

THE BRAILLE SCHOOL FOR THE BLIND AT SAINT MANDE.

WITH the aid of the Société d'Assistance pour les Aveugles that he had founded, M. Pephau, on the first of January, 1883, opened at Maisons Alfort the Braille School, which, first transferred to No. 152 Rue de Bagnolet, in Paris, was afterward definitely installed at No. 5 Rue Mongenot, at Saint Mandé, by the General Council of the Seine, which has made a departmental institution of it.

This school supplies a want that has long been felt by the blind. The child who is admitted to it does not simply receive a very thorough primary instruction, but is developed physically by gymnastic exercises in the open air; and he learns also to like manual labor in passing an hour or so every day in a shop provided for apprentices.

But what care and what abnegation does it not require for such instruction! Of the children taken directly by their parents to Rue Mongenot, how many have been led thither only after a genuine fight of the representatives of the school with the families? It is because a blind child yields a good revenue. No one better than he can draw looks of compassion and good sized coins from passers-by. His infirmity yields receipts. There are professional contractors who exploit him to the great profit of his poor parents. If he enters the Braille School, farewell to all this; the source of an easy revenue is cut off.

Under these conditions the work of the Braille School is not only that of instruction, but, what is doubly difficult, is also disciplinary and social. Its accomplishment requires great intelligence and patience, and especially a genuine goodness of heart and much compassion for human misery. The union of such qualities in all of Mr. Pephau's fellow laborers precisely characterizes the institution created by him, and they exhibit themselves to the visitor as soon as he has crossed the threshold of the school.

See in the corner of the yard that young woman seated upon a very low bench. To her right and left are two very young children of the maternal school recently annexed to the establishment. She is teaching them the Braille alphabet. In the Braille writing, the letters are formed of a combination of dots. The children have to get used to counting the number of these dots and conjecturing the arrangement in order to learn to read. The instructress passes the child's fingers over the page of hieroglyphics with untiring patience, while she plays with the little one and amuses it until she has taught it to find its way in this maze of dots.

The touch is the sense that it is most important to render acute in the blind. This is not all sufficient, however, for hearing, smell and taste have to come to its aid. The development of these senses has to be undertaken methodically and rationally. Before forming an opinion as to the nature and bulk of an object, the blind child has been surrounded with hundreds of elements of observation, and has been taught to remark the hardness, roughness or sonorousness of an object, and then its weight, temperature and dimensions.

In order to attain sufficient precision in the recognition of the things or beings that surround him, the child must therefore devote his senses to numerous preparatory exercises. This is the task of the instructresses. It is facilitated at the Braille School by M. Balon, the director, who, putting his experience to profit, has grouped in one series of object lessons all the exercises capable of gradually making the development of the blind child's senses as perfect as possible. The study of lines, angles, surfaces and geometrical solids permits of learning the form of bodies by comparison. By familiarizing his hands and mind with various lengths (with sticks of 5, 10, 20, 30, 40 and 50 centimeters or of 1, 2 or 3 meters) and with spaces, the child is easily taught to estimate the dimensions of objects and also distances.

Through unremitting attention, knowing that many bodies have a special sonorousness or that the sonorousness varies according to the surroundings, the child succeeds in distinguishing the size of a room that he enters and the stature and age of the person who speaks to him. The voice, in fact, does not resound in the same way in a small room as in a large one, and does not impress the ear in the same manner coming from above or below.

To the blind everything has to be the subject of observations, such as the rolling of a carriage or of a street or railway car, the sound of a bell, the noise of a waterfall, the song of birds, the cries of animals, etc. Even his feet must furnish him with useful information as to the nature of the ground upon which they tread, whether it is macadamized, paved, etc. But, before the blind child has enough confidence in himself to mingle with life in general, or to participate in such acts of the latter as are capable of interesting him, how many patient lessons, how many wise counsels, and what ingenuity in the processes of teaching!

Nothing is more interesting than the spectacle of a class at the Braille School. To appreciate it, one should see with what rapidity and general accuracy the pupils answer the questions put to them by their mistress, such as those concerning the metrical system or natural history, for example. If a measure of capacity is put into their hands, they feel of it, weigh it with the hand, endeavor to determine the material by the rugosities of the surface and the density, and thrust their hand into it in order to ascertain its depth. If, in a lesson on natural history, any sort of an animal is placed before them, such as a starfish, mole, badger, squirrel, duck, etc., they pass their hands over its body in searching for the eyes, legs, teeth, and, in a word, the distinctive characters of each class and each animal. "This is a palmipede, madam. It has a wide bill; it is a duck," answers a pupil. "Strong legs, provided with sharp claws, long teeth directed forward, teeth sharp behind. It is a carnivorous animal, madam. It is a cat." "And this one?" "That is a rodent, a squirrel."

That a blind person can succeed in identifying an animal by feeling of its body is conceivable. But how he can indicate with precision upon a map or a globe such and such a country, such and such a river or such and such a town is not so easily explainable. In order to obtain such a result in the Braille School, the ordinary maps are replaced by maps in relief on which the principal towns, represented by copper tacks, con-

stitute so many datum points. You can revolve the globe and ask the pupil at hazard to find a city of Europe or Asia, and he will pass his fingers over the surface and locate the places for you at once. In the same way, he will go through the streets of a plan of Paris from one point to another in designating them by name and in telling you what he sees therein, for the blind person says "see" for "touch." Another and very simple method of teaching the pupils of this school the configuration of countries has been found. This consists in putting at their disposal those wooden block maps called games of patience that children who can see amuse themselves with.

The results of such instruction, which have more than once amazed pedagogues, are due in great part to the excellence of the methods and to the personnel whose duty it is to employ them.

Certain natural dispositions of the blind for study merit notice. Although the privation of sight creates an evident inferiority, it nevertheless contributes toward increasing the faculties of reflection and reasoning. The blind pupil has an advantage over the one who can see. He is not distracted, but follows his thought or the instructress's explanation and demonstration, without being diverted therefrom (as is too often the case with pupils who have their sight) by insignificant external manifestations, such as the flight of an insect or the grimace of a companion.

Such concentration of judgment gives a visible imprint to the character of the blind, and likewise serves as a motive to the intervention of their educators. The blind pupil does not care much for play. It is necessary to make him love sports. One succeeds in doing this quite easily, and the spectacle is certainly pictur-

tentive care on the part of the foremen and forewomen as that with which they are surrounded in school by the instructresses. The visitor experiences a true feeling of admiration before this beehive of industry where beings that had been seemingly destined to a life of ignorance are producing the wherewithal to assure them a tranquil and proud existence in the midst of a world from which an abyss seemed to separate them.—L'Illustration.

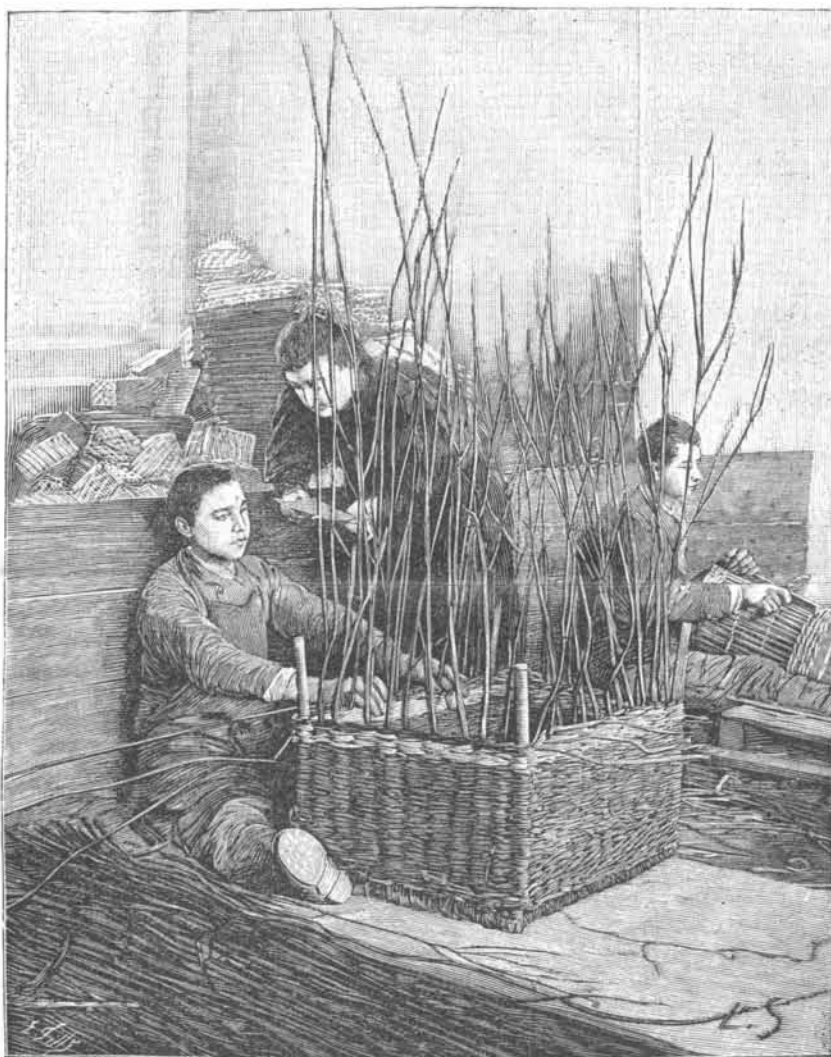
THE DEVELOPMENT OF THE AMERICAN BLOOMING MILL.*

By RALPH CROOKER, Jr.

THE Bessemer and open hearth processes are the survivors of many attempts to produce a cheaper or better material than that produced by puddling.

When these new methods of working iron emerged from the wholly experimental stage and became accepted commercial facts, they found the iron and steel industry already in a highly developed state. The crucible steel process was then about as perfect as it is to-day; while the making of puddled iron, stimulated to the highest degree by the building of railroads—which it had made possible—had reached a point which it has since excelled but little, if any, in quality; although for some years afterward it continued to increase in quantity.

It was to the machinery prepared for the handling of these materials—crucible steel and wrought iron—that the first ingots of the new processes—at first almost exclusively Bessemer—came, to be worked into the shapes that afforded the best market for them, or which stood



BASKET MAKING.

esque in the yard of the Braille School at the hour of recess, with the boys playing leap frog or running without coming into collision, and the girls skipping the rope or dancing.

Being the issue of parents upon whom poverty has left its impress, the children admitted to the Braille School are mostly of unsound constitution. Frequent gymnastic exercises, either in the yard or in an adjoining gymnasium, contribute toward the physical development of the pupils. At the age of thirteen, the latter leave the primary school for the shop. This they are already slightly acquainted with, since manual labor is included in the programme of the primary school. What will they be taught? Simple trades, but such as will nevertheless gain for them the wherewithal to live upon in independence. Some will make brushes, others will do basketwork, others will cane chairs, and others again will make pearl flowers.

The manufacture of brushes is done in the first story. Boys and girls are occupied in this in the rooms situated to the right and left of a small central shop whence, through glazed windows, the foreman and his assistants can exercise continual surveillance. It is interesting to see with what prudent skill the blind operatives use the cutting instruments, the handling of which is reputed to be dangerous even to those who possess eyesight. The same observation is applicable to the basket workers, who cut, shape and scrape the osier with assurance and without ever injuring themselves. Just as there are boys only in the basket shop, so there are girls only in that in which objects of pearl are made.

The caning shop, which is situated upon the ground floor, is mixed. It receives apprentices of both sexes. In a portion of this hall, a few of the children are employed in the manufacture of straw chairs, and here the beginners at all trades try their hands. The apprentices and operatives are the object of the same at-

most in need of such improvement in quality as they offered.

In England, where the greater part of the early development of the Bessemer was done, the ingots were at once sent to the hammer, and submitted to the same treatment as the crucible steel. I am unable to find that any attempt was made to roll it direct from the ingot during the first few years of Bessemer practice; a fortunate circumstance, I think all will agree, who are familiar with the characteristics of that early steel. The product of an English Bessemer works at this time—the middle sixties—was so small—from one to two hundred tons per week—and relatively of so little importance in the large English and Continental works, that the need of machinery especially to care for it does not seem to have been felt. It was a very simple matter to add hammers as the product of the Bessemer works increased, which it did very rapidly; and this was the universal practice, persisted in until the forge department of some of the works attained tremendous proportions, one firm alone having seventy hammers in use before abandoning the system, and making little or no change except to strengthen them and increase the size from four to five, and then to seven and ten tons.

The first to undertake the improvement of this state of affairs was Mr. John Ramsbottom. He undertook to improve the hammer itself, and brought out his duplex hammer, which consisted of two hammer heads moving horizontally toward each other on rollers, the heads being actuated by a steam cylinder through links, the ingot worked upon being placed between the hammer heads, and moved in a direction at right angles with their motion.

Several of these were put in operation, but they do not

* A paper read before the regular September meeting of the Engineers' Society of Western Pennsylvania.

seem to have altogether accomplished their purpose, at least they do not seem to have suited Mr. Ramsbottom, for he shortly afterward introduced his cogging mill, which was one of several devices brought forward at about the same time by different inventors, and the only one of them, so far as I can ascertain, which was ever put in practical use.

This mill in its general features was so nearly like the later blooming mills that one wonders how he managed to miss it. It consisted of a pair of huge housings carrying a pair of arbors, to which were bolted segments of cast iron, forming grooves which went part way around the rolls. The two rolls were made to turn in unison by means of pinions keyed to their necks, and were driven, through very high gearing, by a small reversing engine. The top roll was counterbalanced by a small hydraulic cylinder in the window of the housing between the necks, an arrangement made possible by the great diameter of the rolls—over five feet—and the top roll was forced down by a wedge, driven between the top of the housing and the top box by a hydraulic cylinder, operating through a rack and pinion. The vertical movement of the top roll with this arrangement was, of course, very limited.

While Mr. Ramsbottom was busy trying to correct

So at the latter end of the decade between 1860 and 1870, the universal practice in America was three-high and in England reversing two-high mills.

It is not surprising, therefore, that in its first blooming mills each country should have followed the form of mill prevailing at home; but so fixed was the difference of opinion as to their respective merits that each country stuck to its own, without a waver, for the next ten years, and without, seemingly, caring to know much about the other.

When it was shown that ingots could be bloomed successfully on the "top and bottom" rolls, larger reversing mills, built especially for the purpose, quickly followed, and several were in use at the end of the decade (1860-1870), although hammering was continued in some works for many years.

America did not begin its modern steel making as soon as England and Europe, nor did it advance so rapidly for some time after it began. There were several reasons for this. We were busy with a great war, which absorbed all our energies, most of our money and many lives, costs of installation and production generally were much greater, and uncertainty and dispute as to patent rights made it hazardous to enter upon such undertakings, so it was 1864 when the first

About six months later (July 10, 1871) the Cambria Iron Company put in operation a mill designed by Mr. George Fritz, which had much the same influence on American blooming mills as his brother's earlier invention had had on American rail mills, and fixed the type of mill in almost exclusive use for the decade. This, also, was a three-high mill; but it differed from the Troy mill in having its middle roll stationary, while the top and bottom rolls were movable. The top roll was counterbalanced, and the top and bottom rolls were moved toward the middle one between passes by screws acting together; they were, therefore, only obliged to make the full travel when opening to receive the ingot for the first pass.

The important feature, however, was the tables. These raised and lowered together by hydraulic power, and the tops were composed of rollers arranged to be driven from the main engine by gearing controlled by friction clutches. Combined with this was a manipulator, which consisted of a small car beneath the table with prongs on top of it, extending up through the table rollers when the table was down; this car was moved transversely to any desired position under the table by a hydraulic cylinder, and by lowering the ingot on to the prongs it could be turned, or by pushing the prongs against the side of the ingot it could be moved from pass to pass. This mill was a notable success.

The next year (1872) the Cleveland Rolling Mill Company built a blooming mill which deserves mention as the first reversing blooming mill built in this country and also because it was the only one of its type ever constructed here. It was a clutch reversing mill, and all the auxiliaries, tables, shears and shear tables, were driven from the train engine. As at first put down, it reversed with a three-gear clutch; this was afterward changed to the five-gear system. In both cases friction clutches were used, and I believe that no blooming mill has ever been built here that reversed with crab clutches. English practice largely influenced the design of this mill, and at that time the superiority of reversing engines was not established—although it surely was shortly afterward; but that friction clutches were better than crab clutches for reversing was settled. The engineering periodicals and the records of engineering societies for some five or six years, about 1870, are full of illustrations and discussions as to the relative merits of the many devices proposed to overcome the glaring faults of the crab, and are interesting history.

These three mills (Troy, Cambria and Cleveland) may be grouped as the pioneer American blooming mills; but the Fritz mill, only needs further attention, the others having had no influence whatever on the design of later mills.

If the manufacture of Bessemer steel in America made slow progress in the decade 1860-1870, it quite made up for it in the first half of the next, eight large works being built on much improved plans. These were all intended for the manufacture of rails, and hardly any other outlet for their product was looked for or expected, the power of new railroad enterprises to absorb the product seeming, at the time, to be almost limitless, while the inferior quality of much of the early steel still cast a deep shadow of suspicion on its reliability for other purposes.

For blooming ingots, of the size then made for rails, it was and is still difficult to improve on the Fritz mill; the size of the ingots not requiring excessive length of tables, and the large section of the finished bloom made it possible to do the work on short rolls of comparatively small diameter.

Under these conditions it is easy to understand why nearly all of these eight works, built between 1871 and 1876, put in Fritz blooming mills, and no other kind of mill had a trial until these conditions changed.

As these mills followed each other in rapid succession, each was an attempt to improve upon its predecessors; but the improvements were entirely confined to minor details. Driving the tables by independent power succeeded various methods of driving from the main engines, operating the table rollers automatically by V friction wheels, engaging when the tables were in either the highest or lowest position, came into use and was followed by a positive drive by means of gears, lazy tongs and reversing engines; the rolls, however, continued to be movable.

The great expansion of the Bessemer steel rail business between 1871 and 1876 was followed by an equally great depression in consequence of the business panic of 1873, and during the last half of the decade very little was done in new Bessemer construction, the efforts of the steel makers being entirely directed toward economical production, and it was these efforts which led to the first departure from what had come to be distinctly recognized as the American blooming mill.

The familiar method of increasing the tonnage was the one almost universally adopted to bring about the desired result, and so successful were the managers of the converting departments in this direction that the product of vessels soon exceeded the capacity of the casting pits to handle it, planned, as they had been, for the work of some years earlier.

Faced with this state of affairs, the Cambria Iron Company, in 1878, determined on a radical departure from the prevailing pit practice, which involved the making of ingots much larger than those in common use, and to care for these they put in a mill which deserves attention, being the first blooming mill in the country reversing with engines, and unique in other respects.

When the Freedom works were built in 1868, a plate mill had been imported from England with a reversing engine, said at the time to be "the best of its class yet produced." It was this mill and engine, with blooming rolls substituted for the original plate rolls, which the Cambria Iron Company utilized to work the large ingots. It was, therefore, an English mill; but the tables, which constituted its chief title to distinction, were American, having been designed by the late Mr. Daniel N. Jones. These consisted of large rectangular frames carrying the gudgeons of loose rollers, the bodies of which rested on solid tracks. These frames, with the rollers, were moved to and from the rolls, through a short distance, by hydraulic cylinders. It will thus be seen that when the table, with the ingot resting on the rollers, was pushed by the cylinder toward the mill, the ingot, moving twice as fast, was



A LESSON IN GEOGRAPHY AT THE BRAILLE SCHOOL.

the faults of his duplex hammer, by building his cogging mill, others, who were using them, were wrestling with the same problem, which was forced upon them by the constantly increasing output of their Bessemer works; and the obvious method of rolling the ingots in the "top and bottom" rolls of their rail mills was tried by several, and with considerable success.

With the English rail mills it was an easy matter to do this, and it may be well here to call attention to the distinct difference in practice existing between the English and American mills of the period (1867), a difference which had come about during the preceding ten years.

Up to 1857 the mills for heavy work—those in America being nearly all rail mills—were the same in both countries, two-high and non-reversing, the piece being returned over the top roll. In this year Mr. John Fritz put in use his hanging guide, which made three-high rail mills possible, and within a few years all the American mills were made three-high.

This was not the case in England, however, where efforts were made to improve their two-high mills by reversing the motion of the rolls between passes, so as to work the piece through the rolls in both directions, the means adopted being five gears and a clutch—many kinds of which were used—and later, reversing engines.

ingots were made at Wyandotte, and they, like those produced abroad at the same time, were hammered. Troy, Pennsylvania, Freedom and Cleveland, the only other producers of Bessemer steel in that decade, all used the hammer for blooming.

It was at the beginning of the decade 1870-1880, when the production of Bessemer steel ingots in America had reached 40,000 tons for the year, that the shortcomings of the hammer began to be seriously felt, and the necessity of building blooming mills forced itself upon the steel makers of this country, and the first works to put a blooming mill in operation was Troy, which rolled its first ingots in January, 1871. This mill, following the general practice of American rolling mills, was a three-high mill, being the first three-high blooming mill in the world, as well as the first blooming mill in the United States. Its top and bottom rolls were fixed, the middle roll was carried in a pair of forged steel bolsters and was moved up or down after each pass by four screws driven from the main engine shaft by a belt, shafting and worm gearing controlled by a belt-driven reversing clutch. The tables on both sides of the rolls were raised and lowered together by hydraulic power. The top of the tables was made up of loose rollers, spaced closely, and on these the two rail ingots were pushed straight for the passes and into the rolls with bars and turned with tongs.

projected over the end of the table and into the rolls. With this table was combined a manipulator which was very simple and efficient. It consisted of two hydraulic cylinders; one mounted on each side of the table, but independent of it, with the piston rods extending over it and carrying heads so shaped that by forcing them against the ingot it could be turned or moved from one pass to another. A useful feature of this manipulator was that by stopping the mill with the piece in the rolls a crooked bloom could be straightened by forcing one of the heads against it, an important advantage when ingots have been unevenly heated.

The screws of this mill were operated by a small steam engine, and the top roll was counterbalanced by hydraulic pressure.

It is a singular fact in connection with this mill, with a manipulator in successful use, that none of the numerous reversing mills built were equipped with manipulators of any kind for seven years afterward.

While the blooming mills built up to this time had all been in connection with Bessemer works and with a view to rail manufacture, the open hearth process had been steadily developed since 1870, and it is to be noted that from the time when the building of Bessemer works ceased in 1875 until the phenomenal development of new undertakings following the business revival of 1879-80, the building of open hearths was about the only new work done, and the product was at first almost exclusively devoted to plates as the Bessemer was to rails. The hard times of the last half of the decade forced the Bessemer makers to try to dispose of a part of their steel by rolling their blooms into billets on other mills; at the same time the high quality of the open hearth metal had created a considerable demand for it; but the open hearth makers labored under great disadvantages in getting their material into marketable shape, being compelled to cast small ingots and roll them on the larger bar mills. The Fritz patents had passed into the hands of an exclusive corporation, and the small size of the open hearth works, coupled with the high cost of a blooming mill, made the open hearth people hesitate before putting in so much capital to do so little work.

At last, in 1879, Shoenberger & Company put in operation a reversing blooming mill, in connection with their open hearth furnaces, which was the first to be built except at a Bessemer plant, and also the first to be devoted entirely to the general trade in blooms, billets and slabs.

In this mill the grooves in the rolls were of varying depth, the screws were worked by power from the shears engine through a Hill clutch, and the tables, made of I beam frames and cast iron rollers, were driven and reversed by the train engine direct, through belts. The rolls were driven by a pair of reversing engines which had previously been used on a gunboat, no reversing rolling mill engines having then been made in this country. This mill is of interest, as the experience gained from it was embodied in the design of the one erected at Homestead two years later, thus having a decided bearing on the development of our modern mills, and, furthermore, because on it were made the first four inch billets rolled direct on a blooming mill.

The same reasons which led to the building of the Shoenberger mill caused other open hearth makers to do the same; but so firmly fixed was the superiority of the three-high mill over the reversing mill, in most minds, that the latter received but little consideration. To use three-high mills, however, the Fritz patents must be avoided, and, with this object in view, two mills were built, one for Naylor & Company for billets, and one for the Springfield Iron Company for rail blooms. The peculiarity of these mills was the table arrangement. At the back of the rolls was a table of loose rollers, lifted directly by a jack; on the front side were ordinary hooks, which were raised and lowered by the motion of the back table, but through less distance. A fixed driven roller was placed over the back table in such a way that when the table was raised the ingot was forced against it and thus carried into the rolls.

Another mill should here be spoken of as illustrating the expedients to which steel works managers resorted when the Fritz patents could not be used and before mills reversing with engines were accepted as good practice in this country. It was put in at the Union Works at about the beginning of 1880, and was reversed by the surface friction of large wheels with very broad faces (twenty feet and eight feet in diameter, I think) which were forced in contact by means of a hydraulic cylinder and levers. This mill was afterward replaced by a modern three-high mill, and should be remembered only as taking the place of the last hammer in the business, and as being the last attempt at reversing in any other way than by engines.

With the beginning of the decade 1880-1890 came great changes in the business conditions affecting the steel industry, and these were quickly reflected in repairs, improvements and additions to existing plants and the starting of new enterprises. The tremendous business expansion which began late in 1879 continued through 1880, 1881 and 1882, and the demand for steel works products, especially rails, was unprecedented. This demand came upon works many of which, during the preceding five years, had been run with the least possible expenditure for repairs, and were now driven to the utmost capacity. This usage of machinery quickly made necessary the replacement of several of the earlier blooming mills, while some firms added complete new plants.

In these renewals and extensions the influence of the Cambria practice of large ingots is clearly shown, all the new mills being made larger and stronger, while two mills, a three-high at Bethlehem, about 1884, and a reversing mill at Cambria, in 1885, following the decided tendency of the time, were made forty-eight inches in diameter. The conclusion seems to have been reached, however, that equally good results may be obtained from somewhat smaller mills, and none have since been set up of over forty inches.

With this group of new mills the three-high mill reached a fixed standard which we may call the modern three-high blooming mill, the first one embodying all its characteristics having been put down at Chattanooga in 1878, and since this time no appreciable change has taken place. In these mills the rolls are all fixed, the tables are raised and lowered by a horizontal cylin-

der connected with L cranks and links, and the table rollers are driven by an independent reversing engine through gears carried by a lazy tongs.

How thoroughly efficient this kind of mill has proved itself for the making of rail blooms is shown by the fact that in all the new work intended for rail making, in the decade which we are now considering, all but two were of this description—one at Scranton and the other at the Cambria Works. In this latter case the necessity of making various sizes for other purposes than rails largely governed the choice, and it is of interest that this mill replaced the original Fritz mill.

Of the many new enterprises inaugurated during this period, the works erected at Homestead in 1881 by the Pittsburgh Bessemer Steel Company, from the plans of Mr. James Hemphill, claim particular attention. This plant, the beginning of the great establishment now located there, was the first Bessemer works especially built to manufacture steel for other purposes than rails; it was also the first to be put in operation after the expiration of the essential Bessemer patent, and in its construction a number of patents, supposed by many to be indispensable, had to be avoided.

In designing the blooming mill the experience gained in the Shoenberger mill—alluded to earlier in this paper—was largely availed of, and several features afterward generally used in American reversing blooming mills were introduced. The mill was driven by the first American reversing engine intended for rolling mill use; the rolls were made with all the grooves of equal depth, thus permitting the adoption of straight table rollers and the making of many sizes on one pair of rolls, and the roll screws were worked by a hydraulic cylinder through a rack and multiplying gear. The tables were constructed with I beam frames and the table rollers were driven by an independent reversing engine, the ingot being handled and turned on the tables by ordinary hooks hung from above, and tongs.

This mill proved itself very efficient, and during the following years many mills of similar character were built, the building of blooming mills receiving great impetus by reason of the change of the material used in cut nails from iron to steel and by the increasing de-

considered as particularly departing from it. This is the Sparrow's Point mill, which is the only thoroughly American reversing mill which has yet been intended exclusively for rail blooms, and is noticeable chiefly for the great power of its engines, which demonstrated the capacity of this form of mill when properly engined; and since the installation there has been a marked increase in the power provided for mills of its class.

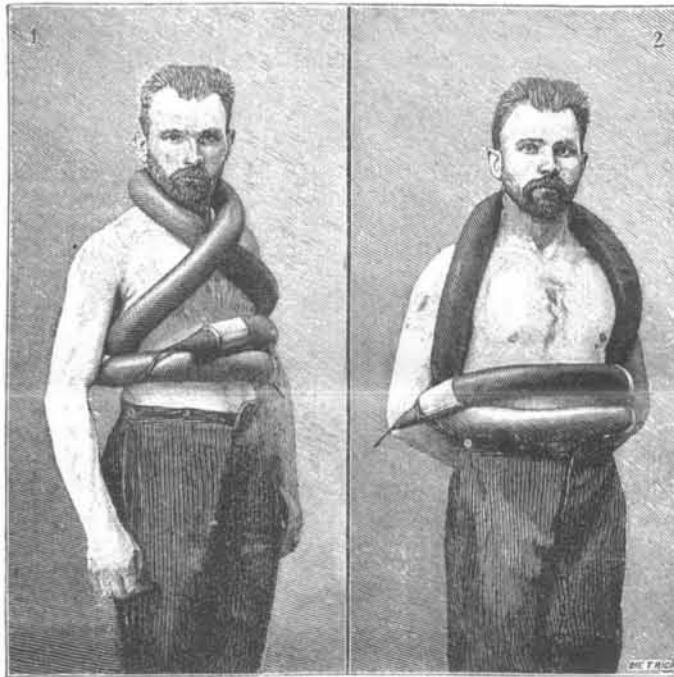
The three-high blooming mill reached its highest development at about the time that the two-high mill began its career, and within ten years of its inception; and since that time their number has diminished rather than increased, partly because of a reduction in the number of rail-making establishments, in which field it has maintained its pre-eminence, and shows how thoroughly adapted it was to the purpose for which it was intended.

With the two-high mill it is a story of progressive development for nearly twenty years. We did not begin with this kind of mills until it had been in use abroad for many years, but we availed ourselves little of foreign experience and followed lines of our own, improving and altering our original designs.

The first table frames made of I beams were displaced by cast iron with the bearings cast on; these were followed by built up wrought-iron and cast-iron frames with separate bearings; the present table frame being a substantial cast-iron bed plate with the bearings bolted on, and in some instances water-cooled.

Table rollers of cast iron with wrought axles cast in were quickly abandoned for the wrought-iron pipe roller in general use on the three-high mills; then came the steel casting with the necks cast on, and to-day the preference is divided between these and a roller made of a cast-iron body fitted with a forged axle.

The driving of the table rollers began by taking power from the main engine, which was soon changed to the use of a separate engine driving both tables together through a countershaft; and finally the countershaft has been done away with, an engine coupled directly to the line shaft being used for each table. At the same time there has been a steady im-



THE LOUITON FLOAT.

mand for Bessemer billets, which followed rapidly when once they were fairly on the market.

In these mills, about the only changes from the Homestead mill was the substitution of heavy cast iron table frames for the I beam construction, and a simplifying of the table driving gearing.

It was on one of these mills, at the Spang Steel Works in 1885, that the first manipulator after the Cambria one of 1878 was tried, and after that they came slowly into use.

Another mill which should be mentioned in connection with the new enterprises of this time is one which was put to work at Scranton for making rail blooms, in 1883. This mill, with its engine, was imported from England, and is the only complete mill ever brought from there. It was a good sample of the typical English mill of the time; very heavy and with great power. The tables consisted of loose rollers, their necks running freely on rails, and the ingots were handled on these with tongs. This table arrangement, which was never copied by American mills, was replaced some years later by a modern driven roller table. This mill seems to have had some influence in calling attention to what could be done by increasing the engine power of our mills, which was emphasized later by the work of the Sparrow's Point mill.

With the decreasing requirements for rails in this decade, and the ever-increasing demand for steel for other purposes, the three-high mill, except for replacements in rail works, received but little attention. It seemed to be accepted, as fact, that the two-high mill was best where a wide range of work was to be done. It is for this reason that a mill put down at the Otis Works, at Cleveland, to combine the advantages of both systems, requires description, being the last of the modifications of the three-high mill.

In this mill the bottom roll was fixed, the top roll was counterbalanced and worked with screws in the same manner as the top roll of a two-high mill, while the middle roll was thrown up and down between passes as in a three-high plate mill; the collars being made extra wide, to support the middle roll, which rested against them when working. The Fritz tables of this mill were thirty feet long, and the only ones of that type ever fitted to a mill for general bloom and billet work.

With the beginning of the present decade practice had become so established that but one mill may be

provement in the tablegearing. In the earlier mills the rollers were divided into groups driven by spurs and idlers; the number of these has been gradually reduced until each separate roller is now driven by a miter gear, and there is not a single intermediate gear or countershaft of any kind in the best mills.

Manipulators, after a few trials, superseded the old-fashioned hooks and tongs, and since 1890 have been in general use. In this matter alone there seems still to be a difference of opinion, and some half dozen kinds have their advocates.

In the mill itself, we have finally widened the windows of the housings so that the rolls may be changed through them; and we now generally use hydraulic counterbalancing for the top roll—methods which have prevailed in other countries from the beginning, but which we reached rather by evolution than by imitation. For working the roll screws there has been but slight change since hydraulic power took the place of belts and engines, although electric motors are used on some mills requiring extraordinary lift to the top roll.

The early mills were driven by engines with gearing of three or four to one: these ratios have been steadily cut down until gearing has been abandoned, and the latest mills are connected directly to the crank shaft.

It seems as though the work of simplifying the two-high mill has about reached its limit, and, like the three-high mill of fifteen years ago, there is little room left for further improvement.

THE LOUITON FLOAT FOR SWIMMERS.

THE Louiton float, which is represented in the accompanying engravings, consists of a long bag made of sheet rubber, and which, when inflated, assumes a cylindrical form with conical extremities. At each end of the float there is a long leather attachment. Each conical extremity terminates in a narrow tubulure, which is closed by a wooden plug. This float is inflated with the mouth, and quite rapidly, too; say in less than a minute. It is afterward wound about the body, as shown in the figures. The dimensions of the apparatus are as follows: Cylindrical length, 3 meters; diameter, 5 centimeters; length of the conical extremities, 5 centimeters; internal diameter at the summit, 5 centimeters; length of tubulures, 4 centimeters, and