Steel Under the Microscope.

An experienced steel maker can estimate very closely the precise quality, chemical composition, tensile and compressive strength, and even the mode of treatment which a steel has undergone, by looking at its fracture. The appear ance of the crystalline texture which is more or less discernable by the naked eye, and the method in which the reflected light gives certain variations of luster, are the scanty yet very important indications from which, by a series of guesses as to probabilities, an opinion may be formed which has every chance of being correct. This being the case, it seems very obvious that, by the assistance of the microscope, we should be capable of observing the texture of steel and iron fractures more correctly and more minutely, and a smaller amount of experience or nicety of observation should be sufficient—should enable us to form a correct opinion of the qualities of any given sample of steel. This is the case, and to such an extent that it is most astonishing how metallurgists could have neglected the use of the microscope to such an extent as it generally has been. We have already drawn attention in this journal to the interesting researches made by M. Schott, the manager of Count Stöllberg's foundery at Usenburg, upon the appearance of liquid and solidifying cast iron under the microscope, and we can quote the experience of this metallurgist as to the advantages to be obtained from microscopic observation of various kinds of steel. M. Schott, at his visit to the Paris Exhibition, made some most remarkable "guesses," as some steel-makers would call his conclusions, with regard to the qualities and method of manufacture of many hundreds of steel samples exhibited there, and of which he, in many cases, had no other knowledge than that which he could gather through the aid of a small pocket microscope, made of two pieces of rock crystal, formed into a very powerful single lens. A pocket microscope of this kind ought to be the companion of every man interested in steel manufacture. Lenses of the usual kind, even if piled up in sets of three or four, are entirely insufficient. The lens must be of a very small focus, and properly achromatic. A little practice is sufficient to enable the user to "see" through this lens; but it is, of course, not quite so easy to learn the meaning of what is thus seen, and to estimate from the appearance the quality of the steel inspected.

M. Schott has established for himself a kind of theory which, we believe, will be useful to those of our readers who desire to use the microscope in their researches upon the qualities of steel. M. Schott contends that each crystal of iron is an octahedron, or rather, a double pyramid raised upon a flat square base. The hights of the pyramids in proportion to their bases are not the same in different kinds of steel, and the pyramids become flatter and flatter as the proportion of carbon decreases. Consequently, in cast iron and in the crudest kinds of hard steel, the crystals approach more to the cubical form from which the octahedron proper is derived, and the opposite extreme, or the shaft wrought iron, has its pyramids flattened down to parallel surfaces or leaves, which, in the arrangement, produce what we call the fiber of the iron. Between these limits, all variations of hights of pyramids can be observed in the different kinds of steel in which these crystals are arranged more or less regularly and uniformly, according to the quality and mode of manufacture. The highest quality of steel has all its crystals in parallel positions, each crystal filling the interspaces formed by the angular sides of its neighbors. The crystals stand with their axes in the direction of the pressure or percussive force exerted upon them in working, and consequently the fracture shows the side or sharp corners of all the parallel crystals. In reality good steel under the microscope shows large groups of fine crystals like the points of needles, all arranged in the same direction, and parallel to each other. If held against the light in a particular direction, each point reflects the light completely, and a series of parallel brilliant streaks are shown all over the surface. Now, the exact parallelism of the pointed ends or of the streaks of light is one of the most decisive tests for a good quality of steel, and this is not visible quite so frequently as might be generally imagined. On the contrary, a great majority of steel fractures show crystals arranged in parallel groups or bundles, as before described, but clustered together in several distinct crystalline layers, which are not parallel to each other. The consequence is that the needle-points, visible under the microscope, appear to cross each other at certain places, or at least they point in such directions that, if elongated, these lines would cross each other at a short distance in front of the fractured surface. Wherever the crossing actually takes place, a ridge or line is generally visible to the naked eye, and the color of the two parts of the fractured surface which contain the different groups is different, since the light which falls upon one group at the proper angle for reflection will be in such a position with regard to the other group as to throw the points of the crystals into the shade. The one part of the surface, therefore, will appear bright or silvery white, while the other will look dark or grey in color. As usual, inferior specimens are more instructive than the best qualities, because there the peculiarities and faults come out most strikingly. We have seen a piece of a Bessemer steel block from a spoiled charge, in which the crystalline structure of the spiegeleisen was seen in some spaces, particularly at the edges of the air-bubbles, perfectly distinguished from the coarse-grained crystals of the mass of steel all round. This mass, moreover, contained groups of very different character within itself. In a specimen of steel or iron, made by another process, we could discover clearly defined crystals of pyrites, indicating the existence of sulphur in an unexpectedly tangible manner. Repeated melting, heating, or hammering of steel has, in general, the effect of reducing the sizes of crystals, and also of laying them more parallel. Still there seems to be a difference between the treatment which gives parallelism and that which causes the reduction of sizes in the crystals. The former seems to be principally due to the action of the heat, and repeated melting is the great panacea in this respect. The small-sized crystals, or what is called fine-grain, can be obtained by mere mechanical operations. In fact, hammering at a dull, red heat, or even quite cold, is known to produce the effect of making the grain of steel extremely fine. This is a property, however, which is lost by reheating, and at a sufficiently elevated temperature, steel seems to crystallize in large grains, which remain if it is allowed to cool slowly and undisturbed by mechanical action.—*Engineering.*

Ice in Deep Mines.

The main entrance to the pits at Dannemora, Persberg, one of the oldest and most celebrated of the Swedish iron mines, is a natural opening or abyss, of so large a circumference as to require some fifteen minutes to walk around its mouth. A scaffold is erected out so as to overhang this abyss, upon which the hoisting machinery is placed. The observer can look down into this frightful abyss upward of 500 feet, to which point the light of day extends, and beyond which all is shrouded in darkness, save when feebly illuminated by the dim lights of the miners. One of the most remarkable facts connected with this mine is the large quantity of ice which is always present there. Professor Von Leonhard, in his "Popular Lectures on Geology," says: "The deeper you go the more the ice increases. And in order to remove it from the pits it must be raised up in buckets. At some places the ice is 90 feet thick; it forms real glaciers, which are never diminished by any change of external temperature. This fact, however, should not be regarded as contradictory to another, which will hereafter be illustrated, and which is that pits become warmer in proportion to their depth. The phenomenon at Persberg, as we shall see, can be explained on natural principles. When the visitor has reached the bottom he is conducted by his guide into vaulted chambers, through immense regions of ice. Many of these vaults are so large that fifty men can conveniently work in them at the same time." This occurrence of ice in deep mines is not an isolated fact. Ice is found in the pits of Ehrenfriedensdorf, in Saxony. Leopold Von Buch tells us that formerly, in Norway, mining was prosecuted above the region of eternal snow. Wood, for the timbering, could not be had there, and its want was supplied by filling up a drift with water, and allowing it to freeze; passages were then cut through the ice as they were needed, the balance of the ice being left in lieu of wood for timbers. It is also well known, says the *Mining and Scientific Press*, that the ancient Peruvians obtained ores on the Cordilleras, in places elevated above the perpetual snow line. The mines of Rauris, in upper Austria, lie entirely within the glacier region, and most of the shafts open in eternal ice, clear as crystal; the miners' huts are surrounded with ice. On what is known as Gold Mountain one of the shafts is sunk 100 feet through pure glacier ice. A gold mine in the deep valley of the Alps, near Salzberg, is the highest in Europe which is now worked. There are two tunnels near this mine entirely surrounded with glacier ice. The miners of this region undergo great hardships from exposures, and to avalanches, which often sweep them to destruction while going to and fro to their work, or while reposing in their cabins on the hill sides. It is stated by one authority that there is a locality deep within one of the iron mines of Dannemora, already noted, where the mass of ice is 120 yards thick.—*Mechanics' Magazine.*

NEW PUBLICATIONS.

WHEELER'S HOMES FOR THE PEOPLE. Geo. E. Woodward, 191 Broadway, N. Y. Price $3.

This is one of a series of new works on architecture, just from the press of Mr. Woodward, who makes it a specialty to publish this class of literature. Gervase Wheeler, author of the work under consideration, had his manuscript ready for the press some years ago, but unfortunately the building where the work was in preparation was consumed by fire and the work of many weary months was lost. But what was this loss was the public gain, for there have been many improvements in architecture since the author's calamity, which he has introduced into the volume before us. The work is embellished with one hundred engravings of villas, cottages, and country houses of every order of architecture, with plans and estimates of cost.

WHEELER'S RURAL HOMES.

The author of "Homes for the People" has also published through Woodward, 191 Broadway, a similar but less comprehensive work entitled "Rural Homes," in which he not only illustrates plans of a number of cheap cottages, but also gives engravings of a variety of rustic furniture suitable for summer houses and lawns, such as settees, chairs, flower stands, etc. The author also gives hints as to the best mode of plumbing and heating country houses; also a form for drawing a specification and contract between the landlord and builder. Price $2.

WOODWARD'S RURAL ART. Geo. E. Woodward, Author and Publisher, 191 Broadway, N. Y. Price $1.50.

The volume before us is No. 2 of Mr. Woodward's annual, on the subject of architecture and rural art. It is not unlike Wheeler's works, noticed above, in its general character. Mr. Woodward designs to issue a work of this kind every year, adding all the new features and fashions in the construction and finish of country houses. Either of the above works will be found useful to builders or persons about to erect or furnish country houses.

HASWELL'S ENGINEERS' AND MECHANICS' POCKET BOOK. New York: Harper Brothers.

Mr. Haswell has long been known as one of our most experienced and reliable civil engineers. His Pocket Book is regarded as one of the standard works, for ready reference, in all that relates to engineering. For some time past the author has been engaged in enlarging and revising the matter contained in previous editions, and the result is now before the public. From about 300 pages he has enlarged the book to 650 closely printed pages, and we venture to say that no work of the kind has ever been produced which contained so much information upon the various branches of engineering, condensed into so small a space. The principal tables, rules, estimates, calculations, etc., employed in the mechanic arts, architecture, railroading, civil engineering, steam navigation, are given in the most convenient and intelligible form. Mr. Haswell's new book ought to be in the possession of every engineer and mechanic in the country.

MANUFACTURING, MINING, AND RAILROAD ITEMS.

Philadelphia claims to be the greatest manufacturing city in the world, except London. In 1866 the factories there produced over two hundred million of dollars worth of staple goods.

Turkey has projected three lines of railway, the first from Constantinople to Belgrade; the second from Enos, a short distance west of Constantinople, to Varna on the Black Sea; the third from Enos to Usknip in Northern Macedonia. The contract for them has been awarded, and the means will be furnished by English, French, and Belgium capitalists.

The gold yield for the country for the present year is about as follows: Montana $12,000,000; Idaho $6,000,000; Oregon $2,000,000; Colorado $5,000,000 Nevada $19,000,000; California $25,000,000, and miscellaneous $5,000,000. Total $74,000,000.

The common 60-seat American railway passenger car costs from $4,000 to $5,000 each, while the English style of railway coach introduced on a few of our roads cost about $14,000. There is a wide difference too, in the weight, in favor of the American car. The interest on the greater cost, and the hauling of the extra weight of the English car must be paid for by those who value exclusiveness sufficiently to use them. In cases where the English coach have been introduced here, they have not proved a profitable investment, and there is very little prospect of their being widely adopted.

The coal deposits of Russian America are pronounced valueless, the mineral being found only in small contorted seams. Iron is found in worthless beds of clay, and far up on the Konkon, gold may be obtained but under such circumstances that it is also valueless, being only workable two months in the year. Stains of copper have been found on rocks near Norton Bay, but no ledge or seam.

There is a stone quarried in Cornwall, Eng., called the Polyphant stone, which can be cut by a hand saw with ease when first mined, but in time becomes exceedingly hard. It occurs of a neutral grey color, and also of a green with red spots and is admired by architects for its chromatic effects.

The New York and New Haven railroad have just introduced a new system of warming their passenger cars, by means of hot water circulating through pipes placed under each seat. By following this plan all the heat is economized and thus keeping the feet of the passengers warm, the whole body experiences an agreeable sense of comfort. We hope to see other roads adopting this excellent mode of warming cars.

A train of thirty cars was loaded with railroad iron at the Cambria iron works, Johnstown, Pa., last week, the destination of which is a point on the Pacific Railroad over five hundred miles west of Omaha, Nebraska. The distance to be traversed is fifteen hundred miles, considerably more than half way "across the continent," and all this distance is to be traversed without transhipment of the iron.

The number of Bessemer steel converters now established in Europe, numbers 115, which are capable of producing half a million of tuns per annum. England with fifty-two converters turns out weekly 6,000 tuns. Prussia with twenty-two converters is the next greatest producer, 1,460 tuns weekly. Next comes France with twelve converters and 880 tuns; Austria, fourteen converters, and 650 tuns; Sweden fifteen converters, and 530 tuns. The Bessemer process is worked at one locality only in Belgium, and Italy has two establishments, with a very small yield.

South America does not propose to be outdone on the trans-continental question by its northern compeer. A project is on foot to extend the Valparaiso and Santiago railroad across the Andes to Buenos Ayres. A German engineer, Otto Von Armen, has surveyed the route, a company has been formed, the government has been applied to for a charter and grant of land on both sides of the track upon which they propose to establish German colonies, although liberal inducements will be held out to all other nationalities to settle there. As an instance showing how railroading pays in South America, it is stated that the road from Santiago to Valparaiso has earned during the past year the sum of $910,241, being quite an increase over the previous year.

The experimental elevated railroad in Greenwich street this city has been completed for quarter of a mile from the Battery. At the last meeting of the stockholders the engineer's exhibit of present and probable future cost, having been inspected it was unanimously resolved to proceed with the extension of the road one quarter mile further, to Cortlandt street, preparatory to its inspection by the State commissioners, as required by law.

The Massachusetts State Council, recently by a unanimous vote, annulled the contract made in July with Messrs, Dull, Gowan and White, for completing certain portions of the Hoosac tunnel, including the central shaft. They authorized the commissioners to take possession of all the tools etc., belonging to the State and to make an immediate settlement with the contractors. The reasons for this are that the bids for the contract were much too low and an increase of rates would soon be necessary, and the council are adverse to making any advance in that direction.

Recent American and Foreign Patents.

Under this heading we shall publish weekly notes of some of the more prominent home and foreign patents.

MANUFACTURING BRICKS.—E. W. Crittenden, Pittsburgh, Pa.—This invention relates to certain new and useful improvements in manufacturing bricks, designed for operating on a large scale, and more especially with a view of dispensing with the hard labor and expensive manipulations hitherto required in the process of brick making. The invention consists, 1st, in an improved means for crushing or pulverizing the clay, and bringing it to a proper elastic state to be molded or compressed into bricks. 2d, in an improved means for molding and compressing the clay into bricks, and 3d, in a novel and improved means for drying the compressed clay, or unburnt bricks to render them suitable for burning in the kiln.

SAFETY ATTACHMENT FOR WATCH POCKETS.—Edward Williams, New York city.—The present invention relates to an attachment to watch pockets of wearing apparel, the object of which is to prevent the abstraction or removal of the watch carried in such pocket from the same, without the knowledge or consent of the wearer or owner, thereby obviating all possibility of the watch being stolen when the person wearing it is in a crowd, or otherwise favorably situated for the operations of thieves, pickpockets, etc.; the said safety attachment being of such a nature and construction as to be easily manipulated by the wearer, and to offer no impediment to the free removal of the watch by such person.

MACHINE FOR HEADING AND SQUARING BOLTS.—Albert R. Bailey, New Haven, Conn., and Wilson W. Knowles, Plantsville, Conn.—This invention relates to a new and improved machine for heading and squaring bolts, and it consists in a novel arrangement of dies and a header, arranged to operate in such a manner that a square is formed on a bolt, contiguous to its head, of greater thickness than the body or main portion of the bolt, and the head and square formed on the bolt at one operation.

CORN PLANTER.—J. M. Sampson, Waynesville, Ill.—This invention relates to a new and improved corn planter, of that class in which the seed distributing device is operated by hand, the device being mounted on wheels, and all so arranged that a very simple, cheap and efficient corn planter is obtained.

BRUSH HOLDER.—Joseph Messinger, Springfield, Vt.—This invention relates to a new and improved holder, by which scrub-bushes may be firmly secured to a handle to admit of the brush being used without the necessity of the operator stooping over and working on the knees, as is now universally done. The invention consists in constructing the holder in such a manner that the handle thereof may be turned or adjusted in a position at right angles with the brush, or longitudinally therewith, and the holder at the same time be perfectly simple in construction, and economical to manufacture.

GATE SPRING.—W. W. Sutliff, Town Line, Pa.—This invention relates to an improvement in a spring for a gate or door, and consists of a flat, covered, metal spring, hinged at one end to the back of a gate, while the other end is free to catch in one of a series of notches in a block fastened to the post or frame of a gate or door, which spring, by its pressure, keeps the gate closed when it is not forcibly pushed open.

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