us (and that only approximately) the quantity of organic matter in a certain measure of the fluid; and, by a still further refinement of his analysis, the presence or absence of nitrogen, thus allowing us to judge of its animal or vegetable origin. Beyond this he cannot specify its nature, condition, or source.

Neither can any help be expected from the zoölogist toward a solution of the question. Careful and accurate examinations of the affected waters, both by the naked eye and the microscope, made by specialists in this department of natural history, have failed to show in them any more than a normal quantity of animal life, and this not of a character nor in a condition to produce any effect whatever.

It is the botanist then, probably, to whom we shall have to look mainly for an elucidation of the matter, although it must be confessed that the results that we have received from this quarter so far are eminently unsatisfactory and inconclusive. The evil that we speak of is not confined to any one region or district, but extends pretty widely over the Eastern and Middle (and perhaps other) States. We have precisely the same reports from New York, Brooklyn, Albany, Troy, Poughkeepsie, Hartford, New Haven, Boston, Charlestown, Burlington, Lynn, and many other cities. Many of these cities have wisely taken measures to investigate the trouble, and in doing so have called to their aid the services of well known and able scientists. Let us examine the opinions of the latter.

When the Croton supply of the city of New York became offensive in 1859, Dr. John Torrey (who, with Dr. James R. Chilton, was commissioned to examine it) reported that, in his opinion, the peculiar condition of the water "was owing to a rapid and abundant growth of a microscopic, conferva-like plant, which abounds in a volatile, odorous principle soluble to some extent in water." He referred this plant to the genus *Nostoc*. He thought it probable, moreover, that it occurred more or less every summer, but only occasionally by excessive growth communicated an offensive odor and taste to water, and was thus brought into popular notice.

In Poughkeepsie, in 1875, during a like contamination of the water, Mr. C. Van Brunt, after a careful examination, ascribed the peculiar taste, not to the growing confervæ in the reservoir, but to the disintegrated plants diffused through the water, and undergoing decomposition in the service mains, especially near the hydrants, where the taste was observed to be most marked and unpleasant.

In 1871, Hartford suffering from the same evil, a committee, aided by Professor C. T. Jackson, made an investigation. Starting with the theory of an organic growth on the inner surface of the pipes, they ascribed the offensive taste of the water to the breaking up of the organisms and their subsequent decay in the "dead ends" of the service pipes.

On one of the occasions (1865) of an impurity of Rensselaer Lake, from whence Albany derives its supply, the board of health invited Professor Philip Ten Eyck, Drs. Hun, Vanderpoel, Mosher, and Boulware to carefully examine the lake and reservoir. Their report stated that they attributed the evil to vegetable matter, brought into the lake by the streams upon which it depends for its supply.

Finally, not to multiply cases, Boston having several times suffered from the same evil, occasion was taken on a recurrence of the trouble in 1875 to make a thorough investigation. At this time only one of the two storage basins was affected by the unpleasant cucumber taste. Dr. Farlow, on request, made a botanical examination of both basins. This gentleman stated in his report that the plants found in both basins were practically the same; and in neither one of them was there found any peculiar vegetable organism that might not be expected in any fresh water pond of that region. After a thorough examination, both of the living plants and those in a state of decay, he gave it as his opinion "that the cucumber taste is not caused by the presence of any living plant, nor by any plant undergoing any form of decomposition, which can be detected by the microscope," and "that there is no probability of obtaining any definite results from the botanical side of the question, unless many months, or even years, be devoted to the subject."

A great number of theories have been advanced in regard to the origin of these impurities, but unfortunately they have emanated from those who know little or nothing about the subject experimentally or otherwise, and are consequently of little importance. The few examples given may be said to comprise about all of the opinions of the different gentlemen who have investigated the subject in the interest of science, and whose names are a sufficient guarantee that their statements are worthy of consideration. How far these opinions are consistent with facts will be examined further on. The following data, gathered from the reports of various water boards, show all that is positively known on the subject up to the present time; and, while they may add nothing more than that already given towards a solution of the problem, they at least narrow the question down to limits within which future investigations may perhaps meet with success. We learn, then, that:

1. The appearance of these impurities is confined to no particular season. They have occurred in spring, summer, and autumn, and occasionally lasted through a whole winter. 2. As to duration, they have appeared suddenly, lasted a few days only, and then as suddenly disappeared; at other times they have continued a few months. 3. They have affected water supplies procured both by gravitation and pumping. They have appeared in reservoirs (both natural and artificial) fed by rivers and creeks, and by lakes, sometimes small and shallow and sometimes large and of great depth. In 1854, when the water in Cochituate Lake, Boston, became bad, *several wells* near the lake and in other places were similarly affected, as were the waters (usually remarkably pure) of