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THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 393,

For the Week ending July 14, 1883.

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THE WORKINGMAN'S SCHOOL.

We have frequently had occasion to refer to the growing dissatisfaction felt with our present system of school culture, and the efforts made to improve it. At the College of the City of New York, preparations have begun for the erection of a workshop, and in some of the public schools in Boston one of the school rooms has been converted into a carpenter shop where the boys spend a few hours each week in learning the use of tools.

A large and well ventilated building has recently been erected in West 54th Street, New York, for the accommodation of a "workingman's school." This name does not, as many suppose, imply that it is a trade school, nor yet a school for men, but that its benefits are intended to accrue to the children of the workingmen, who may themselves become workingmen. It is in fact a post-graduate kindergarten, taking children at that susceptible age when their faculties have been aroused in the kindergarten, and, by substituting work for play, continuing the natural method of object teaching. In the kindergarten, however, the child learns by *observation*, in the school he learns by *creation*, by the production of things. This creative method, as applied to education, is not intended, in that school at least, to make the child machine-like or subserve "the bread and butter interests" of later life, but to be applied to the training of the intellect, to the development and refinement of the taste, to the formation of character. Such are the aims and purposes of the founders of the Workingman's School. In how far they will be able to carry out in practice these high ideals, how far they can impress their thoughts upon the material at hand, and to what extent they will realize their own expectations, time alone can prove. Teachers have to be trained, methods devised, and details arranged.

The present workings of the school are such as to encourage the hope that much will be realized, and a glance at some of their methods may be of interest to our readers.

The youngest class (VIII.), as it comes from the kindergarten, which is in the same building, are taught to draw as well as to make things. The workshop and atelier are side by side. For example, the first exercise in drawing consists in placing before the class the model of a house, the end consisting of a square and triangle. A ruler and triangle are used in drawing it on drawing paper. In the workshop the pupil lays out a square of the same size on a piece of clay, and then carves it out, thus learning the use of the chisel and try-square. So the exercise of drawing rectangles, parallelograms, and triangles on paper is followed by carving them from clay. Clay has the advantage over wood that it does not require the use of very sharp tools, which could not be safely intrusted to children of six or seven years.

In the next class (VII.) the use of compasses and dividers is introduced both in drawing and carving. In class VI. drawing boards, T-squares, compasses with pencil and needle points, and scales are introduced into the drawing room. In the work room geometrical forms are cut from pasteboard. A cube, prism, pyramid, etc., are made from pasteboard after solid models. In the next class (V.) the pupil gains an idea of area and of a unit of area, while the use of a hand bracket saw is introduced. These four classes are already at work, and their productions are viewed with interest by those who visit the school.

In addition to the work above described, the pupils learn to model in clay from copies, and then make plaster casts of their own work. This affords an opportunity for awakening the slumbering art instincts, as they learn to model leaves, heads, and ornaments.

Instruction is not limited to the few subjects above mentioned, for there are many other things that go to make up a general culture. Reading and writing are taught simultaneously, as in Germany. A word is broken up into its elements and written by the children in script. Beginners in arithmetic use little numbered blocks of two sizes for tens and units. No slates are allowed, being injurious to eyesight.

In teaching geography one year is spent on the city, another on the State. It has been found that in the next year the children are able to master all of the United States, and draw the maps.

Music and calisthenics receive due attention, and are made as attractive as possible.

In 1881 and 1882, two weeks were spent in out-door life on a farm in the country, Sherman, Wayne Co., Pa., having been the spot selected. The results were most satisfactory. There in the woods, and among the hills, and along the streams, they gained not only new health and vigor, but also that more vivid realization of natural objects which contributes greatly to enhance the value of their winter study.

The pupils in this school, it must be remembered, do not represent the best possible material to work upon, being taken mostly from the tenement houses of a large city. Yet the principal, in his last annual report, says: "We have very few, perhaps 1 in 100, that deserve to be called bad; that is, persist in an evil practice in the face of gentle but continued repression of bad propensities and encouragement of good ones, which marks the ordinary discipline of the school. As a rule, the children of the workingman's school are wideawake, but cheerful and obedient. As to the mental status of the school," he says, "a good number of the children are exceedingly intelligent, and in the 150 members of the school there is no really feeble minded child, and only a few are slow or stupid."

Whether the system of education here introduced for the first time shall prove worthy of imitation in schools for the wealthy or well-to-do or not, there can be no doubt that this school is doing a good work among the poorer classes of New York.

LOSS BY LACK OF SYSTEM.

The manufacturer can usually, by reference to his books, ascertain the cost of any article of his production, and the amount of his regular daily expenses. He can discover how much material has been lost by waste, and possibly he can make approximate allowance for loss by incompetence of his workmen. But there is one source of loss that cannot be readily estimated, and yet exists and has its effect on the results of the year's production. This is the loss from the lack of a rigid system in the using of tools and from the habitual carelessness this want of system encourages.

In every shop there must be tools that are for general use and are not individual possessions. If each successive user mislays a tool that is intended for general shop use, the aggregate of time lost in seeking for it may amount to a serious waste. Drills, taps, reamers, boring bars, arbors, milling tools, wrenches, and other implements may be intended for general use all about the shop, but when not in use they should have a home—an abiding place—so that no time would be lost in searching for them. And they should be left in proper condition for immediate use, either by the last user, or by some person whose business it is to keep them in condition. In every large shop provision should be made for this purpose, a repairer or sharpener being designated to perform this duty.

Attention to these little details is fully as important in small shops as in larger ones; for sometimes the loss of small sums occasioned by carelessness will seriously affect the balance sheet. A good practice, which is a rule in many large establishments, could be followed in smaller ones with saving results. This is to have a series of shelves or pigeon holes to contain the drills, reamers, arbors, etc., each numbered and each provided with a marked tag of sheet metal designating the tool. Every workman has a hook convenient to the pigeon holes, with a card bearing his name. When the workman takes a tool from its rack, or pigeon hole, he hangs its corresponding tag on his hook. A single glance shows where the missing tool is, and when it is returned to its place its tag is replaced over the corresponding pigeon hole. In effect, the workman charges himself with the tap, drill, or other tool when he takes it, and credits himself with it when he returns it.

The practice of this system has a good general effect on the workmen. They cannot fail to see the advantages to themselves in the saving of vexation in an aimless search for a missing tool; and the habit of care for general shop tools will extend to a similar care for their own bench and machine appliances. A saving of time could also be made in many shops by a more generous provision of general bench appliances. A single bench block for the use of a dozen vise men is not enough; it would be well if every vise had a bench block, a casting say eight or ten inches long, by four or five inches high and wide, planed on one face and side. Its cost is trifling and its uses many. It saves the hammering on the vise, and the defacing of the bench when used for straightening rods and small forgings. Encouragement to order in the care of lathe and planer tools would be given by providing for each lathe a handy tray, or sliding shelf of wood, to lie across the ways; lathe tools should never be laid on the ways of a lathe; the nicely trued surface of the Vs of a lathe cannot stand the batter of steel tools as they are usually dropped from the hand. Such a tray is useful, also, on the platen of a planer, which is too commonly used as a general receptacle for anything that should be laid on a bench.

Every shop should be provided with boxes or other conveniences for holding bolts, nuts, washers, angle irons, and blocks, for lathe and planer use, and boxes for receiving odds and ends not of present apparent value. These boxes should be distinct from the scrap heap, which ought to receive nothing of real possible shop use. They not only conduce to habits of order, but are valuable magazines to draw from in cases of emergency.

SCIENCE ON SORGHUM.

No subject connected with our agricultural resources is to us of greater national importance at the present time than that of sorghum. This to many may seem a stronger statement than truth will warrant. *Sorghum* has become to some degree a sort of by-word, for though largely cultivated in the Western and Northwestern States, and producing annually a return worth about $8,000,000, still it has confessedly failed to do what was expected of it. Somewhere about thirty years ago the Chinese variety of the plant (the varieties are numerous) was introduced into this country, and the excitement in relation to it was not small. Its sugar producing qualities were extolled above measure; our sugar trade was to be revolutionized, so to speak; every farmer was to have a little mill, and a little kettle, and he was not only to boil out his own sugar, but to supply his less fortunate neighbors.

Some way, however, things did not seem to work right. The sugar no doubt was in the sorghum cane, for when its juice was boiled down a sweet sirup was obtained, but there the demonstration stopped. The sugar was in the sirup, but it most persistently refused to come out of the sirup; it could not be induced to crystallize; and though the sirup had a certain degree of value, yet it was not the thing wanted, and in the disappointment the popular feeling swung round to the unjust judgment of condemning sorghum, simply because it had been the victim of ignorance and mismanagement Such utter and inexcusable carelessness and negligence prevailed in the treatment of the plant, that even the sirup was often nearly spoiled, and had a nauseous, disgusting, "burnt pumpkin" flavor which could not fail to bring it into disgrace, and most justly so for itself, but not justly so for the plant from which it was derived. Recent researches however have done much toward explaining and removing the difficulties which have been in the way of successfully crystallizing the sugar from the juice of the sorghum.

Part of this has been accomplished by work in the laboratory and part by work in the field, the mill, the boiling house, etc., and they together have shown that the statement made above of the "national importance" of sorghum is not an exaggeration. The report presented by a committee of the National Academy of Sciences in 1882 has just been published as a Senate document. It is entitled, "Investigation of the Scientific and Economic Relations of the Sorghum Sugar Industry, being a Report made in Response to a Request from the Hon. George B. Loring, U. S. Commissioner of Agriculture." The committee consists of Prof. Bremer, of Yale, Prof. Chandler, of Columbia, Prof. Johnson, of Yale, Prof. Silliman, of Yale, Prof. Smith, of Louisville, and Dr. G. E. Moore, of New York.

The report shows clearly that essentially the two points on which success depends are maturity of the cane, and prompt correctness in working. With these sugar from a field of sorghum can be as surely and safely expected as from a like field of sugar cane, and with perhaps fully as great a return.

The immense possibilities which such a revelation opens for the future sugar crop of the United States must be discussed at another time.

THE STORAGE OF WIND POWER.

The great question of all questions at the present day, in the line of invention and mechanical application, is, How can we best turn to account the natural forces which are in play about us? Setting aside for the present the direct use of electricity as a motive power, we have two fluids at our command, air and water. Both have from time immemorial been pressed into the service of man, and yet even at this moment, with all the modern advances in practical science, we are only on the threshold of the workshop in which we ought to have full command. It is not too much to say that of the power exerted by the movements of water and of air throughout the world, the percentage utilized is so small as to be practically inappreciable. Let our inventors look to this, for it is a field which promises well.

The idea of using the power of water-falls at a distance, transmitting the energy by means of—say compressed air, or electric wires—has been often suggested and tried, but thus far with no very satisfactory results. The loss of power through the agents employed in transmission has been so great as to much impair the economic value. But let us take up another line of thought, and see if we cannot start some inventive brain into a plan which will bring out something practical. The power to which reference is made needs no transportation; it is ready at hand; it is simply the wind.

It seems incomprehensible that such a ready and potent agent should escape practical use so completely as it does. The probable reason for this is that the power is destitute of all uniformity, and has on that account hitherto been deemed unmanageable; sometimes furious, sometimes absolutely nothing, and at all times unsteady and capricious.

Before referring again to this feature, let us estimate for a moment the amount of power at our command, within a given space, *if we can only control and utilize it.* We will assume an area 40 by 150 feet, no larger than the flat top of many a manufacturing establishment, store, etc. Within this extent it is entirely practicable to place thirty-two wind-wheels, each 12 feet high by 8 feet in diameter, and so arrange them that each shall have full sweep of the wind from whatever quarter it may blow. The wheels here contemplated would revolve on vertical axles—or horizontal if preferred—with fixed blades, one-half shielded and turning so as to suit the direction of current. They would need no attendance, no brake, no check, let them spin with the utmost fury of a gale, or lie still in a calm. Rapid motion could do no harm, only increasing their efficiency; whenever they turned they would do work, when they lay still they would do nothing. Each wheel would drive an air-pump of size suited to its power, and each stroke of the piston would send its given quantity of air into the common reservoir provided. That reservoir becomes then a magazine of compressed air whose energy is reported by the gauge, and is used by any of the means now so well known.

A wind-wheel of the size stated carries on each of its blades a surface of 48 feet. The pressure of wind in what is known as a "strong breeze" is about 2 pounds per square foot, and its rate of motion about 1,750 feet per minute. It is easy to see, therefore, that theoretically the efficiency of such a wheel in such a wind is safely reckoned at five horse power.

But here comes in the difficulty, and it is *the* difficulty of all and must be overcome, or this power is of practically no value in the line of which we have been speaking. The power is capricious, and unless we can steady it no form of business can depend on it for service. How shall we *store* the power that may come to us by day or by night, Sundays and week days, gathering it at the time when we do not need it and preserving it till we do? This is the problem. Who is the man to solve it. Surely it should not be set aside as too difficult for trial.

Why should it not be dynamized into electricity? No distant transmission with its loss of energy comes into play, for a line of shafting can be driven directly on the spot. It is true the whole field of electric storage is yet too little explored to answer this question on the instant, but is it not worth considering?

Other modes of turning to account the compressed air, and using it only as needed, are also within our reach.

A factory or other building, of the size already given, with the wind-wheels on its roof, taking the average rate of the wind as it is known to be in our region and climate, has at its command, if it can *store* the power, at a fair and moderate estimate, 4,200 horse power per week, thus giving it a 70 horse power engine for six days of ten hours each. And this power is without engineer, without fuel, without labor; practically without expense.

Store the wind power, and render it of even application, and all this is perfectly possible. Shall we admit that this cannot be done?

W. O. A.

THE AURANIA'S BROKEN ENGINES.

The new Cunarder Aurania which left Liverpool on June 23, after having made a quick and pleasant run, broke one of the connecting rods of her engine, on Sunday morning, July 1, when off the eastern end of Long Island. The accident which was caused by a flaw in the connecting rod, resulted in the almost complete wreck of the engine, cracking the cylinder, knocking off the cylinder head, and doing much other serious damage. At the time of the accident the shaft was making sixty-one revolutions to the minute, with a steam pressure of 85 pounds. The speed of the vessel was 17¾ knots.

Capt. Hains estimates the damage at more than $100,000. The ship will have to go to the Clyde under sail. It will probably take a year's time to repair the damage. The Aurania is a Clyde built steamer of 7,500 tons register. She was a new vessel, and this was her first trip out.

She is regarded as a very fast steamship. During the trip as high as 429 miles was logged in one day.

The disabled vessel was towed into this port by six tugs.

Heat from the Sun.

The Mount Whitney observations show the sun to be hotter than was supposed. The heat received at the earth's surface is probably more by one-half than was estimated by Herschel and Pouillet, and even materially exceeds the values assigned by more recent investigators. It would in one year melt a crust of ice over the whole sunward half of the earth six hundred feet thick. This is, of course, a statement in very round numbers. The scientific phrase would be that the sun's vertical energy would raise the temperature of one gramme of distilled water three degrees Centigrade per minute for each centimeter of the earth's surface nominally exposed.

Having supplied us with an increased amount of heat, the Mount Whitney experiments also favor us with new figures of intenser cold. The estimates of Herschel and Pouillet made the temperature of space 224° below the zero of Fahrenheit. The new results carry it down nearly to the calculations for the absolute zero, the absence of all heat, say minus 450° F. To the non-scientific mind the distinction between such far down temperatures is not unlike that between the pains of rheumatism and those of the gout—the first being as from a thumbscrew twisted to the last point of human endurance, the gout giving one turn more.

Further, it appears that the direct heating power of the sun cannot raise a thermometer quite 50° F. above its surroundings whatever they may be. If we suppose the whole globe a thermometer and without an atmosphere, the sun could only heat it fifty degrees above the cold of space, leaving it at about minus 400° F. under full sunshine. The internal heat of the earth may be disregarded in these calculations. It seems paradoxical to say that if the atmosphere were removed from the earth its surface would receive more heat and yet be much colder. But this is a fact of the same kind as our experience in ascending a mountain. The atmosphere does indeed cut off a great deal of heat, but on the other hand it keeps a great deal of that which it permits to pass through. When the air is heated up to its retaining capacity, an "equilibrium" is established.

To illustrate, let us imagine a large, empty, windowless hall, with two doors partially obstructed by Centennial turnstiles, one for entry and one for exit. A procession of one hundred persons enters per minute. At first there is abundant room; few want to come out. At the end of the second or third minute perhaps only three people are leaving for one hundred arriving. After a longer interval the number of departing guests is much greater. At last the hall is crowded to its utmost capacity, and if we still suppose one hundred per minute entering, it is absolutely certain that one hundred per minute must be getting out. This final condition is one which we may call equilibrium. If the turnstiles of Centennial pattern record their turnings, we can ascertain exactly how many people are in the hall at any moment. Now to apply the illustration to heat-bearing rays entering our atmosphere, we may suppose that nearly all reach the soil through radiation; but ninety per cent go out through the regular exit of "convection;" nine per cent squeeze back through the turnstile by which they entered—"radiation;" and one per cent climb out through the chimney of "conduction." It follows that by merely regulating the turnstiles, by modifying this capacity for selecting and holding rays of certain wave lengths, atmospheres could be constructed which would keep the planet Mercury cool or the far off Neptune comfortably warm. Here is a hint for romancers who wish to plant their *dramatis personæ* in some other world.

The Allegheny and Mount Whitney observations firmly establish the fact that the sun is blue. The particular shade of color which it has, if viewed without intervening atmosphere, may be laid down as that on the border of the blue near the green, about where the line *F* appears in the spectrum. Sad to say, this is not an "æsthetic" hue; it is more like that referred to in one of Southey's poems: "You could almost smell brimstone, their breath was so blue, for he painted the devils so well."—*William C. Wyckoff, in Harper's Magazine.*

Bids for New War Vessels.

The bids for the construction of the three steel cruisers and the dispatch boat ordered by the last Congress, were opened July 2 in Washington, and it was found that John Roach & Sons' bids were lower in every single instance than any others, and they will probably be awarded the contracts.

For the 4,500-ton steel cruiser C. H. Delamater & Co., New York, bid $1,163,000; the Harlan & Hollingsworth Company, Wilmington, $1,120,000; Cramp & Son, Philadelphia, $1,080,000; John Roach, Chester, $889,000. Each bidder sent in a $30,000 certified check with his bid.

For the 3,000-ton steel cruiser the following bids were made: The Harlan & Hollingsworth Company, $777,000; Harris, Loring & Co., Boston, $748,000; Cramp & Son, $650,000; John Roach & Son, $619,000.

Each bidder sent in a $20,000 check.

For the 3,000-ton cruiser the following bids were made: Harlan & Hollingsworth Company, $775,000; Quintard Iron Company, New York, $763,400; Cramp & Sons, $650,000; John Roach, $617,000.

Each bidder sent in a $20,000 check.

For the dispatch boat bids were made: H. A. Ramsey & Co., Baltimore, $420,000; Allen & Blaisdale, St. Louis, $380,000; Cramp & Son, $375,000; John Roach, $315,000.

It is believed in Washington that the vessels can be built and finished in eighteen months, if the armament can be procured in time.

The Despised Trade Dollar.

Since the 1st of July the trade dollar has come into such disfavor that it no longer passes in this city at par. The brokers are buying them at 85 cents, but Government officers advise parties to keep them, intimating that Congress will at its next session provide some measure for their redemption. According to one of our contemporaries, the trade dollar is intrinsically of more value than the modern silver dollar. The trade dollar contains seven grains more silver than the standard dollar and is a better coin. But Congress never endowed it with legal tender attributes. It was originally coined for use in the Chinese trade, at a time when our currency was paper, as a favor, it is said, to the bonanza silver kings, who wished to find some use for the product of their mines.

Adulterated Teas.

Under the operation of a new law against the importation of impure teas, more than 3,000 packages of tea brought from Shanghai, China, and valued in the market, if sold, at $20,000, were condemned recently by the appraiser at the port of New York. The teas were mixed with sand and gravel, exhausted tea leaves, and dirt and paste rolled into pellets to represent dried leaves. In several instances the impurities were evident to an inexperienced observer. When taken in the hand and crushed between the fingers, the sand was plainly visible.

About 500 packages of colored Japan tea, of which a greater portion was dust, were also rejected after a careful examination. This tea was of high color and mixed with mineral substances to increase the weight.

The Gradual Cooling of the Earth.

IN a "Treatise on Natural Philosophy," by Professors Sir W. Thomson and P. G. Tait, Sir W. Thomson, speaking of an opinion advanced by Sir Charles Lyell, respecting the possible maintenance of the earth's heat without change throughout countless ages, used words which, says *Knowledge*, may be applied without change of a word to the stupendous theory advanced by Sir C. Siemens not so very long since—such an idea of a practically endless cycle "violates the principles of natural philosophy in exactly the same manner, and to the same degree, as to believe that a clock constructed with a self-winding movement may fulfil the expectations of its ingenious inventor by going for ever." The earth is necessarily cooling from century to century; her volcanic energies are certainly diminishing, as certainly, to use an illustration of Sir W. Thomson's, as the quantity of gunpowder in a "monitor" is diminishing when hour after hour she is seen to discharge shot and shell, whether at a nearly equable rate or not, without receiving fresh supplies of ammunition.