### Practice and Theory.

In a lecture on the "Reflective Powers," James Freeman Clarke makes the following pertinent remarks: "There is an objection often urged against these higher reflective faculties in their exercise for common objects—that they give theoretical rules which are not practical. Thus, if one not actually engaged in teaching suggests any new view intended to improve the processes of education, he is apt to be told that this is not 'practical.' It is sometimes even assumed that theory and practice are opposed to each other. We often hear it asserted that a notion may be 'true in theory but false in practice'; that is, useless for practical purposes. I, for one, esteem practice. I trace all real knowledge to experience. I care for no theories, no systems, no generalizations, which do not spring from life and return to it again. I feel, perhaps, undue contempt for the vague abstractions we often listen to, idle figments of an idle brain, speculations with no basis of sharp observation beneath them. Yet we are in danger of going too far in this direction, and of undervaluing theory in its proper limits. People often eulogize *practice* when they only mean *routine;* boasting themselves as practical teachers, intending thereby that they only do what always has been done, and do not mean to do any better to-morrow than they did yesterday. Practice and theory must go together. Theory, without practice to test it, to verify it, to correct it, is idle speculation! but practice without theory to animate it is mere mechanism. In every art and business, theory is the soul and practice the body. The soul without the body in which to dwell is indeed only a ghost, but the body without a soul is only a corpse. I sometimes pass a sign on which the artisan has painted, "John Smith (or whatever the name may be), Practical Plumber." I should not wish to employ him. When the water-works in my house get out of order, I want a theoretical plumber as well as one who is practical. I want a man who understands the theory of hydrostatic pressure; who knows the laws giving resisting qualities to lead, iron, zinc, and copper; who can so arrange and plan beforehand the order of pipes that he shall accomplish the result aimed at with the smallest amount of piping, the least exposure to frost, the least danger of leakage or breakage; and this a merely practical man, a man of routine, cannot do. The merest artist needs to theorize, *i. e., to think*—to think beforehand, to foresee; and that must be done by the aid of general principles, by the knowledge of laws."

### The St. Petersburg and Cronstadt Maritime Canal.

The Cronstadt Canal was opened on May 20 last, this being the second anniversary of the coronation of the Czar.

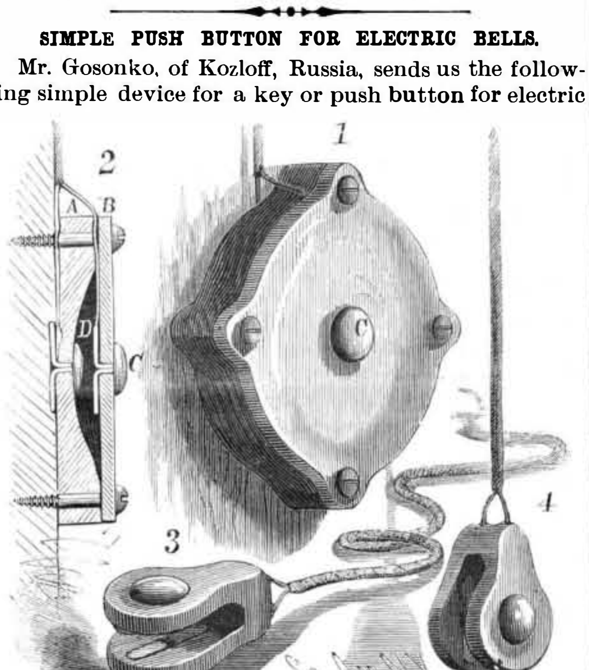
After a religious service, the Emperor and Empress went on board the magnificent yacht Dershava, anchored at the spot where the canal commences. At a quarter past twelve o'clock the Dershava proceeded to Cronstadt. Near Cronstadt the entire Baltic fleet was assembled, numbering 111 vessels and torpedo boats, when the forts of Cronstadt thundered forth a salute, and announced thus that the ceremony of opening the canal had been performed.

Although it was a leading idea in the mind of Peter the Great that St. Petersburg was to be a seaport, it has never been fully realized till the present day. Cronstadt has been the real port all this time. No vessel drawing over nine or ten feet of water could float over the bar of the mouth of the Neva and reach the capital; all vessels requiring a greater depth of water than this had to deliver their cargoes at Cronstadt. The goods were then put into barges, which were either poled or tugged up to St. Petersburg. All commercial operations were carried on at a great disadvantage under such a mode of operations. This will be best understood by stating that goods can at the present day be sent from London or Hull in about a week, but the transshipment of them at Cronstadt, with the short but slow passage to St. Petersburg, and the delivery there, usually occupied as much as three weeks, at times even more. This will now be all changed: sea going vessels of almost any size will now be able in the future to proceed direct to St. Petersburg by the new canal, at the end of which docks have also been constructed and connected with the railways. Cronstadt is to remain exclusively a port for the naval marine. It will henceforth be the Portsmouth of Russia.

In 1872 Count Bobrinski, then Minister of Ways and Communications, issued a report on the subject of the canal, and a commission was appointed under the presidency of the Engineer Kerbeds to study the question. This led to two projects being evolved. One was produced under the triple authorship of Cotard, Champoulion, and Janicky, and the other by a councillor named Poutiloff. This last was the one finally adopted in 1874, when it received the sanction of the Emperor. It was about three years later before the works were commenced. This was owing to the necessary machinery—such as dredgers, etc.—having to be made in Finland and England, and many of them were damaged and some were lost on their way to the Neva. The whole length of the canal is about seventeen miles. It starts from the island of Goutouieff, on the southern side of the Neva, where the river enters the Gulf of Finland, and it extends westward along the south side of the gulf, terminating at Cronstadt. The canal, after leaving the islands of Goutouieff and Wolnoy, and the low marshy ground known as the Isle des Cannoniers, passes all the rest of the way, which is nearly its whole length, through the waters of the gulf. On this account, instead of calling it a canal, the work might be described rather as the making of a channel through a shallow portion of the sea. At the eastern end a few miles of it had to be embanked, to prevent the deposit of sand and mud, which produces the bar at the mouth of the Neva. The longer portion on the west, which is not liable to this deposit, is simply a channel which has been dredged out, and its course will be indicated by means of buoys. A large dock has been formed on the island of Goutouieff, to which the railways have been connected. As the traffic increases, there is ample space on the islands for the construction of more docks. By the Neva, Schlusselburg on Lake Ladoga is reached, where the vast canal system of Russia begins. This system was another of Peter the Great's schemes in relation to his new capital, by which the city was to be connected with the great rivers of Russia, such as the Marinskaya, the Tichwinshaya, the Wishnevolodjskaya, and the Volga, the last being 2,500 miles in length; these form, with the canals, a communication between the Baltic and the Caspian. The steamers which are sailing at the present moment on the Caspian were built either in England, Sweden, or Finland, and were floated in pieces by the canal and river system from St. Petersburg to Astrakhan.

### SIMPLE PUSH BUTTON FOR ELECTRIC BELLS.

Mr. Gosonko, of Kozloff, Russia, sends us the following simple device for a key or push button for electric




GOSONKO'S PUSH BUTTON FOR ELECTRIC BELLS.

bells. A circular piece of wood, A, has formed in it a cavity, in which is placed an ordinary paper fastener, D, which is connected with one of the wires of a bell circuit. A diaphragm, B, of flexible rubber is placed across the face of the wooden disk, A, and has at its center a paper fastener, C, which is connected with the other circuit wire. By pressing the fastener, C, against the fastener, D, the electric circuit is established. In Figs. 3 and 4 is shown a modified form of the device to be attached to the end of the flexible conducting cord. This very simple and effective push button may be made by any one.

### A Queer Superstition.

Abram Reed, a farmer living in Beaver township, Pa., cut down a large oak tree on his farm, and in cutting it up he found, embedded in the trunk, seven or eight feet from the ground, a small glass bottle and what had the appearance of a lock of hair. The bottle had been inserted in a hole in the tree made by an auger, then a pine plug was driven into the hole over the bottle, the hair also being held in the hole by the plug. The bottle was corked, and contained a colorless liquid. Over the plug had grown six solid rings of wood, besides a thick bark. There was a superstition among the early settlers, and it is held by many of their descendants, that asthma and other affections could be cured by the victim standing against the tree and having a lock of his hair plugged in it while the hair was still attached to his head. It must then be cut off close to his head, and the afflicted person walk away without looking at it or ever passing by the tree again. While the use of a bottle was not included in this treatment, it is believed that the one with the hair discovered in the heart of the oak tree was put there in the early days of the settlement by some believer in the superstition to cure an ailment of some kind.—*Lumber World.*

### The Different Processes of Preserving Timber.

The American Society of Civil Engineers publishes a summary of the report of its committee on this subject, which is to be one of the topics discussed at the next annual convention of that body. The report classifies three principal methods of working, viz.: 1. Steeping. 2. Vital suction or hydraulic pressure. 3. Treatment in close vessels by steaming, vacuum, pressure, etc.

The experience in the United States is given in five tables, comprising the results, more or less conclusive, of 142 authenticated trials or experiments. In each case these are referred to to give the reasons for success or failure, and the lesson taught. The five heads corresponding to the tables are:

1. Kyanizing, or use of corrosive sublimate.
2. Burnettizing, or use of chloride of zinc.
3. Creosoting, or use of creosote oil.
4. Boucherie, or use of sulphate of copper.
5. Miscellaneous, or use of various substances.

Of the first, *Kyanizing*, it is stated that an absorption of four or five pounds of corrosive sublimate per thousand feet, b. m., is considered sufficient, and it would now cost about $6.00 per 1,000 feet, b. m. It is not recommended except in situations where the air can circulate freely about the wood, as in bridges and trestles, but in very damp locations (as for ties when in wet soil and pavement) its success is doubtful. Its cost when first used led to cheating, which for a time brought discredit upon it.

*Burnettizing* the committee do not consider the best adapted to use where the timber is exposed to the washing action of water (as this removes the preservative); but, on account of its cheapness, it is probably to be preferred at the present time to any other process for the preservation of railroad ties. The Wellhouse, Thilmany, and other modifications of the process aim at making the chloride insoluble, but are yet on trial. This process has been largely and successfully introduced in Germany. Experience shows the life of soft wood ties to be doubled and trebled by its use. Its cost in this country is about $5.00 per thousand feet, b. m., or 20 to 25 cents per tie, and for the latter purpose the committee particularly recommend it.

The work must be well done; but some of the failures were from doing it *too* well, that is, from using solutions of too great strength, thus making the timber brittle. A solution of 2 per cent by weight of chloride of zinc in water is recommended.

*Creosoting*, or the injection of timber with hot creosote oil in a cylinder under pressure, is considered to be the very best process which has been fully tested, where *expense* is not considered. It is as yet the only one known which is sure to prevent the destructive attacks of the teredo or other marine animals, and to give absolute protection against decay in very wet situations. It is a somewhat expensive process, requiring for protection against the teredo from 10 to 20 pounds per cubic foot of timber, and costing from $12 to $20 per 1,000 feet, b. m. For resisting decay alone a cost of $10 to $14 is sufficient.

The *Boucherie* process, in which green timber is impregnated with sulphate of copper either by *vital suction, hydraulic pressure*, or a *vacuum*, when well done, using a solution of 1 pound of sulphate to 100 of water, has proved fairly successful.

Under the head of "miscellaneous," are classed 41 experiments with almost as many substances, sulphate and pyrolignite of iron, lime, resin, oil, tar, etc., but with as yet no commercial success. The general principles laid down are, to select the process with reference to the subsequent exposure. Use *open-grained, porous* timber, for that reason *in general* the cheaper woods. Extract the sap and water to make room for the material to be injected, natural seasoning, except for the Boucherie process, being very desirable. Steaming takes the place of seasoning. Use enough of the antiseptic to insure a good result, and then let the timber dry before using, as its durability will thus be increased. Do not hasten the work if it is to be well done. Protect ties or timber in the track as far as may be from water by drainage. Contract only with reliable parties of established reputation, under a skilled inspector, who must be in constant attendance when the magnitude of the order warrants.

There is at the close a discussion of the question, Will any preserving process pay? This is answered in the affirmative. The chairman of the committee gives a careful estimate in one of the appendices in an actual case in this country; another general estimate is given based on European experience, and three other separate appendices give different methods of examining the question of economy and comparing values. Other appendices (to the number of twenty in all) treat of the general question of destruction and conservation of forests, and give reports of the personal experience of a number of engineers, with methods pursued, apparatus used, etc.

THE use of electric lights on athletic grounds has been tested for a few weeks at Williamsburg, L. I., where the grounds of the Williamsburg Athletic Club are now lighted by electric lamps. By their light games were carried out in the evening.

### The Typhoid Epidemic at Plymouth, Pa.

In all the medical literature upon the subject of typhoid fever, the late epidemic will undoubtedly be considered unique. Seldom, if ever, in the history of any disease has the excreta of a single patient directly communicated its poison to so many people. Between 700 and 1,000 were inoculated almost simultaneously, during the time from March 26 to April 1, and this in a little mining town having less than 2,700 inhabitants. The population was in a ripe condition for the development of the typhoid genus, as they had been drinking river water contaminated with sewage. A new supply of water was received on March 26, from a presumably pure mountain stream. But, most unhappily, the excreta of a typhoid patient living near its banks had been thrown within a few feet of the water, and with the melting of the snow was carried into it. The stream, now released from ice, soon filled the nearly empty reservoir, but an eighth of a mile distant. The great outburst of fever occurred between April 12 and 18, the time of incubation of the typhoid germ being from 10 to 20 days, and during the weary weeks since then the town has been but one large hospital. As many as ten deaths have occurred in a day, and almost 300 families have been at one time dependent upon charity; $14,000 have already been distributed, but there is still destitution. The town, even now, is in a very unwholesome condition, but in spite of the terrible warning they have received, the local authorities are doing little or nothing for its improvement.

### How Thought Presents Itself among the Phenomena of Nature.*

Every phenomenon which a human being can perceive may be traced by scientific investigation to motions going on in the world around him. This is obvious to every scientific man in regard to such phenomena as those of color and sound, and these simpler cases were first adduced by the lecturer. He then pointed out that the statement is also true of all other material phenomena, and he specially dwelt on the phenomena investigated in the science of mechanics, showing that all the quantities treated of in that science, such as force and mass, prove, when the investigation is pushed far enough, to be expressible in terms of mere motion. He also showed that the prevalent conviction that motion cannot exist unless there is some "thing" to move will not stand examination. It proves to be a fallacious conviction traceable to the limited character of the experience of motions which we and our ancestry from the first dawn of organized thought on the earth have had within reach of our senses. This conviction accordingly has no authority with respect to molecular motions and to some others that have been brought to light by scientific study. He also showed that the "thing" which in common experience moves, proves in every case to be nothing else than these underlying molecular motions, the transference of which from place to place is the only kind of motion which common experience can reach, when unassisted by science.

The intermediate steps between the world external to our bodies and the brain which take place in our organs of sense and nerves can also be ascertained to be motions. And finally, a change consisting of motions takes place in the brain itself, whereupon we become conscious of thought, *i. e.*, a change occurs within the brain which would be appreciated as motions by a bystander who could search into our brains while we are thinking, and could witness what is going on there while all the time the change that we experience is thought. It must be borne in mind that our brain is a part of the external world to the bystander whom we have supposed to be observing what is going on in it. It thus appears that every phenomenon of the external world is reducible to motions and their modifications, while all that is within the mind is thought.

Now this motion to which all other material phenomena are reduced, this motion as it exists in nature, must be distinguished from man's conception of motion, which, after all, is one of his thoughts—a very complex one, no doubt, but not part of the external world. This particular conception in our minds is one remote effect of the motion as it exists outside us, and what we really know of that external cause is that it is a cause which does unfailingly produce this effect if the intermediate appliances of our senses and nerves are also present. Motion, the cause, must no doubt stand in absolutely rigorous relations to its effect, viz., our conception of motion; but it need not be like its effect, the presumption being quite the other way. The lecturer pointed out that, under these circumstances, the simplest, and so far the most probable, hypothesis that can be advanced is the monistic hypothesis that this unknown cause is itself thought; and he pointed out that it is no objection to this view that we are unconscious of all the thought here supposed, for this is only to say that it is external to that particular group of interlacing and organized thoughts which we call our own mind, just as the thoughts of the many millions of our fellow men and of all other animals are external to our little group.

The lecturer accordingly recommended the following hypothesis: (1) as consistent with everything we know, (2) as the simplest hypothesis, (3) as a hypothesis which dispels all the difficulties that encumber the dualistic supposition that there are two kinds of existence, viz., the hypothesis that if a bystander were armed with adequate appliances to ascertain what is going on in our brain while we are thinking, then what we should experience to be thought is itself the remote cause with several intermediate causes of that change within the observer's brain which determines his having that complex thought which he would call perceiving some of the motions in our brain—in short, that what he appreciates as motion we experience to be thought.

If this view be correct, it will follow that the thoughts of which we are conscious are but a small part of the thought going on even in our own brain, and which would be seen by a beholder as motions, the rest being unconscious cerebration, and as much outside our consciousness as are the thoughts of other people. We are led also to the conclusion that the thought, which is going on in the brains of all the animals that exist is but the "small dust of the balance" compared with what is going on throughout the rest of the mighty universe.

* Short Abstract of Royal Institution Friday evening discourse (February 6), by G. Johnstone Stoney, M.A., D.Sc., F.R.S.—*Nature.*

### Sir Astley Cooper a Horse Dealer.

In the life of Sir Astley Cooper it is said that he required his coachman to attend every market morning at Smithfield, and purchase all the lame young horses exposed for sale which he thought might possibly be convertible into carriage or saddle horses, should they recover from their defects. He was never to give more than seven pounds for each, but five pounds was the average price. In this manner thirty or forty horses were sometimes collected at Gaelisbridge, his farm. On a stated morning every week the blacksmith came up from the village, and the horses were in successive order caught, haltered, and brought to him for inspection. Having discovered the cause of their lameness, he proceeded to perform whatever seemed to him necessary for the cure. The improvement produced in a short time by good feeding and medical attendance, such as few horses before or since have enjoyed, appeared truly wonderful. Horses which were at first with difficulty driven to pasture, because of their halt, were now with as much difficulty restrained from running away. Even one fortnight at Gaelisbridge would frequently produce such an alteration in some of them that it required no unskillful eye in the former owner himself to recognize the animal which he had sold but a few weeks before. Fifty guineas were paid for one of these animals, which turned out a very good bargain, and Sir Astley's carriage was for years drawn by a pair of horses which together cost him only twelve pounds ten shillings.

We believe a similar business to that of Sir Astley Cooper is carried on by a class of horse dealers in New York and other large cities. Lame and otherwise worthless horses are bought for a few dollars and taken to the country, where the change to pasture diet, the needed rest, and the watchful and careful treatment of the owner frequently transform a worthless horse into a valuable animal.

### Mechanical and Steam Engineering.

Of all created beings, we of the human family are the only "tool making animal"—the only living beings who have the faculty of observing the effect and looking for the cause, or *vice versa.*

In the department of mechanics there is a large field for the exercise of our powers. The steam engine alone is a study for a lifetime.

Water will store up more energy, or force, with the application of heat, than any known substance, except hydrogen. We find that combustion in a furnace produces a perfect magazine of power. The heated gases pass off in a spiral or rotary motion through flues and tubes; by conduction delivering up their caloric to the water. A unit of heat, which raises one pound of water one degree Centigrade, will raise nine pounds of iron or thirty-three pounds of bismuth to the same degree. It is essential that every engineer should understand the fundamental principles, and the responsibilities of his profession, and should recognize the vigilance required to handle as much force and energy as is stored up in a steam boiler.

But with the requisite skill and intelligence there is nothing mysterious in the physical laws that govern water, heat, and combustion.

One cubic inch of water, with the requisite amount of heat, and at normal pressure, flashes into sixteen hundred cubic inches of steam, as would be the case in the bursting of a steam boiler. (An expansion about the same as that of gunpowder. Nitro-glycerine expands about ten thousand times its original volume.) Many engineers entertain the idea that as long as the requisite amount of water is maintained in the boiler there is no danger of an explosion; that the pressure will merely relieve itself by causing a rent in the boiler; not realizing that the bursting is one thing and the explosion is what follows, from the stored up energy, or heat in the water.

The water heater that surrounded the uptake, or smokestack, of the steamship Great Eastern on her trial trip is an instance of the destructive and fearful results of the stored up energy in water, with the application of heat. These boilers were constructed with very little knowledge of the laws of combustion.

There is a vast field for the constructive engineer in the study of the laws of combustion, the proportions of grate bar surface, combustion chamber, and of flues and tubes, with the smokestack, to obtain the best results with the different classes of fuel.

One of the most essential things for the constructive engineer is to look after the free circulation of the water in the boiler. The lack of the free return of the water to the heating surface of the boiler is one of the principal causes of foaming and general derangement of the successful working of the boiler. (Probably the danger of bringing the hot sheets of the boiler in contact with the steam has been overestimated.) Take, for instance, the careening of a small class of steamers in a rough sea-way, or the upright type of boilers, where the tubes go through the steam; there are tens of thousands of these in use, and we scarcely ever hear of any disastrous effects. The tubes are not as durable in steam as the parts immersed in water.

We frequently hear engineers make the remark, in commenting upon an accident, that it was not possible for water and steam to make such an explosion, ignoring the fact that the boiler was not strong enough to sustain the pressure. The more one studies the chemical laws of water, the less will he believe in gas theories or similar delusions.

It is difficult to conceive how the two gases that compose water can be torn asunder as long as there is any water in the boiler. There might barely be a possibility of separating the two gases by the steam coming in contact with the white hot tubes and sheets of the boiler, by which the oxygen is absorbed and the hydrogen left free. But these conditions would not be possible as long as there was any water in the boiler.

The boiler of the future will probably be constructed with more regard to the free circulation of the water in all its parts, especially the lower part, as it is very difficult to drive heat downward below the fire or heating surface.

The "Galway," an English type of boiler, is probably one in the right direction.

Vertical flues or tubes through the main firebox insure a good circulation from the extreme bottom of the boiler. Some of the best forms of the water tube or sectional boiler carry out this principle. They are at present taking a prominent position as a steam generator, and will probably be the boiler of the future.

Success depends largely upon actual practice, and close observation upon the construction and wear and tear of the weak points, to draw correct conclusions in regard to the efficiency and durability of a boiler.

J. R. WILLIAMSON.

### The Hebrew Technical Institute.

The Hebrew Technical Institute in New York city has now been established about ten months, and by its gratuitous instruction is doing an excellent work among the poorer Jewish children of the metropolis. The pupils vary in age from 12 to 15 years, and the training given them is intended to make them good, practical mechanics. As far as the capacity of the school will permit, all are taken who want to learn, and the results obtained from this rather indifferent material—boys often without any previous instruction whatever—are surprisingly favorable. Six hours daily are spent at the school, the time being equally divided between the English branches, including geometry and physics, free hand and mechanical drawing, and the workshop. The course is intended to cover three years, the third being devoted to the particular branches in which the pupil has shown the greatest aptitude. It is the aim of the Institute to impart the general underlying principles rather than the details of any particular trade. Mr. Leipziger, who is in charge, has done admirably during the short time he has been at work. A recent exhibition at the Institute made a very creditable display of drawings, modelings, and cabinet work accomplished by the pupils. It is intended to include metal work in the next year's course.

### Electric Lights for Cars.

The Pennsylvania Railroad Company continues the experiments with lighting cars by electricity from Brush storage batteries, using the lights on a train running between Altoona and Pittsburg. The arrangement has worked satisfactorily. The storage batteries are charged in the company's shops by connection with a Brush dynamo-electric machine. It takes about nine hours' running to charge the batteries with sufficient electricity for the round trip. The intention is, should the plan be found advisable for general use on through trains, to establish electric plants at different stations for charging the batteries.—*Philadelphia Railway World.*