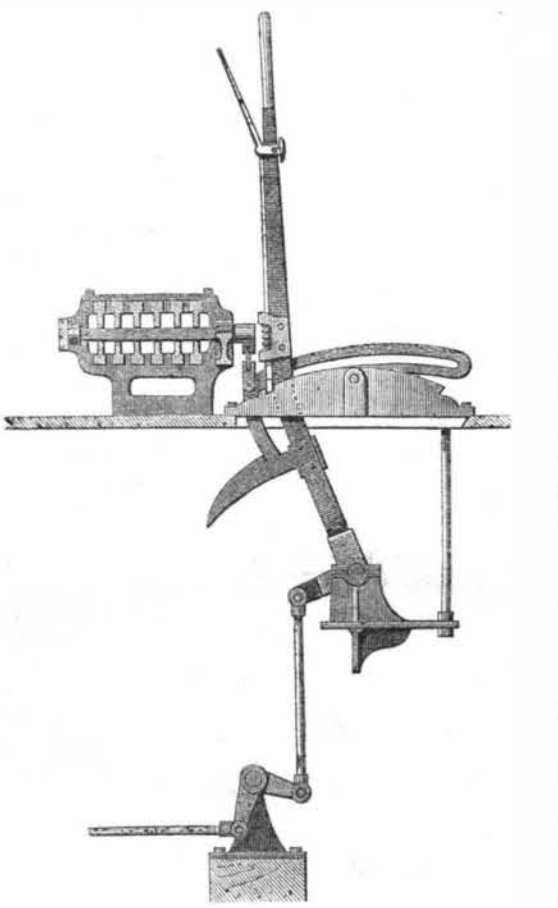
rises up like one side of a parallel ruler, a little above and to one side of the rail, and swings over to a new position. The plate connects with a three-way crank, and the latter with bolts which shoot into the cross piece between the points. It is obviously impossible for the plate to swing over during the passage of a train, for the wheels prevent. Red and green levers manage the home and distant signals, and by suitable wire cords either turn the lights or lower the arms, arms being exhibited by day and lights at night. In rear also of the levers is a plate, showing their uses; and numbers on each serve to individualize them in accordance with a plan of the switches, etc. On each signal lever, besides its number, are marked the numbers of the other levers which must be moved before it can be, so that the operator is provided with every means for showing him instantly what he has to do. It is impossible for him to move No. 2 signal, for example, until he has moved point lever 7 and locked it by lever 8; and then after he has pulled No. 2, that very operation prevents his stirring Nos. 11 and 15, which govern points crossing to the line shown clear by the signal; nor can he move No. 14, which might enable him to give a safety signal to lines which the open road crosses. A point lever cannot be stirred when a signal which should be at danger stands at safety. In brief, the device resembles a kind of permutation lock, each portion of which is both latch and key; sometimes the projections on the bars which serve as the tumblers cause said bars to be shoved to one side, throwing other bars into or out of engagement—and thus all parts are inter-related in an ingenious manner.



The levers are all worked by one man, and he is instructed by the telegraph, the operator and instruments being located in the same apartment with him. The instant the wires deliver the message the levers are quickly moved, and in a few seconds the smoke of the approaching locomotive is seen far down the line. Should any part of the mechanism break, even at the last minute, there is no peril incurred. If any portion of the locking or switch gear give way or get out of adjustment, the signal lever cannot be stirred, and the semaphore arm remains at danger—its normal condition; so, also, if the signal mechanism itself rupture, the result will be negative, for the arm, being counterweighted, will not fall of itself, and, from the break, cannot be pulled down. The levers are moved in an instant; twenty seconds suffices at the Cannon street station in London to move ten pairs of points and all the signals belonging to them. We need not suggest the number of hands and the length of time which would be required to do the same under the old systems, nor the economy in expense and freedom from risk involved in the substitution of the new method.

Mr. Joseph Dixon, Secretary of the Broadway Underground Railway Company, is the agent for Messrs. Saxby & Farmer in this country, and from him, at the office of the above named corporation, 263 Broadway in this city, further and more minute particulars may be obtained. The mechanism in the locality above described was manufactured in the factory of the inventors, an immense establishment in London, N. W., employing some 1,800 men, and imported hither. Certainly, the invention is one of surpassing importance and value; and with that conviction we can confidently direct to it the attention of the railway companies, as well as that of the public in general.

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A kind of tracing paper, which is transparent only temporarily, is made by dissolving castor oil in absolute alcohol and applying the liquid to the paper with a sponge. The alcohol speedily evaporates, leaving the paper dry. After the tracing is made, the paper is immersed in absolute alcohol which removes the oil, restoring the sheet to its original opacity.

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SCIENCE IN COMMON SCHOOLING.

If it were possible to dispossess an average school boy of all the mental development and discipline, with all the knowledge, general and special, which he did not get in school, there would, we fear, be precious little left for the schoolmaster to take pride in. Still more, were it possible to set off, against the certain benefits of schooling of the usual sort, the advantages which a better ordered system of primary culture would afford, the popular appreciation of the schools would, we are certain, be seriously disturbed.

There are few places that can boast a more liberal scheme of public schooling—liberal, that is, in time and material—than this city of New York. Her children may begin with the alphabet and end with a college diploma without other aid than that which the free schools afford. Yet the records of the schools show that, of the hundreds of thousands of children who have begun their schooling in them, more than half have gone out unable to read intelligently an easy page of print. Of those that are able to stay longer—that is, more than three or four years—it is but the fortunate few who are able, when their school days come to an end, to read with understanding the foreign telegrams in the morning paper; probably to not one in a hundred is the daily report of prices current any more intelligible than a page of integral calculus.

The fault lies less with the brevity of their school life than with the misuse of it which the school system entails—a system which makes a fetich of alphabet and multiplication table, and wastes on these tools of culture the children's best opportunities for gaining power to use them.

To insist that Science teaching be grafted on a system whose practical results are so meager is only to make matters worse. The sciences belong to a higher level of education, and should be left for riper years. At this stage of the child's development, the Sciences, as systematized groupings of related facts and principles, have no existence, only objects and sensations, palpable facts and tangible relations, have being in the child world; and the child is merely the observing traveler and explorer. The scientific geographer, geologist, and the rest come later. Could we control the work of the common school, therefore, we should rigorously exclude all Science teaching, real or pretended, and all teaching not scientific.

Schoolmasters who imagine that teaching scientifically means cramming children with facts, principles, and theories in geography, grammar, physiology, physics, and what not may accuse us of making a distinction where there is no difference; but the difference is as wide as between right and wrong. The most unscientific teaching which the common schools—and not a few of our higher schools, also—are guilty of appears in their teaching of the sciences. We would have none of it. Nevertheless, we say, as we have said before, that to educate truly, the work of the primary school, in matter and spirit and method, should be, from first to last, purely scientific. In other words, the work of the primary schools should be shaped to accomplish these three ends:

(1) The systematic development and training in quickness, keenness, and accuracy of all the child's faculties of sense, through the pleasurable exercise of the senses; for in primary culture joy is the great quickener and inspirer of effort.

(2) The systematic development of the child's mental faculties by varied acts of discrimination, judgment, and memory, dealing primarily, if not exclusively, with sensations.

(3) The formation of right habits in knowledge-getting, and in applying knowledge, through the personal observation, handling, investigation, and using of common things.

As the young surgeon is set to study the human body; as the student of mining engineering is made sensibly acquainted with the ores he expects to deal with, their mineral associates, and the conditions of their existence; as the practical machinist studies mechanics, so the child should be taught to study the world he has come to live in; not as a specialist in Science, but as a practical man, determined to master his environment. In this way only can his powers of sense and intellect be rightly developed and trained, and he be fitted to play well his part in the great game of life.

To this end letters are useful as auxiliaries, and for the cultivation of the wide fields of thought that lie without the pale of Science; but they should not be made the beginning nor the end of instruction. If one part in ten of a child's school life be devoted to letters, and the rest employed as we have indicated, he will not make less progress in reading than if the whole time be given to them; and he will be immensely better fitted to turn the art to advantage in after years. Besides, if the child's schooling be untimely cut short, as now happens in the majority of cases, his scientific training would fit him to make something, nay, to make the most, of his out-of-school opportunities. Far better absolute ignorance of letters, with the inquiring habits of mind and educated senses to be got by scientific training for a year or two, than the half-acquired art of reading, which the majority of children carry from the schools, weighted with the unawakened faculties and apathy of knowledge which they too commonly exhibit.

◆

SYRIAN SPONGES.

The latest project before the Acclimatization Society of Paris is the cultivation of the celebrated Syrian sponge in the waters of Southern France, a valuable and most useful product, which, like many another gift of the sea, is in danger of extermination through excessive fishing.

The sponge-producing grounds of Syria occur along the coast, from Mount Carmel in the south to Alexandretta in the north, the centers of production being Tripoli, Ruad, Lattakia, and Bartroun, on the coast of Mount Lebanon. The best qualities are found in the neighborhood of Tripoli and Bartroun. According to a late report of the British vice consul at Beyrout, as many as three hundred boats are engaged in the fishery; the annual yield, though falling off through the exhaustion of the grounds, still amounts to $100,000 to $125,000. The majority of the boats used are ordinary fishing boats, from eighteen to thirty feet in length, three parts decked over, and carrying one mast with an ordinary lug sail. They are manned by a crew of four or five men, one to haul and the rest to serve as divers.

In former years the coast was much frequented by Greek divers from the islands of the Archipelago; the number is now restricted to five or six boats a year, the skill of the Syrian combined with his better knowledge of the fishing grounds, enabling him to compete successfully with his foreign rival.

Diving is practised from a very early age up to forty years after which few are able to continue the pursuit profitably The depth to which the diver descends varies from five to thirty "brasses," or from twenty-five to one hundred and seventy-five feet. The time he is able to spend under water depends on natural capacity, age, and training; sixty seconds time is reckoned good work—in rare instances eighty seconds are spent under water. The Syrian diver uses a heavy stone to carry him quickly to the bottom, and is drawn up by a comrade. On the bottom, he holds the guide rope with one hand and tears off the sponges with the other, placing them in a net which he carries. No knife, spear, or instrument of any kind is used in detaching the sponges; nor does he, like his Greek competitor, ever use the diving dress, having an antipathy to it on the score of its reputed tendency to produce paralysis of the limbs. Two or three fatal accidents occur annually, mainly among the skillful and daring, who sometimes drop the rope to secure a tempting prize, and missing it on their return, attempt to rise to the surface unaided, and are drowned. At other times the diver will be wounded by jagged rocks, or his rope will become entagled, exposing him to great risks where the depth is great.

Though varying much in quality and size, the sponges are roughly divided into three classes: (1) The fine white bell-shaped sponge, known as toilet sponge; (2) the large reddish variety called bath sponge; (3) the coarse red sponge used for household purposes, carriage cleaning, etc. Two thirds of the produce of the Syrian coast are purchased by native merchants for exportation, while the remaining third is purchased on the spot by French agents. France takes the bulk of the finest qualities. One tenth the price received by the finders goes to the government for revenue.

It is possible that this high-priced and durable variety of sponge might be cultivated in our southern waters, as a substitute for the beautiful but tender sponge they now yield. The experiment would be worth trying.

INSPECTION OF BOILERS.

We have recently received the report of the Hartford Steam Boiler Inspection and Insurance Company for 1874. These annual reports always contain a great deal of information valuable to steam users, and we give a summary of the present one.

The company report the total number of boiler explosions of which they have knowledge, occurring during the year in the United States and Canada, to be 105, killing 183 persons and injuring 199. They were only able to ascertain the causes of a few of these explosions, but venture the opinion that they might have been prevented in great part by a system of careful inspection. As we have already explained to our readers, the ground in England is so well occupied by boiler insurance companies that the cause of every explosion is carefully investigated; and the results of these investigations confirm the opinion of the Hartford company, that boiler explosions can be prevented.

During the year, the company inspected 29,200 boilers. Of this number, 9,451 inspections were internal and complete, and the hydraulic test was applied to 2,078 boilers. The number of defects discovered by these inspections was 14,256, of which 3,486 were regarded as dangerous, or, in other words, the company declined to take any risks until the defects were remedied. The report is mainly taken up with explanations of the nature of these defects and the proper remedies. It is not uncommon to find a furnace out of shape, or with a fractured sheet, as the result of overheating and sudden cooling. Blisters in plates are caused by imperfections in the iron. They should be trimmed off and a patch applied, if the thickness of the sheet is much reduced. External corrosion is caused by exposure to the weather, leaky fittings, and the like. Boilers should be set so that they can readily be examined externally. Internal corrosion is ordinarily caused by acids in the feed water, and the remedy is, of course, to purify or change the feed. In cases of internal corrosion, some plates of a boiler will be clean and bright, while others are corroded and pitted. This seems to be due to differences in the iron composing the sheets. Internal grooving is caused by change of shape, due to varying temperature and the action of acids in the feed water.

One of the most common difficulties is caused by the deposit of scale in boilers. The principal impurities in water are lime, sodium, and magnesia, with salts of iron and organic matter. The carbonate of lime is deposited in the form of a soft slush; but combined with other impurities, it forms a hard scale. If a boiler is blown out while the water is hot, this slush remains, and is baked into a hard mass; but by allowing the water to cool, and then letting it run out, the slush can readily be removed by a stream of water from a hose. The sulphate of lime, unlike the carbonate, forms a hard scale at once, and is, therefore, much more troublesome than the carbonate. It becomes necessary in such a case to use some kind of scale preventive. The company hesitate to recommend any of the patent compounds in the market, since it is impossible to say that a preparation which is good for one boiler will be good for all. Frequent blowing will be found very beneficial, lowering the water level two or three inches at a time. Potatoes act mechanically, enveloping the deposits and preventing their adherence to the boiler. Petroleum has been found useful in some cases, but its general application is not recommended. Astringents, containing tannic acid, decompose the carbonates, forming insoluble tannates; but the tannic acid in some cases attacks the iron of the boiler. Common soda appears to be one of the best solvents, being introduced with the feed, in ordinary cases in quantities of from 1 to 2 pounds a day. Whenever solvents of any kind are used, the boiler should be cleaned frequently. The use of feed water heaters, to collect the impurities, has been recommended in former reports. These views are entitled to great respect, from the extensive experience of the company with deposits in boilers and the means of preventing and removing them. We can fully indorse the recommendations given above.

While we have necessarily been brief in our review of this admirable report, we have endeavored to notice all the most important points.

MICHIGAN'S SALT INTERESTS.

The first establishment for the production of salt in Michigan went into operation in the spring of 1860. Four thousand barrels were made the first year. In 1864, the yield was upwards of half a million barrels. The next five years showed little progress; since then the gain has been steady until 1874, when the total product was 1,026,979 barrels. Thus in fifteen years the Saginaw Salt Springs have become as productive as the Kanawha (Va.) Springs, where the manufacture of salt has been carried on since 1804; and two thirds as productive as our New York springs, where the manufacture was begun as early as 1797. The manufacturing capacity of the salt works of Michigan is now about 1,800,000 barrels a year: the total product since 1860 being nearly eight million barrels. Owing to the constant efforts of the State Inspector, and the intelligent care of the manufacturers, during the past two or three years the quality of the salt produced in Michigan has been much improved, so that it begins to compare favorably in the markets with the products of Onondaga.

The first satisfactory evidence of saline waters in the State, of a strength to make the manufacture of salt profitable, was published by the State Geologist, Dr. Haughton, in 1840. The untimely death of that gentleman deprived the State of its main reliance for giving intelligent direction to the development of the industry which promised so much advantage, and the interest languished for twenty years. Since 1860, as we have already seen, the correctness of Dr. Houghton's opinions have been amply demonstrated.

The primary source of the brines of Michigan is not yet fully determined, though indications point strongly to a deposit of rock salt underlying a large portion of the northern part of the Lower Peninsula. No borings have yet demonstrated this theory; still such would seem to be the most probable source of the present supply of brine. The immediate sources of the saline waters appear to be areas of depression in the strata known as the Michigan salt group and the contiguous sandstones above and below. Along the Saginaw Valley, the depression seems to be greatest, and here the brines have the highest specific gravity. The rocks which furnish the brine lie a thousand feet or so below the level of the lakes, and all wells carried to a sufficient depth in this region are sure to yield rich and productive brines. The quantity of brine seems to be unlimited. The strength of the brine increases with the depth; in the first well sunk it marked 1 degree at the depth of 90 feet; 40° at 516 feet; 60° at 559 feet, and 90° at 636 feet.

Borings have also been made in the Michigan representatives of the Onondaga salt group, which furnish the brines of New York, but thus far they have failed to afford more than a reasonable hope that these rocks may yield brines sufficiently strong to be worked with profit.

The salt-producing territory of the State is divided into twelve inspection districts, comprising sixty-eight salt companies, working forty kettle blocks, as many steam blocks, twenty-two pan blocks, and forty-four hundred solar salt covers.

The first variety of salt block consists of fifty or sixty kettles and the stone or brickwork in which they are set, a protecting building from 75 to 100 feet long and about 20 feet high in the center, and sheds on each side containing drainage bins. The brine is pumped to vats, near each block, whence it is carried in pump logs along the brickwork between the double rows of kettles, with a spout for each kettle.

The process of manufacture is very simple. The kettles are filled with brine and heated, and the scum which rises is skimmed off. Then the brine is boiled, whereupon crystals of salt form on the top and fall to the bottom. When the brine is about half evaporated, the salt is dipped out and thrown into baskets to allow the mother liquor to drain away.

In the steam process, the brine, after settling in vats as in the kettle process, is drawn into the steam settlers, strong wooden cisterns, from 100 to 120 feet long, 8 feet wide, and 6 feet high. Here the brine is heated by steam pipes until brought to complete saturation; then after standing awhile to settle, the clear brine passes to the grainers, which are wooden vats differing from the settlers only in being shallow, and heated in the same way. The saturated brine begins to deposit salt at once, and in the course of twenty-four hours is exhausted. During this time the hot brine is constantly stirred, making the crystals fine. The salt is then thrown out upon draining boards; thence it is taken to the packing house, where it remains a fortnight for complete drainage, before it is packed in barrels.

A pan block is a building large enough to cover the settler, the pans, and the packing room. From the settlers the saturated brine is drawn to the pans, set in flues so that the heat is applied at bottom. In this process—which is considered most economical—the evaporation is very rapid, and the salt makes continually, with great economy of heat.

The solar process is the simplest of all, the evaporation being effected by sun heat alone. Shallow wooden vats, 18 feet square, are employed, each provided with a movable roof or cover, so as to protect or expose the brine as the weather may require. The evaporation begins in April, or as early as the weather becomes sunny, and continues until November. The first crop of salt is gathered about the middle of July, the second in September, and a third in October. The middle crop is the most valuable, owing to its greater coarseness. About a tenth of a crop is gathered in November, which ends the season. The annual product of a "cover" is about fifty bushels.

Four grades of salt are recognized by the State Inspector, to whose annual report, for 1874, we are indebted for the foregoing information:

Fine salt: Suitable for general use for family purposes. Made with artificial heat; of this grade the yield last year was 960,757 barrels.

Packers' salt: Suitable for packing and bulking meat and fish. Yield, 20,090 barrels.

Solar salt: Coarse and fine. Claimed to be equal to the best Onondaga solar. Yield, 29,391 barrels.

Second quality salt: Includes all salt intended for No. 1 of the foregoing grades, but not up to the standard. Good for salting stock, hay, hides, etc. Yield, 16,741 barrels.

THE MISSION OF THE FLY.

The generally received opinion about flies is that, despite limitless ingenuity expended on patent traps and poisoned paper, they form one of those ills of life which, it not being possible entirely to cure, must perforce be endured with as good a grace as may be. Consequently when they ruin our picture frames and ceilings, insinuate themselves into our milk and molasses pitchers, or lull us to sleep with their drowsy buzzing, only to bite us during our slumbers and render the same uneasy, we thank fate that the cold weather will rid us of the pest. To be sure they are scavengers in their way; but after we have spent several minutes in picking a score or more out of the butter dish, we arrive at the conclusion that it is an open question whether they do not spoil more good material than they carry off bad.

Festina lente, good reader, hasten slowly and do not anchor faith to such opinions until you are certain that the above sum up all of the fly's mission in this world. *Musca domestica* (Science uses six syllables in Latin to express that which good round Saxon epitomizes in two) is a maligned insect He fulfils a purpose of sufficient moment to cause you to bear his inroads into your morning nap with equanimity, o even complacently to view him congregated by the score within your hidden sweets.

Did you ever watch a fly who has just alighted after soaring about the room for some little time? He goes through a series of operations which remind you of a cat licking herself after a meal, or of a bird pluming its feathers. First, the hind feet are rubbed together, then each hind leg is passed over a wing, then the fore legs undergo a like treatment; and lastly, if you look sharp, you will see the insect carry his proboscis over his legs and about his body as far as he can reach. The minute trunk is perfectly retractile, and it terminates in two large lobes, which you can see spread out when the insect begins a meal on a lump of sugar. Now the rubbing together of legs and wings may be a smoothing operation; but for what purpose is this carefully going over the body with the trunk, especially when that organ is not fitted for licking, but simply for grasping and sucking up food.

This query, which perhaps may have suggested itself to thousands, has recently for the first time been answered by a Mr. Emerson, an English chemist; and certainly in the light of the revelations of that gentleman's investigations, the fly assumes the position of an important friend instead of a pest to mankind. Mr. Emerson states that he began his self-appointed task of finding out whether the house fly really serves any appreciable purposein the scheme of creation, excepting as an indifferent scavenger, by capturing a fine specimen and gluing his wings down to a microscope slide. On placing the slide under the instrument, to the investigator's disgust the fly appeared covered with lice, causing the offending insect to be promptly released and another substituted in his place. Fly No. 2 was no better off than fly No. 1, and as the same might be predicated of flies 3, 4, 5 (or of *n* flies, as the algebras have it), Mr. Emerson concluded that here was something which at once required looking into. Why were the flies lousy? Meanwhile fly No. 2, on the slide, seemed to take his position very coolly, and, extending his proboscis, began to sweep it over his body as if he had just alighted. A glance through the microscope, however, showed that the operation was not one of self-beautification; for wherever the lice were, there the trunk went. The lice were disappearing into the trunk; the fly was eating them. Up to this time, the investigator had treated his specimen as of the masculine gender; but now he changes his mind and concludes it to be a female, busily devouring not lice but her own progeny. The flies then carry their young about them; and when the family get too numerous or the mother too hungry, the offspring are eaten.

Awhile reasoning thus, Mr. Emerson picked up a scrap of white writing paper, from which two flies appeared to be busily eating something, and put it under the instrument. There were the progeny again on the paper, and easily rubbed off with a cloth. "This," he says, "set me thinking. I took the paper into the kitchen again and waved it around, taking care that no flies touched it, went back to the microscope and there found animalcules, the same as on flies. I had now arrived at something definite; they were not the progeny of the fly, but animalcules floating in the air; and the quick motions of the flies gathered them on their bodies, and the flies then went into some quiet corner to have their dainty meal."

The investigator goes on to describe how he continued the experiment in a variety of localities, and how, in dirty and bad smelling quarters, he found the myriads of flies which existed there literally covered with animalcules, while other flies, captured in bed rooms or well ventilated, clean apartments, were miserably lean and entirely free from their prey. Wherever filth existed, evolving germs which might generate disease, there were the flies, covering themselves with the minute organisms and greedily devouring the same.

Mr. Emerson, while thus proving the utility of the fly, has added another and lower link to that curious and necessary chain of destruction which exists in animated nature. These infinitesimal animalcules form food for the flies, the flies for the spiders, the spiders for the birds, the birds for the quadrupeds, and so on up to the last of the series, serving the same purpose to man. He certainly deserves credit for an interesting and novel investigation, and for an intelligent discernment which might even attack the more difficult task of teaching us the uses—for Nature makes nothing without some beneficial end—of the animalcules themselves.