Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, NEW YORK.

O. D. MUNN. A. E. BEACH.

TERMS FOR THE SCIENTIFIC AMERICAN.

One copy, one year, postage included.. **$3 20**
One copy, six months, postage included.. **1 60**

Clubs.—One extra copy of THE SCIENTIFIC AMERICAN will be supplied gratis for every club of five subscribers at $3.20 each; additional copies at same proportionate rate. Postage prepaid.

Remit by postal order. Address

MUNN & CO., 361 Broadway, corner of Franklin Street, New York.

The Scientific American Supplement

is a distinct paper from the SCIENTIFIC AMERICAN. THE SUPPLEMENT is issued weekly. Every number contains 16 octavo pages, uniform in size with SCIENTIFIC AMERICAN. Terms of subscription for SUPPLEMENT, $5.00 a year, postage paid, to subscribers. Single copies, 10 cents. Sold by all newsdealers throughout the country.

Combined Rates.—The SCIENTIFIC AMERICAN and SUPPLEMENT will be sent for one year, postage free, on receipt of *seven dollars.* Both papers to one address or different addresses as desired.

The safest way to remit is by draft, postal order, or registered letter.

Address MUNN & CO., 361 Broadway, corner of Franklin Street, New York.

Scientific American Export Edition.

The SCIENTIFIC AMERICAN Export Edition is a large and splendid periodical, issued once a month. Each number contains about one hundred large quarto pages, profusely illustrated, embracing: (1.) Most of the plates and pages of the four preceding weekly issues of the SCIENTIFIC AMERICAN, with its splendid engravings and valuable information; (2.) Commercial, trade, and manufacturing announcements of leading houses. Terms for Export Edition, $5.00 a year, sent prepaid to any part of the world. Single copies, 50 cents. ☞ Manufacturers and others who desire to secure foreign trade may have large and handsomely displayed announcements published in this edition at a very moderate cost.

The SCIENTIFIC AMERICAN Export Edition has a large guaranteed circulation in all commercial places throughout the world. Address MUNN & CO., 361 Broadway, corner of Franklin Street, New York.

NEW YORK, SATURDAY, JANUARY 10, 1885.

Contents.

(Illustrated articles are marked with an asterisk.)

TABLE OF CONTENTS OF

THE SCIENTIFIC AMERICAN SUPPLEMENT,

No. 471,

For the Week Ending January 10, 1885.

Price 10 cents. For sale by all newsdealers.

THE YOUNG MECHANIC'S CAPITAL—HOW TO INCREASE IT.

The increase of capital as ordinarily reckoned—money saved and prudently invested—is not at present under consideration. Every workshop proves beyond the need of discussion that by industry, thrift, and the avoidance of wasteful habits, to say nothing of more reprehensible habits, it is possible for any, even the lowest paid, workmen to put by something, and thus, however slowly, accumulate a reserve which may be used as a money capital when opportunity serves. The industries of the country are so full of evidences of this fact, that it need not be insisted on here. Let us consider rather some of the means by which wage earners (particularly those whose mental and manual habits are not set by age) may increase their working capital more effectively and rapidly than by any possible saving of wage money. By working capital we mean whatever adds to the productive value of a man's time, and increases his income without requiring any increase in the duration or severity of his labor. The intelligence or trustworthiness which causes one laborer to be selected from a gang to oversee and direct the work of his mates, with an addition of half a dollar a day to his wages, is productive capital just as much as money at interest yielding an equal sum a day. From two to five years' earnings of our laborer, saved in bulk and securely invested, would add no more to his income than those qualifications which gained for him his slight though materially valuable promotion. And almost any young man can add fifty per cent, may be five hundred per cent, to his income by increasing his worth to an employer, easier than he can save the equivalent of even one year's wages.

Accordingly, while we would not decry in any way the good advice usually given to young men beginning life as wage earners, "Save money for future capital," we would emphasize this collateral advice: "Improve your spare time, as the quickest way to make capital."

A young man of ordinary capacity does not have to work long at any mechanical art before he can earn a dollar a day. He need not be very strong, or very skillful, or very intelligent to be worth that. An income of a dollar for each working day is equal to the interest on $10,000 in United States 3 per cent bonds, or $7,500 in 4 per cents, or $5,000 at legal interest in the majority of the States. That is the value of the common laborer's working capital—that is, his ability to do an average day's work at rough or unskilled labor three hundred days in a year, coupled with a willingness to do such work.

Our young mechanic, we will suppose, very properly aspires to be something better than an unskilled laborer. How can he most surely win promotion and a more liberal income? Tied down and hampered every way by the necessity of daily toil, it may seem to him that the doors of advancement, for the moment at least, are closed against him; and without a struggle to better his position he may drift along, waiting for an opportunity that may never come. Or he may quietly set to work to increase his working capital by trying to fit himself for a better paying grade of work.

This is usually the most obvious and the easiest thing to do. By steadily trying to do the work he has to do a little better or a little quicker, and by closely observing the working methods of more skillful men, he can usually add rapidly to his productive capital. When he has fitted himself to earn half a dollar a day more, he has accomplished as much as if he had increased his deposit in the savings bank by the handsome sum of $5,000. And his increased skill is quite as secure an investment and quite as well worth working for as so much money on deposit. So, too, a good handwriting or a knowledge of simple accounts, which any young mechanic can acquire by evening study and practice in a single winter, may easily secure his promotion to a position worth half a dollar a day more than he could earn as a mere laborer. A patient study of mechanical drawing furnishes a still more rapid means by which a young mechanic can increase his working value, in other words, his productive capital.

When our young mechanic has added to his knowledge and skill enough to make his services worth two dollars a day to an employer, he may fairly reckon that he has added $10,000 to his capital. And on this reasonable basis it is manifest that, of two young workmen of equal capacity, the one who—making no effort to improve himself—should have placed to his credit in bank $5,000 a year for five years, would not be so well fixed for life as his companion who should devote his spare time rigorously to the work of increasing his practical and technical knowledge of his trade and its associated arts, while endeavoring during his working hours to excel himself as a skillful and conscientious workman. A capital of $25,000 in cash is not to be despised; but it will not earn so much for a man as the knowledge, skill, and mental and moral discipline which our studious, faithful, and wide awake mechanic might acquire. There is nothing that men pay for more liberally than ability and sterling character; and there is no way by which these may be got and demonstrated so quickly and surely as by the habit of doing one's best at all times, with the habit of seeking useful knowledge during those hours of leisure which so many young men waste in idleness or worse.

The means most admirable for self-culture necessarily vary with the requirements of each seeker for such increase of working capital. A few are of almost universal utility, among them these: practice in writing and drawing, particularly drawing; the study of arithmetic and bookkeeping; the study of elementary physics, chemistry, and mechanics; critical observation of machines and mechanical processes; the careful reading of a paper like the SCIENTIFIC AMERICAN; independent experimental work, machine construction, and invention, and so on. Begin where you are, with whatever lies readiest at hand. With pluck, patience, and a determination to succeed, the most exacting and difficult arts and sciences have been mastered by men most unfavorably situated. And never forget that the habit of overcoming difficulties is the most valuable and productive element of any man's working capital.

Artesian Well at Bourn, Lincolnshire.*

BY JAMES PILBROW, M.INST.C.E.

The subject of artesian wells is not without interest to the engineer whose attention is chiefly directed to the supply of towns and other places with water. For this reason, the description of a small but productive artesian well, completed at Bourn in Lincolnshire, in 1856, is presented. The well was intended to supply the town of Bourn with water, the undertaking being in the hands of a small joint stock company. The town had been until then without any public supply, and almost without a private one. The wells were shallow, as in most of the towns in that part of the county; but many houses where wholly dependent upon carts, which fetched water from a considerable distance. These circumstances gave increased importance to the fact of such a supply being found under the site of the place.

The boring, 4 inches in diameter, passed through several oolitic strata to a depth of 92 feet. Below the alluvial soil and gravel a hard shelly limestone, 32 feet in thickness, was encountered. The bore hole here was made slightly conical to admit of the taper end of a cast iron pipe being inserted and driven tightly, to exclude any surface water, and to prevent water from the bore escaping into the gravel, and thus lose its full power to rise above the surface. The boring was then continued through various beds till it reached a stratum, 6 feet thick, of compact and hard rock, in passing through which, at 92 feet below the surface, the tool fell suddenly about 2 feet, evidently into a chasm or hollow, striking upon the hard surface of the underlying rock. The water immediately rushed up with great force, and drove the men from their work; and it was not without difficulty that the joints for attaching the curved pipe and sluice valve at the surface could be accomplished.

The site of the town of Bourn partakes of the ordinary character of the country, and is flat; the highest part, where the well is situated, being only about 6 feet above the general level. It had been the intention of the author, should the water rise with sufficient force, as he believed it would do, to supply the town direct from the boring, and in this way the work was carried out, the flow and pressure having proved even greater than was anticipated.

An air chamber was fixed at the well to regulate the pressure, and to equalize the supply of water to the town. The water rose at the Town Hall exactly 39 feet 9 inches above the ground. The yield at the bore and surface level, ascertained by filling a tank capable of containing 5,000 gallons, was at the rate of 567,000 gallons per day, and there was no diminution on letting the whole run continuously to waste. The yield was also tested by a "notch board," which, by using the coefficient 0·563, and measuring at still water and not at the "crest," gave 575,201·8 gallons.

The author knows of no other boring of like dimensions, either in this country or on the Continent, which yields so large a quantity of water, or where, the boring being made on the general level of the surrounding district, the water from which flows to so great a height above the ground.

It is needless to say that the town of Bourn has since enjoyed an unlimited supply of pure water without the assistance of engine, pumps, or reservoirs, and in far greater quantity than it requires.

The town of Spalding, several miles distant, has subsequently been supplied from the same source, the water being conveyed by pipes laid under the turnpike road. The water mains were laid under every street, with fire cocks at intervals, and it was satisfactory to all, and surprising to some, to see the water thrown upon the roofs of houses by a hose and jet pipe, as from a fire engine, and that only by the natural pressure of the spring.

The water, by Professor Brand's test, gave 19·4 degrees of hardness, arising chiefly from the presence of bicarbonate of lime; but by boiling it is rendered much softer.

* From selected papers of the Institution of Civil Engineers, copied from *Engineering News.*

Field of the Telephone.

Professor Bell is sanguine that the usefulness of the telephone has by no means as yet attained its natural limit. Since the recent decision sustaining the patents of the American Bell Company, he has been devoting himself with assiduity to experiments intended to improve the telephone, with the idea of making it feasible to speak over longer distances than is now possible. In a recent interview with a newspaper reporter, he predicted that it would in time be as easy "for a subscriber in New York to call up a friend in San Francisco, and to engage him in conversation, as it would be to call another subscriber to the telephone in the city of New York." The service between New York and Boston, by means of a circuit of double copper wire, is now said to be working very satisfactorily; but Professor Bell thinks that all wires in cities should be placed underground, that "the efficiency of the telephone cannot be fairly judged and tested in a large city, where the wires are supported on poles and buildings."

Prof. Bell does not believe in the relay system for strengthening the current along the line, but believes that the sound can be so intensified at the receiver as to be heard in the remote corners of a large room. As to this point, he says: "We find this difficulty—when the sound is intensified, it is at the expense of distinctness and of perfect articulation. This fault can probably be corrected in a measure, so that if persons desire it they will be able to sit some distance from the telephone and hear all that comes through the receiver. The transmitter can also be made to convey sounds brought to it from a distance."

Besides his direct experiments with the telephone, Professor Bell has long been actively interested in efforts to promote the education of deaf mutes. He has, in this connection, invented an instrument for accurately measuring the hearing capacity of the human ear. It is composed of one stationary and one sliding coil, between two horizontal rods, on one of which is a graduated scale reduced to the metric system. A telephone receiver is attached to the instrument, and the current is supplied by a magneto-electric machine which has a wheel composed of alternate sections of conducting and non-conducting surfaces, by means of which the current is rapidly and regularly closed and opened. A musical sound is produced, which the telephone receiver communicates to the ear. Holding the receiver to the ear, the operator moves the sliding coil from the stationary one, and as the distance between the coils increases the sound grows fainter and fainter, and finally is lost altogether. The scale on the side rod marks the point which the sliding coil had reached when the sound ceased to be heard. If a standard of normal hearing capacity can once be obtained, it will be an easy matter to measure the exact capacity of every ear which is tested. Every element, by the use of this instrument, is calculable.

Professor Bell has tested this instrument in some of the New York public schools, and estimates that ten per cent of the children attending them have slight defects of hearing. He says that "one per cent of this number are so deaf that they derive no benefit from the usual methods of instruction. The scholars know, of course, when their hearing is bad, but the teachers, as a rule, do not, and often think a child dull when it is only deaf. If the teachers were aware of the infirmity, and understood it, the pupil whose hearing was defective could always be given a position in the room and classes which would enable him to profit by the instruction which he is now, in many cases, losing. I find a great difference in the hearing capacity of people. Some persons can hear equally well with both ears, but most persons have a greater hearing capacity in one ear than in the other. The hearing capacity ranges from zero to an abnormal degree of acuteness."

Carbonic Acid Fire Extinguisher.

A new method of utilizing carbonic acid gas for extinguishing fire is now being introduced by Mr. Monch, of Berlin, several establishments in Berlin having been fitted with the apparatus. The system depends upon filling the room where a conflagration has commenced with a sufficient quantity of carbonic acid gas to suppress the flame. The apparatus consists of a wrought iron receiver of sufficient strength to resist a pressure of 250 pounds to the square inch, and which is filled with highly compressed carbonic acid. This receiver can at any time be charged by means of a battery of wrought iron flasks connected to it. Such flasks, filled with highly compressed carbonic acid, are a regular article of commerce in Germany, and when attached to Mr. Monch's receiver, the latter can be filled with the gas as desired at any convenient pressure. From the receiver branch pipes fitted with valves are laid to the different apartments it is desired to protect, and which can at any time be filled with the gas discharged from suitable nozzles fitted to the pipes. Smaller and independent reservoirs are also made which can be carried easily from place to place, and the contents liberated at any desired spot. In Germany, where fluid carbonic acid forms a large and increasing industry, Mr. Monch's system would naturally find favor, and at one of the places where it has been adopted—the varnish works of Mr. Krauthammer, of Berlin—its efficiency has been proved by the prompt suppression of an incipient fire, which is the special role of this class of apparatus.

A Papier Mache Floor Covering.

A new papier mache process for covering floors is described as follows: The floor is thoroughly cleaned. The holes and cracks are then filled with paper putty, made by soaking newspaper in a paste made of wheat flour, water, and ground alum, as follows: To one pound of flour add three quarts of water and a tablespoonful of ground alum, and mix this thoroughly. The floor is then coated with this paste, and a thickness of Manila or hardware paper is next put on. If two layers are desired, a second covering of Manila paper is put on. This is allowed to dry thoroughly. The Manila paper is then covered with paste, and a layer of wall paper of any style or design desired is put on. After allowing this to thoroughly dry it is covered with two or more coats of sizing, made by dissolving one-half pound of white glue in two quarts of hot water. After this is dry, the surface is given one coat of "hard oil finish varnish." This is allowed to dry thoroughly, when the floor is ready for use. The process is durable and cheap, and, besides taking the place of matting, carpet, oil cloths, etc., a floor thus treated is rendered airtight, and can be washed or scrubbed.

Hudson's Bay Route to Europe.

The prospects of a proposed route from the Canadian Northwest to Europe *via* Hudson's Bay are not considered encouraging. A diary for August shows that ice prevailed in the straits for nineteen days out of the thirty-one, and that snowstorms prevailed on five other days. As the straits ought to be open during August, the outlook for the other months cannot be bright. Mr. J. W. Klatze, a Dominion Government official, who was sent to inquire into the feasibility of constructing a railway from Winnipeg to Hudson's Bay, has returned to Ottawa. He does not speak favorably of the ultimate success of the undertaking, and thinks, if it is ever accomplished, it will be at a price which few capitalists would care to pay. Putting the difficulties of the navigation of the straits and the almost insurmountable barriers in the way of constructing a railway to the bay together, the outlook for northwest settlers having direct communication by this route with Europe is not at all hopeful.

Natural Gas.

Many interesting points came up during a discussion of a paper upon this subject read by Mr. William Metcalf before the Engineers' Society of Western Pennsylvania at its November meeting.

In regard to the waste of gas, it was said that more gas is being wasted within twenty-two miles of Pittsburg than is being used to-day. There is, on a close estimate, 65,000,000 to 70,000,000 feet of gas going to waste in the Murraysville district. Take, for instance, the Verner well, the Hukill well on the McWilliams farm, and the Hukill well on the Daum farm. There are three large and one small well going to waste. There are three large wells blowing the gas to waste in Washington County. There are three large and one small well going to waste in the Tarentum districts to-day—one there giving out gas at a pressure of fifteen to seventeen pounds, with the casing wide open." One great well near Wellsburg, W. Va., has been burning for years, the loss being estimated at $1,200 per day. These cases of waste form but a small portion of the whole.

Wells are being drilled every day, and this waste is expensive. A well which one year ago gauged to fully ten ounces pressure, mercury pressure, is to-day blowing not more than eight or eight and a quarter ounces. Although this difference seems trifling, the quantity of gas yielded is enormously decreased. The advantages to be derived by the proper consumption of this gas may be inferred from the following: "The idea of blowing 50,000,000 cubic feet of gas away in a day right along, and then complaining that our competitors are selling iron cheaper than we can make it, and we not using this gas! One cause of the decrease in the flow is attributed to the pores of the rock becoming choked with incrustations of salt and "gas dust." Blasting with light charges of nitro-glycerine might be of use, as a greater area with new pores would present themselves for the exit of the gas; but in the case of wells about Pittsburg it is necessary in blasting to make sure that the gas rock stratum is not so much shattered as to admit water from the salt water veins below." Pieces of rock have been brought up to the surface [from blasted wells], and on the pieces you find little barnacles, or rather a substance looking like barnacles. You see a large hole next to the rock, and a little lower another one somewhat smaller, and then get smaller and smaller until it forms a cone, and the last layer of that cone closes it up entirely." In some wells that get plugged it is found that in the rock next to the shell the holes are closed by paraffine. There is no way of stopping it when the ocean of salt water under the gas veins gets broken into; this is known among drillers as the Atlantic Ocean, because analysis of it shows it to be of very nearly the same composition as the ocean itself.

Waste of gas has been stopped by the wells being plugged, but the task is a difficult one, and the result is not always successful. Therefore the pertinent question came up: "Could not some of our mechanical engineers invent some sort of a tap pipe with a sliding valve on it that could be left out when the gas was struck, so that the pipe would be enabled with the valve to prevent the waste?" The reply was that this had been tried, "and the only success it met with was to bore a hole through the top of the derrick." So far all the valves have been made for the casing, and the idea was advanced to have a heavy pipe for the top, and arrange the valve so as to use it or not, as required. The plan of stopping the drill before entering the gas stratum was cast one side, since in undeveloped districts there would be no certainty that the gas could be obtained when needed, by simply completing the bore.

In addition to its use in the manufacture of iron, it is believed that natural gas will soon be largely employed in the making of glass. The operation of annealing, now so difficult and troublesome, could be soon perfectly performed with the aid of natural gas, since it can be so utilized that it can be shut off so easily and gradually as to let the molecules of the glass come to their normal position without strain.

Another application of this gas is to the manufacture of very thin sheets of metal, either iron or steel, where the difficulty is in pickling the scale off in order to get a fine finished surface. By a process for which a patent has been asked the annealing box is brought to the requisite heat by the use of natural gas, and then a pipe, connected with the box, turns in a stream of the gas when the metal is hot enough, and allows it to pass through. The box is kept hot for some little time and is then cooled gradually, when the plates come out perfectly clean—as clean as tin, but not so bright.

Steel Bridge in South Africa.

The first steel bridge in South Africa, and the first bridge in the Orange Free State, was recently built over the Caledon River between Smithfield and Rouxville. It is of the bowstring type, is in four spans 650 feet long, and the total length, including approaches, is 1,200 feet. It stands 50 feet above low water mark, and the lowest part of the superstructure is 10 feet above the highest water mark ever known. The piers are 12 by 30 feet, are of stone masonry laid in cement, and rest on solid rock. The whole weight of the superstructure is 350 tons including all necessary timber. It was erected on a staging made of steel wire ropes, one inch in diameter, stretched from pier to pier, with wooden trestles on top to make up for the sag caused by the weight of each span. This method worked admirably, and the structure was completed without hitch or accident of any kind. The bridge cost $160,000, including $5,500 duty paid to the colonial government for material; it was built by Messrs. Scrimgeour Bros., of Port Elizabeth, to whom we are indebted for the foregoing particulars.

Automatic Car Couplers.

As the result of recent examinations, the Railroad Commissioners of the State of Massachusetts recommended for adoption by the companies of the State either one of the following self-acting couplers: The Ames (hook link), U. S. (link and pin), Cowell (hook), Janney (hook), Hilliard (hook). At a recent meeting of delegates appointed by the managers of the railways of the New England States, sixteen roads and six States were represented, namely, Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut, in all fifty-six votes. After considerable discussion and voting, the preference of the delegates finally settled upon two of the above couplers as the best for general adoption. These were the Ames and the Cowell couplers, each of which received 22 votes, or 44 in all—12 votes not being cast. Illustrations of these couplers will be found in SCIENTIFIC AMERICAN SUPPLEMENT. A resolution was passed calling for a national convention of railway representatives to consider and decide upon the best form of automatic coupler for general adoption.

The American Exhibition, London, 1886.

The above is the designation under which an exhibition is announced to open in London in May, 1886. It is intended to be so arranged that a visitor on entering will be reminded of the approach to this country through New York harbor, and thence taken in imagination by successive stages to the most prominent objects usually sought by sightseers, including a "trip across the continent," the whole being so arranged as to exhibit the arts, manufactures, products, and resources of the United States, of every kind, from the broker's office in Wall Street to the camp fires of Nevada. Applications are said to have been already made for considerable space in this unique exhibition from prominent American manufacturers and patentees. Mr. John R. Whitley is the Director-General, and Charles B. Norton, Secretary, 7 Poultry, London, E. C.