The Scientific American.

MUNN & COMPANY, Editors and Proprietors.

PUBLISHED WEEKLY
At No. 37 Park Row (Park Building), New York.

O. D. MUNN, S. H. WALES, A. E. BEACH.

TERMS—Three Dollars per annum—One Dollar in advance, for four months.
Single copies of the paper are on sale at the office of publication, and at all periodical stores in the United States and Canada.
Sampson Low, Son & Co., the American Booksellers, No. 47 Ludgate Hill, London, England, are the British Agents to receive subscriptions for the SCIENTIFIC AMERICAN.
☞ See Prospectus on last page. No traveling agents employed.

VOL. VIII, NO. 22...[NEW SERIES.]....*Nineteenth Year.*

NEW YORK, SATURDAY, MAY 30, 1863.

MALLEABLE IRON AND STEEL FROM PIG IRON.

What is called the "Bessemer process" for converting pig iron into steel and malleable iron is generally understood to consist in forcing currents of air through molten pig metal as it is run off from a smelting or a cupola furnace. By this process it is held that the oxygen of the air-blast combines with a portion of the carbon which exists in excess in the pig iron, removing it in the form of carbonic acid gas. The extraction of a small quantity of carbon from the crude metal still leaves sufficient to form steel, which is a compound of iron and carbon; the removal of a larger portion of carbon reduces the metal to malleable iron. Immediately after this process had been prominently brought before the public, some years ago, it was noticed that while good steel was produced at one smelting, very inferior steel sometimes resulted at the next smelting, although the operations had been conducted in precisely the same manner. So much uncertainty was felt respecting the quality of steel and iron thus produced, that the process was held to be impracticable in its application on a large scale. But Mr. Bessemer devoted himself to the subject of investigating the causes of uncertainty in securing uniform results, and at last he worked out the problem, for his process is now practiced in England, Sweden, Germany and France, and also used in the works of Corning Winslow & Co., near Troy, N. Y. Thousands of tuns of steel are made annually by it in Europe and its use is rapidly extending. It was found by Mr. Bessemer that different qualities of pig iron gave different results, and that workable steel could not be produced by the mere passing of air through all kinds of molten pig metal. It was observed that although the excess of carbon was removed by the blast, other impurities, such as phosphorus and sulphur that are common to inferior crude metal, remained. The next course was to experiment with the best pig iron, the quality of which was known to be uniform. With Swedish charcoal pig-iron uniform success attended every effort, and similar grades of steel were produced at every smelting. Thus, in a general sense, the process was perfected for practical application. With the best brands of Swedish pig iron good qualities of cast steel and bar iron for forging are now asserted to be made by this process. The loss of weight in the material in converting the crude iron into steel is from 12 to 15 per cent; in converting it into bar iron, from 18 to 22 per cent. A tun of molten pig iron may be converted into steel in seven minutes—the pressure of the blast used ranges from seven to twenty pounds on the inch, according to the quantity of metal smelted. About 1,200 cubic feet of air is required for refining a tun of metal, and a better result is obtained with this than a smaller quantity. It is indispensable to the production of good steel and bar iron, by this system, that the best qualities of pig iron be used; yet coarse steel, called "semi-steel," and common malleable iron may be made from inferior pig iron, by using a small quantity of manganese and Franklinite pig iron mixed with it.

As it is now better understood, this peculiar refining process commends itself to many of our iron manufacturers. By a simple and not very expensive arrangement of apparatus and mechanism they may produce medium cast steel and bar iron from pig iron at a small cost compared with the tedious modes now practiced, consisting of several re-heatings involving a great expenditure for fuel and mechanical labor. The magnetic iron ores are abundant in Maine, New Hampshire, Massachusetts, New York, New Jersey and other States, and from these, when smelted with charcoal, pig iron can be obtained, similar in every particular to the Swedish brands. Our natural supplies of this ore are inexhaustible, and with anthracite coal it may yield superior pig metal, as that fuel does not contain sulphur like the coke made from bituminous coal. This is a subject of vast importance. Iron is now superseding wood in every department of engineering and mechanism, and every effort should be made to improve its quality and reduce its cost. The demand for it seems to increase faster than the supply. In house-building, bridge-building and ship-building it is fast becoming the leading material, and there can be no question of the fact that, with an abundant supply of cheap steel, all the useful arts will be benefited and advanced.

A PNEUMATIC POST.

The instantaneous connection of remote points by mechanical means has become one of the necessities of the age. The stage-coach has had its day and it has been superseded by the locomotive, and even the business communication between cities, at one time easily transacted through the mails, has been vastly aided by the introduction of the telegraph. This latter medium is available for messages only, and if we desire to transport material we must, in the present state of things, have recourse to the rails again. Science provides a remedy for the matter in the adoption of the pneumatic post; and packages, propelled by atmospheric pressure, are now safely and swiftly transported from point to point in England. The question arises how far these lines are capable of practical development, and what degree of economy exists between the substitution of air as a propelling agent for the power of steam? These questions we cannot answer decisively, but they can be readily solved by experiment. The principle of the pneumatic post consists in applying the weight of the atmosphere to a sliding or rolling object in an exhausted tube; and it was formerly supposed, in the earlier experiments on this subject, that the degree of mechanical accuracy which was necessary to the perfect working of so subtle an agent as common air, would materially interfere with the utility of the scheme. It has been found, however, on the English lines at least, that mathematical accuracy was wholly unnecessary and that the inherent difficulties were over-estimated. It must be borne in mind, however, that the English line of pneumatic post is quite short and is worked at what we consider a low rate of speed, that is, from 20 to 30 miles an hour; we do not state this positively, but we have been so informed. At such speeds there can be but little advantage derived over the ordinary means of communication, since the express trains, running at 40 and 45 miles an hour, would outstrip the pneumatic post. The only way in which a line of this kind could be rendered superior to the ordinary methods of transportation would be in having the speed of the package transmitted under control, so that greater or less rapidity could be given to it, as desired. Where the working pressure is a fixed quantity, as in the case of an exhausted tube, it is manifest that the means of regulating the velocity of the goods forwarded must be very uncertain. If, however, we modify the apparatus, so that instead of depending on the simple pressure of the atmosphere against an object *in vacuo*, we not only obtain a vacuum but also condense the air behind the package to be driven through the vacuum, we shall have a force limited only by the extent to which the air is condensed, minus the difficulties existing in the tube and car. These difficulties will be apparent to all who have ever given attention to the subject.

An apparatus on this principle has been already experimented with. We recently saw a short line at Carhart and Needham's extensive melodeon manufactory in Twenty-third street, this city; and no serious objections were apparent to us in the general plans of the inventor, Mr. Needham. The idea (we are at liberty to make it public) is simply an endless tube having relays of exhausters, most suitable for the object in view, at various intervals. The car containing the package is placed in the tube, and the exhausting apparatus set in motion. The package constitutes a diaphragm or partition in the tube, and the air is removed from before it and delivered behind it by the same machine. This is simply the idea and it worked well in the imperfect wooden model which we have mentioned. The proper means were pointed out to us for checking the package car at the station, and for removing the contents at any station almost instantaneously. This scheme is perfectly feasible and one that should be tried on a larger scale. Operated almost entirely under ground, the pneumatic post is open to none of the objections which apply to express companies generally, and there need be none of those expensive and cumbrous vehicles which are used by companies of the kind last-mentioned. English enterprise and energy have outstripped us in this respect, and there is at present a line of pneumatic post at work in London. Steps ought to be taken in this matter and the subject looked at in all its bearings at once, so that if there are as many advantages to be derived from it as there would seem to be, the people should have the benefit of them.

INTELLECTUAL TOOLS.

It is a matter of very great surprise and regret to us to hear, as we have heard, mechanics exclaim when recommended to take this or that mechanical work—"Oh! I don't want that," or "I guess I can't afford it now," and kindred objections mistimed and ill-applied. These men were not, as many would suppose from their exclamations, ignorant; on the contrary, they eagerly sought all means of obtaining practical knowledge of their professions and were emulous of the first position as artisans. If their tool-chests were examined the result would disclose a complete assortment of the most improved instruments in use, and a great many others not generally known, that the ingenious makers had contrived for special needs and ends. When the hours of labor were transpiring, the men of whom we speak were diligent at their duty, but when their work was done those men lost sight of every thing and let the "shop" go until the next day. A proper relaxation of the mental powers is just as necessary to perfect health as rest to the over-taxed body, but an utter neglect of mental culture brings its own punishment with it.

It is impossible for any workman to keep up with the spirit of the age unless he consults such works as are published for his special benefit. If he ignores utterly and wholly the discoveries of men of science at home and abroad, he alone will be the loser by it. A mechanic may be very skillful, intelligent and apt at his calling, but he does not combine all the mental energy of the period, and however enterprising he may be, there are others, his equals and superiors, who might benefit him if he would only lend an ear to their teachings.

There are undoubtedly many seasons in the life of an artisan, as there are occasions in the personal history of every individual, when he feels straightened in his circumstances and unable to afford the small sum necessary to purchase intellectual aliment. But if we look upon these papers, books, or whatever form the knowledge is issued in, as *tools*, we must admit the justice of purchasing them at some sacrifice of needless gratification. On the one hand we see a mechanic furnishing his mechanical *repertoire* with all modern appliances wherewith to prosecute his business successfully, but on his intellectual needs he expends not a cent. We have all read the fable of the hare and the tortoise; how the former challenged the latter to a race, and, confident of his ability to outstrip his toiling antagonist, set out in the morning, ran awhile, then sat down and slept. While he slept the tortoise, slowly but certainly, devoured the way and reached his goal just as the hare came panting up too late. The brilliant but unlettered mechanic is the hare who runs his race in the heyday of his powers, while the less gifted individual, who depends not alone on the work of his hands, but unites brain with muscular exercise, achieves his end not less quickly and much more certainly, than he who relies blindly on mere dexterity. It is only by a proper union of intellectual cultivation with man-

ual dexterity that the most eminent mechanics have succeeded; and those who aim at renown but despise the road thereto will do well to remember this fact.

THE IRON-CLADS AT FORT SUMTER.

Now that the smoke of battle has cleared away, and the fearful cannonading at Fort Sumter, which so annoyed the twittering reporters has ceased, we may review the event dispassionately and with reason; at least, in so far as it concerns the offensive and defensive powers of the *Monitors*. The daily press, through its accredited representatives, made great haste to assure the public that their favorite batteries, those in which (not unwisely) they placed the greatest confidence, were altogether unsuitable and, in fact, were not available against heavy artillery. At the time we were compelled, against our judgment, in view of the overwhelming representions of these self-constituted authorities, to accept as a fact that we were beaten in the contest and compelled to retire from the fort by sheer force alone. Even at the time of the action, and in days supervening, that portion of the press of the country who criticized the conduct of the attack were immediately frowned down, and, to say the least, sent to "Coventry" by other papers, whose interests or opinions led them to sustain the part our commanders took on that occasion. We were treated with graphic accounts of the effects of the rebel shot on the *Monitors'* turrets, and it was asserted that the most destructive shot that was fired on the occasion struck the *Passaic's* turret near the top, and after scooping out an immense portion of it, broke all the eleven plates and spent its force on the pilot-house, which it very nearly demolished. This is the spirit, if not the exact letter, of the accounts furnished. Now, we have examined the turret of the *Passaic* since her arrival here for repairs, and with all due respect for the reporter's rhetoric and his sensatorial paragraph, we must say that it is *bosh*. The shot *did* strike the turret, *did* scoop out a portion (which might weigh 25 pounds), and did strike the pilot-house with great force, besides breaking the turret plates in its passage. But what of all this? When iron meets iron (as when Greek meets Greek) then comes the tug of war, and it is not to be supposed that a shot moving at the rate of say 1,500 feet per second will strike an iron structure in its weakest part and not damage it.

The simple facts of this loudly-trumpeted performance of the rebels are that the shot which struck the *Passaic* did not endanger her safety in the least; for all the effect they had on her externally she might have been fighting away till this hour and, in reality, have been none the worse for it. We have examined the shot-marks on the *Passaic*, said to be sixty-eight in all, though we did not count them, and find an accurate representation of the Whitworth shot impressed in the turret in many places. If these much-boasted projectiles are not able to do any greater damage than they did, we may safely defy all the English iron-clads and their armaments. The Whitworth shot or *fac-similes* of them, in a majority of cases struck sideways; they reached the turret in all possible positions and show very poor shooting on the part of the rebels. There were several bolts driven in on the turret which injured the persons within; but the majority of the indentations and scars could be covered by and filled with a common tea-saucer. These are, simply, the "terrible" effects of the rebel shot. Now what person possessing ordinary judgment and at all conversant with the properties of iron, could conscientiously report that the *Monitors* were unable to cope with artillery? For our own part we assert that the favorable opinions hitherto expressed in regard to those vessels have been greatly strengthened, and we do not hesitate to say that, with the present artillery, they can successfully defy any fort or any iron-clad afloat; so far as the impregnability of their armor is involved we would not hesitate an instant to confide our personal safety to the thickness of their walls. We have no desire to disparage any official in connection with this subject, but so far as the *Monitors* being disabled (except temporarily) in the late attack is concerned, we must avow our utter skepticism. The *Passaic* is the only iron-clad sent North; *ergo* the *Passaic* must be the one most injured. What injuries are those that merely indent iron plates, and what terrible shot those must be which strike and leave no sign internally to tell the story of their spent force and impotent rage! We think a much better sensational report could have been made on the occasion by writing the facts: How the minions of the rebel Government did their utmost to demolish the *Monitors* and how signally they failed; how, backed and aided by English capital and skill, they hurled their powerful projectiles against the impenetrable iron-clads and were worsted in the encounter; how grandly those little vessels withstood the enemy's fury; and how, saving one poor little eggshell craft, they bore unflinchingly the most furious cannonading that was ever known, in the shortest space of time. These features would have been worth commenting upon, and were we in the rebels' situation we should prefer a naval assault to take any shape but that proceeding from a fleet of those vessels. Properly handled and armed they can defy any ship now floating; and improvements are being made which will render their utility past all doubt.

We have considered in this light merely the question of the impregnability of the *Monitors*—supposed to be the first requisite of a modern war-vessel; that they have other objectionable features we do not deny, but taking them as representatives of fighting machines—the greatest offensive power in the very smallest compass—they cannot be excelled, and the nation does well to estimate them among its staunchest defenses.

It is singular, in viewing the effects of the shot on the *Passaic's* turret, to note that they exhibit none of the characteristics of a plunging fire. The shot that "scooped out a tremendous portion" of the top of the *Passaic's* turret struck the pilot-house at nearly the same hight, showing that it must have been fired at point-blank range, or nearly so. So also those that struck the base of the turret—no marks are visible on the deck which would lead the observer to suppose that the missiles were fired from such an elevation as the barbette of Fort Sumter; and we conjecture that the batteries on Morris Island and Battery Bee must have taken a hand in the engagement, although we think it is stated in the reports that those batteries were silent. We hope, when the *Monitors* attack Charleston again, they will go there with the intention of doing their duty, and not come back with school-boy tales of monstrous torpedoes. The sluggard will not plow by reason of the cold; and the fool saith "There is a lion in the streets, I shall be slain without!"

The Income Tax.

We copy the following explanation of the income-tax law from the *Legal and Insurance Reporter;* the whole matter is very simply explained, and will be found useful to many of our readers:—

"Every person must make a return of the receipts of his business, or of his property of every description. Guardians, trustees and administrators must do the same in their character as fiduciary agents. The assessors decide what deductions the law allows, but assessments are submitted to examination, and appeals may be made. If persons refuse to make a statement of their income, or the statement is not deemed to be true, a list will be made on the best information the assessors can obtain, subject to the oath or affirmation of the persons assessed, as prescribed by the law. Mechanics, manufacturers and merchants will return the whole amounts of the avails or revenue of their business, and a statement of the expenses of the same for labor, material, &c. Co partners will return their share or interest in the co-partnership income; corporators, the amount of profits, whether in the form of dividends or otherwise. Salaried men will return the full amount of the salaries received. A return must be made of the income or dividends derived from stock in any bank, insurance company, savings institution, trust company, railroad, railroad bonds, steamboat, ferryboat, or bridge, between January 1, 1862, and August 31, 1862, inclusive. The net gains or profits of manufacturers must be returned. All income received from bonds, mortgages, notes, stock in gas companies or manufacturing companies, during the whole of the year 1862, is to be returned and taxed. The deductions made from the aggregate income of any person, are $600 in the first place; State and local taxes of the calendar year, January 1, 1862, to December 31; interest, dividends, &c., of stock in banks and other moneyed corporations, from which the statute tax of three per cent. has already been deducted or retained, *i. e.* since August 31, 1862. Receipts derived from advertisements on which a duty shall already have been paid; the rent actually paid for rent of a dwelling-house or estate, the residence of persons assessed. The value of rent of house occupied by owner is not deducted. The amount of hired labor, and value of the board of such labor. Persons receiving rent are entitled to deduct the cost of repairs, insurance and interest on incumbrance upon rented property. The cost of extraordinary repairs, new structures, &c., will in no case be deducted."

DEATH OF BENJAMIN PIKE, SEN.

One of our old and much respected citizen mechanicians has lately gone "where the weary are at rest." Benjamin Pike, Sen., the well-known philosophical instrument-maker, died at his residence in this city on the 2d inst., at the advanced age of eighty-six years. Since his decease we have gleaned some interesting facts respecting his life and character. Mr. Pike was born in London in 1777, and came to this country in 1798, at the age of 21 years. In 1805, he established himself in business, in this city, as an optician and manufacturer of mathematical and philosophical instruments, and he soon became widely known for his mechanical skill. He was an enthusiast in his profession and gave it his undivided time and attention. His ambition was to serve the public with instruments equal to the increasing demands of science. He was a careful and diligent student; and after the labors of the day had ended he thoroughly informed himself of the researches and advance of natural philosophy. For half a century his store was the headquarters of scientific men, and he was the companion of Fulton, Eckford and others whose genius has done credit to our country. He manufactured models and instruments for them, and he was really the great pioneer manufacturer of philosophical instruments in America. Several years since he purchased a farm, a short distance from the city, which afforded him much quiet pleasure in his declining years, but to the last he manifested a deep interest in all things connected with skillful and ingenious mechanism. In manner he was unobtrusive and retiring, a man of few words but large ideas, and a consistent Christian.

Assistant War-Secretary Watson.

"The Assistant Secretary of War, Peter H. Watson, went to the State of New York to-day, to find in the quiet of a Delaware county farm, the health and strength which he has so prodigally wasted in the service of the Government. When the history of the gigantic struggle to save the great republic is written, mention will be made of those men who, noiselessly and in the recesses of departmental bureaus, have, with complete conscientiousness, great intelligence and that rare courage which dares pursue a line of duty through obloquy and opposition, organized armies, created navies, guarded the Treasury, purified administration and repressed domestic treason. Among these none will have a more honorable or enduring fame than the Assistant War-Secretary, Watson.''

[We copy the above from a special dispatch of the New York *Times*, and can heartily endorse these deserved words of commendation. Mr. Watson is one of the most laborious and faithful men in the service of the Government.—Eds.

Fast Naval Steamers.—Two fast steamers are to be built at once for the Government; capable of overhauling any foreign ship now afloat. Mr. Delano, the naval constructor at this port, and Mr. Henry Steers of Greenpoint, are to furnish each a model, while Mr. E. N. Dickerson is to design the engines. The vessels will be about 300 feet in length and 8,000 tuns burthen.

It is stated that an Irish girl, an operative in Smith's paper mill, Lee, Mass., recently found five genuine $1,000 Treasury notes in the paper rags, and another girl in another mill, in another lot of rags, found a gold chain valued at $60.

Philadelphia receives $400,000 per annum for water rents.