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The editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE MERCHANTS' ASSOCIATION AND THE JEROME PARK RESERVOIR.

The Merchants' Association of this city abundantly justified its existence and earned the everlasting gratitude of the municipality when it ran to earth and effectually killed that most colossal fraud of the last Tammany administration known as the "Ramapo steal." The Association is doing disinterested and noble work in standing guard over the city's interests and maintaining a careful watch for the incipient evidences of actual fraud or culpable negligence in the administration of municipal affairs. The need for such an association is pressing; its members are leading citizens of unquestioned integrity, and no one doubts for a moment the high character of its aims and the singleness of purpose with which they are followed. Although the Association has at times been misled, as it has to a certain extent in its attitude in the present Jerome Park reservoir controversy, the mistakes have been due to the fact that the subject of them was, as in the present case, a highly technical matter, in which the Commission was entirely dependent upon more or less interested technical advisers for its actual or supposed facts. The present attempt of the Association to bring about the impeachment of the Aqueduct Commissioners is not, however, altogether unjustified by the circumstances; for we defy anyone to prove that the interminable delay that has taken place in the construction of Jerome Park reservoir would have been possible, had the Aqueduct Commissioners under the former and present administration shown the proper amount of active interest in their duties. Had they taken the trouble to acquaint themselves fully with the condition of the work, and had they brought all possible pressure to bear upon Mr. McDonald, the contractor, there is not a doubt that the Jerome Park reservoir would have been now approaching completion and not, as it is, some three years behind contract time.

The attitude of the Merchants' Association toward the whole question of the Jerome Park reservoir is at once both right and wrong. We are heartily in sympathy with it in its endeavor to prove that there has been culpable *misfeasance;* at the same time we just as heartily disagree with it in its charge that there has been willful *malfeasance*. The Commission's sins are those of omission, not of commission, and in this respect it is to be placed in the same category with various other superfluous and practically useless commissions, such as that of the East River Bridge, which have encumbered the prosecution of great public works in this city. On the other hand, for proof that a commission, if it will but energetically discharge its duties, can be of enormous value to the city, witness the zeal of the Rapid Transit Commission, whose great work would have been consummated but for labor troubles in the closing days of the present year, or several months before the contract date. The Jerome Park reservoir contract, which was let over eight years ago, was to have been completed last November. At a recent public hearing, the contractor promised that one-half of the reservoir should be ready for water by the opening of the year, a promise that is simply preposterous in view of the present backward state of the work. After a personal visit to the reservoir we do not hesitate to say that the city may be thankful if the western half is finished within twelve months, and that it will be lucky if it gets the whole reservoir in working order within two years from the present writing.

Regarding the complaint of the Merchants' Association that unnecessary changes have been made in the plans of the work, to say nothing of the insinuations of incompetence or worse against the present Chief Engineer with which the complaint of the Association is so liberally seasoned, we have this to say: that, after a careful comparison of the old and new plans, and of the physical conditions existing both at Croton Dam and Jerome Park, there is not only no ground whatever for these charges, but the changes as now being carried out are in every case based on sound engineering considerations, and are due to failure on the part of the engineers who drew up the first plans to fully appreciate the difficult nature of the sites upon which the reservoirs are built, and the conviction of the present Chief Engineer, that in constructing works of this magnitude and importance it is imperative that the work should be in acordance with the very latest engineering practice, and that the dam itself as completed; should be absolutely free from any possible cause of weakness or subsequent failure. As the work developed, it was found that if the original plans were followed, the core walls would have to be built upon a loose material which, under the hydraulic head of the impounded water, would run like so much quicksand. These core walls were immediately condemned, and in place of them solid masonry walls bedded everywhere upon good rock foundations were inserted. In the eyes of any unprejudiced engineer the change is so obviously necessary that the question of its utility does not admit of a moment's discussion. The other structural question, as to the advisability of substituting eight inches for three inches of concrete flooring over the whole of the reservoir, is also a purely technical one. If the whole floor of the excavated reservoir were formed of homogeneous material, a three-inch concrete finish would be sufficient; but where, as is now the case, the floor varies from solid or impervious rock to fissured and broken rock and filled or swampy ground, the proposal to put a thin three-inch concrete veneer over a floor of such a heterogeneous bearing quality, is doubtful on the face of it. To our thinking, the question is not whether eight inches is too much, but rather whether twice eight inches would be sufficient to provide an adequate and unbreakable floor over so variable a foundation.

There is no field of engineering that develops in the course of the execution of a great work so many unexpected obstacles and new conditions as that of the civil engineer, and there is no branch of civil engineering of which this is so emphatically true as that which is concerned with such works as the Croton dam and the Jerome Park reservoir. Plans for works of this character are always somewhat tentative and flexible, and when an engineer finds that in the development of the work, radical and far-reaching changes, involving heavy expenditure and a seeming, but not actual, reflection upon the judgment of his predecessor, are necessary, it is his bounden duty to make these changes. Such a course demands no little professional courage; for the engineer is well aware that his action, as in the present case, is liable to expose him to a great deal of ill-considered, extremely harassing and altogether unjust criticism.

The radical changes that have been made both in the Croton dam and in the Jerome Park reservoir are as necessary and commendable as the exasperating delay in executing these great works is inexcusable and deserving of the most searching criticism and judicial investigation that the Merchants' Association can bring to bear upon it.

CHICAGO DRAINAGE CANAL AND THE CITY OF ST. LOUIS.

The city of St. Louis is seeking to obtain a Federal injunction to prevent the city of Chicago from discharging its sewage by the way of the Chicago drainage canal into the Mississippi River, claiming that this diversion of the sewage is polluting the Mississippi, from which source the city of St. Louis obtains its water supply. It is pretty generally known (and if it is not it should be) that the great Chicago drainage canal was cut through at a cost of $36,000,000 from Lake Michigan to the Illinois River for the purpose of carrying the sewage of Chicago into that river and securing its ultimate discharge into the Mississippi. Previous to the opening of the canal, the sewage of this great city of two million souls had been discharged into Lake Michigan, from which the city draws its water supply.

We have to go back nearly half a century to find the inception of this splendid work, when the project was mooted by E. S. Chesebrough, one of the best-equipped and most far-seeing sanitary engineers of his day; and in the interval it has been indorsed by such men as Prof. John H. Long, Rudolph Hering, George E. Waring, and other qualified authorities. The boldness and originality of the undertaking, its magnitude, and the extremely ingenious methods of excavation adopted in constructing the canal, attracted the attention of the whole civilized world, and the success of the scheme since its inauguration has been such that the Chicago drainage canal stands to-day as one of the most successful of the great engineering works of this or any other age. The proceedings in the suit of the State of Missouri and the city of St. Louis against the canal led to the carrying out by a commission of the Department of Health of Chicago of a very exhaustive examination of the flowing waters between Lake Michigan at Chicago and the Mississippi River at St. Louis, with a view to determining their condition and quality before the opening of the drainage canal, as compared with their condition and quality after dilution with the waters flowing into them by way of the drainage canal. To insure that the facts of the investigation should be ascertained and presented truthfully and impartially, it was originally proposed that the examination should be made by three scientific institutions of high reputation, namely, the Washington University, St. Louis, Mo.; the University of Chicago, Ill.; and the Illinois State University, Ill.; triplicate samples of the waters being collected at the various points selected, and one set sent to each institution for examination. Subsequently it was proposed that for the greater satisfaction of St. Louis, the examination for that city be made in the laboratory of the St. Louis Water Commission. The two Illinois institutions signified their readiness to undertake the work; but as no response was made by the Mayor of St. Louis to the suggestion as affecting his city, the laboratory of the Sanitary District of Chicago filled the vacant place, and the examination was conducted on the triple lines as suggested above. Under the plan that was followed, every week samples of the water of the Illinois and Mississippi Rivers were collected from forty different stations commencing at Bridgeport, Illinois and Michigan Canal; and including La Salle, Illinois River; Peoria, Illinois River; Grafton, Mississippi River; and several points at St. Louis below the Missouri and below the city itself, the last sample being taken from the St. Louis city water supply.

The results of the investigation as gathered and presented in the report of Dr. S. Reynolds, Commissioner of Health, Chicago, clearly proved that running streams, if adequately diluted, do purify themselves from sewage pollution. This is proved by the complete disappearance of any trace of Chicago sewage in the Illinois River long before it reaches Averyville, and in the better quality of the Illinois River water as it merges into the Mississippi at Grafton than that of the Mississippi itself. It must be admitted that after reading carefully the report before us, the bugaboo of Chicago sewage injuriously affecting the drinking water at St. Louis is completely and effectually disposed of by the work of the investigators, The report of the Laboratory of the City of Chicago was made by Prof. Gehrmann; that of the University of Chicago by Prof. Jordan; while Prof. Palmer reported for the University of Illinois. That the turning of the waters of Lake Michigan, even with the sewage of Chicago contained in them, into the Illinois and Mississippi Rivers has improved the quality of these waters is demonstrated indirectly by the fact that the State Fish Commissioner reports an enormous increase in the fish harvest. Fish that have been driven away from ever-increasing reaches of the river, year by year, by the undiluted sewage of the Illinois and Michigan Canal, and of the larger towns below Chicago, are returning to the purified waters, and the denizens along the banks of the Illinois, who were hitherto hostile to the canal, are now clamoring for the fullest flow of the channel in the interests of improved navigation. The majority of sanitary authorities are agreed that water under certain conditions is capable of self-purification; and in view of the fact that the present investigation has been conducted on a scale of larger magnitude than any similar inquiry that has preceded it, the results obtained may be considered conclusive; that is to say, it is now clearly proved that running water which is not too heavily charged with organic pollution will purify itself through the natural biochemical processes, of which bacterial action and insolation are the most important. Such is Dr. Reynolds' conclusion in his report, and he points out pertinently that "it must be conceded that unless this self-purification were true, there would be no such thing as pure water in streams affected by human habitancy." Among the many facts brought out in the investigation that prove the existence of a process of self-purification in running water, it may be mentioned in closing that a study of the death rate among the colon bacteria added to the river water in sewage combats the idea that typhoid bacteria will survive passage down the river; for it was found that the colon bacteria, which are present in large numbers in Chicago sewage—undoubtedly in much larger numbers than the typhoid bacilli—disappear almost completely in less than 150 miles flow. It is urged by Prof. Jordan that since all investigators are agreed that the colon bacillus is more hardy than the typhoid bacillus and can live in water for a longer time, there is every reason for supposing that the latter microbe dies out with at least the same rapidity

THE OLDEST MAP OF ROME.

There is preserved in Rome an interesting document, which is the oldest plan of the ancient city of Rome in existence. The Forma Urbis, as it is called, was cut upon 140 pieces of marble of various sizes, and

covers a superficial area of 266 square meters. It was made during the reign of Septimius Severus, between 203 and 211 A. D., and was attached to a wall of the Templum Sacræ Urbis, the present church of SS. Cosma e Damiano. The most curious feature of this map is that some sections or divisions of the city are represented upon a much larger scale than the other parts. This is notably the case respecting the Palatine and Roman Forum. The reason for this distinction antiquarians and archæologists have failed to adduce. and the peculiarity rendered it a difficult matter to piece the fragments of the map together correctly. It is also evident that the relic is the product of several different hands, since some portions are very skillfully and diligently prepared, while others are very negligently made. The map was also permitted to fall into disrepair, and fell to pieces in the course of time. The first fragments were found in 1562 and roughly placed together by Antonio Cosio, but the work of building up the map has been diligently continued ever since, until now 1,049 pieces have been found and joined together. That the map was originally of a tremendous size is testified by the fact that according to Prof. Lanciani, the present portion of the plan is but a fifteenth of the whole. This Forma Urbis is of immense value to archæologists, since by its aid several parts of ancient Rome, hitherto unknown, have been found.

A MUD-PUDDLE COMMUNE; OR, THE BEGINNINGS OF MIND.

The varied and multitudinous forms of life which are to be found in a road-side mud-puddle are as wonderful as they are diversified and numerous. Although I have chosen to entitle this paper "A Mud-Puddle Commune," it must be confessed that these organisms hold nothing in common save the water in which they dwell. For theirs is not the peaceful and quiet existence of the ideal commune; many a terrible tragedy of violence and murder, aye! of infanticide, filicide, fratricide, patricide, and insensate cannibalism takes place beneath the calm surfaces of these turbid pools during each second of time.

Several years ago in my work on mental traits in the lower animals ("The Dawn of Reason," The Macmillan Company, 1899) I advanced and demonstrated (so I believe) the proposition that notwithstanding the fact that the nerve-*cell* is not differentiated in these primal forms, nerve-elements are, nevertheless, present in these, and serve to direct and control life. In a letter to me the late Dr. Elliott Coues wrote as follows: "It seems to me that you express a *great fact* when you speak of neuroplasmic as well as nerve action proper; for otherwise we cannot account for the amount of nerve an amœba certainly possesses."

Mind acts in two ways—consciously and unconsciously; and the conscious mind is, unquestionably, the offspring, the true and logical descendant of the unconscious mind. Consciousness is the result of sensual perception, and there can be no question but that the unconscious, vegetative mind was in existence long before the first sense was evolved. Yet these lowly creatures, whose life cycles are almost purely vegetative in character, every now and then give evidences of sense perception (although no sense-organ can be made out) which fact clearly leads up to the conclusion that the nerve-plasma itself must necessarily contain the elements of consciousness to a certain extent.

In all probability, the lowest forms of animal life are to be found in the sub-kingdom, Protozoa, and every mud-puddle is rich in protozoan specimens.

Under a lens of high magnification a protozoan appears as a little mass of animal matter or protoplasm, cell-like in shape when it is quiescent. Suddenly, while it is under observation, a small, teat-like protuberance will make its appearance on its surface. This protuberance will prolong itself into a narrow arm or foot (*pseudopod*) along the surface of the glass slide. The body-substance of this queer creature can then be seen flowing toward the distal end of the out-reaching arm or foot, until finally, all of the protoplasm has gone into it, and the protozoan has progressed just the length of this pseudopod.

In its wanderings over the stems of grasses and stalks of algae in the waters of its turbid home, every now and then it will find a starch-cell which has escaped from some over-ripe spore, and it immediately begins to avail itself of its welcome "find." It drags itself close to the starch-grain; a little pouch infolds on its surface; this pouch rapidly surrounds the starch, until the latter soon finds itself on the inside of the hungry animalcule; there is a charming movement of the protoplasm of the protozoan and the starch-grain is soon disintegrated and its nourishing elements absorbed. And its indigestible portions—what becomes of them? The little animal simply reverses the *infolding* process, and puts itself *outside* of all the substances it can not digest.

If microscopic crystals of uric acid be placed upon a slide which has an amœba on it, the protozoan will pass them by; or, if it does ingest a crystal, it will immediately proceed to get rid of it. On the contrary, if grains of sand be sprinkled on the slide, the amœba will take them in and will retain them some time before eliminating them. Each grain of sand, in all probability, has upon its surface colonies of microbia, too small to be made out by the microscope, yet large enough for the amœba to recognize them as a source of sustenance. The crystals of uric acid contain no microbia, hence the amœba readily recognizes the fact that they are not good for food. Again, if starch grains, sand, and uric acid crystals be placed upon the slide, the protozoan will show conscious choice by giving the starch grains preference.

On one occasion while examining a bit of alga there suddenly appeared in the field a colony of delicate, tulip-like, or bell-like organisms which appeared to grow upon stalks. I moved the slide slightly when, immediately, every creature disappeared as if by magic. In a few moments, however, these queer "jumping jacks" again popped into view and I then recognized them; they were *vorticellæ*, "bell animalcules," belonging to *Infusoria*. When I moved the slide, currents were set up in the water which spelt danger to the *vorticellæ* and they, therefore, coiled themselves on their stalks and sank down upon the bit of alga, feigning death! I discovered, after experimenting, that they soon became accustomed to the sudden currents in the water of this miniature sea made by moving the slide, and that such cause would no longer occasion them to "play 'possum."

Still more wonderful is the action of the rotifer, *Brachionus urceolaris*, in the presence of the giant water-beetle, *Dyticus marginalis*. This little animal recognizes its enemy, through some unknown sense, stops the movement of every cilia, and sinks as though smitten by sudden death! Some of the nematoids or threadworms will also feign death when they encounter *Dyticus*, and will hang motionless in the water like bits of thread or bleached and dead algæ. The water louse, familiar to everyone, gives evidence that it possesses, comparatively speaking, a high degree of mental development. On one occasion, while observing the action of one of these active little beings, I saw it approach a ruptured starch cell, seize a grain of starch, and then hide behind a bit of mud until it had devoured its delicate morsel. It then came back to the ruptured cell, procured another grain and again retired to its hiding place. This it did several times, thereby evincing memory, conscious choice, and conscious determination.

JAMES WEIR, JR., M.D.

HIGHEST WIND RECORD.

Point Reyes, an important United States weather bureau and storm signal station, located on the California coast some 35 miles north of San Francisco, holds the world's record for high, strong, continuous winds.

Last year Point Reyes captured this honor from the weather stations of the earth, and again this month (May) has gone several notches higher on the meteorological scale.

On May 18, 1902, the wind at Point Reyes attained a velocity of 102 miles an hour, and, for several minutes was rushing along at the furious rate of 120 miles per hour.

A fearful gale lasted for three whole days, and at one time the winds in a playful mood ripped the cups from the anemometer. The number of miles recorded during the 72 consecutive hours, was 4,701, which would be equivalent to nearly one fifth the distance around the earth in three days.

This year on May 14 the winds commenced to blow again with the greatest violence. For four days the velocity registered averaged more than 60 miles an hour. For nine days the average velocity was 52 miles an hour. The total number of miles recorded on the anemometer was 11,223 miles.

This is the highest velocity of wind for the time on record in the world.

These automatically marked records will be photographed by Prof. McAdie, who is in charge of the main weather bureau office in San Francisco, and sent to Washington.

FAILURE OF THE MONOLITH LATHE.

Further details of the failure of the great monolith lathe are now available. It will be remembered that the Cathedral of St. John in New York is to have thirty-two granite columns in the choir each 54 feet high and 6 feet in diameter, their weight being 160 tons each. It was intended that these columns should be monoliths, but it was found impossible to turn such huge blanks even in the great lathe which was built to receive them. In the SCIENTIFIC AMERICAN for January 12, 1901, we illustrated the lathe and the turning of one of the columns. The blanks weighed 310 tons, and they were placed on the lathe, whose bed is 86 feet long, which weighs 135 tons and swings 6 feet 6 inches. Eight tools were used, each taking a 3-inch cut. The turning operation proceeded smoothly, the lathe was operated day and night and the column lacked only a few hours of completion, when late one night it broke in two, entailing the loss of a year's time, to say nothing of the valuable piece of stone. The second monolith never reached the polishing stage, for it gave way while being rounded into shape. It is perhaps not fair to say that the lathe failed, although the result was the same. The accident should undoubtedly be attributed to the great torsion which deformed the block beyond the modulus of elasticity. The third attempt was also a failure, and the company deemed it inexpedient to risk any more columns of the monolithic type, so they are now being made in two sections. They will be towed to New York from Vinalhaven, Maine, on a barge, four sections at a time, and will be landed at the foot of West 32d Street, and they will then be rolled to the cathedral. Had it been possible to produce the monoliths, they would only have been exceeded in size by those of St. Isaac's Cathedral, in St. Petersburg.

SCIENCE NOTES.

The municipal authorities of London and other large provincial cities in England are experiencing a peculiar difficulty in connection with the wood paving of the thoroughfares. The wood blocks after they have been laid down are susceptible to a species of fungus which attacks the wood vigorously and rapidly deteriorates it. The authorities are strenuously endeavoring to check this malignant fungus, since the damage wrought by it amounts to several thousand dollars annually, but the only reliable means of checking it, however, is to closely examine the wood blocks before they are laid down. Should a contaminated block be put down the fungus will immediately spread to the surrounding paving, with the result that the whole is soon destroyed.

An expedition has been sent out under Dr. George Shattuck, for a scientific survey of the Bahama Islands. In the party are members of the faculty of Johns Hopkins University and officials of the United States Museum, including Bashford Bean, chief of staff for marine zoology, and J. H. Riley, chief for land zoology; also Dr. Oliver F. Fossig, of the Weather Bureau. Bernard N. Baker has given the party a glass-bottomed boat through which to study life in tropical waters. Dr. Fossig will use several huge kites with registering apparatus to study the trade winds and magnetic conditions. The windlass about which the wire rope to govern these kites will be wound weighs 500 pounds. T. H. Coffin, of Johns Hopkins, will make a special study of the mosquitoes, particularly as to their capacity for carrying disease germs.

In a recent lecture M. Charles Rolland inquires if it be true that human beings expend, in general, far less energy of motion than do the other animals, and he answers the question in the affirmative. To demonstrate the assertion rigorously it would be necessary to perform exact mensurations not yet accomplished, to measure the mechanical energy corresponding to equal nutritive action, both in men and in animals. But if we consider the production of motions in the animal and in the human kingdom it is easy to see that men are inferior, especially in respect of locomotion. The inferiority begins at birth, since it is necessary to teach painfully our children to walk, And it continues throughout our lives, during which we are subject to a thousand affections of the motor apparatus, and on the threshold of old age to senile impotence. This latter is invariable for men but the rarest thing in animals. The variety of animal locomotion is remarkable. Animals fly, swim, crawl, jump, etc., all without the painful apprenticeship of men; and the force they expend, relative to the weight of their bodies, is immensely greater than is the case with us. The beetle is a hundred times as strong as a horse, weight for weight, and the horse is stronger than a man. If men were, relatively, as strong as beetles they could juggle with weights of several tons. These and other like facts lead to the obvious conclusion that the motor functions occupy in the totality of physiological activities a far less important place with men than they do with animals. As an organism rises in the scale and as its nervous system increases in complexity the nervous energies have less and less power to express themselves in exterior reactions, in motor reactions for example. There is, in this point of view, the same difference between men and animals that is found between men of thought and peasants. The former are quiet, but expend their forces in intellectual effort: the latter spend their energies in movements which are for the most part automatic. Animals move less the more they think and the more they comprehend. As Anatole France says in "Clopinet": "I have always sought to comprehend and in the effort I have wasted precious energies. I discover too late that not-to-comprehend is a great power. If Napoleon had been as intelligent as Spinoza he would have written four quarto volumes in a garret"—and that would have been the end.