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SCIENTIFIC AMERICAN SUPPLEMENT

No. 1060.

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THE INVENTION OF THE BESSEMER PROCESS.

The recent controversy between the aged Sir Henry Bessemer, who carries his knighthood by virtue of the fact that he has been considered the inventor of the famous process which bears his name, and Mr. Joseph D. Weeks, president of the American Institute of Mining Engineers, who disputes his right to the glory of the invention in favor of William Kelly, formerly of Pittsburg, Pa., and lately deceased, is notable both for the unexpected nature of the claim and for the high position of the contending parties.

The statement that the Bessemer process is not Bessemer's is so startling and seemingly so improbable that nothing short of the highest authority could render it worthy of serious consideration. As it is, the announcement was made by the president of the American Institute of Mining Engineers, and it formed the subject of his annual address before that distinguished body. Both the high official position of the author of the address and the occasion on which it was delivered gave an importance to the statement which no one was quicker to realize than the veteran inventor himself—he is now in his eighty-fourth year—and he at once wrote a lengthy reply to Mr. Weeks, which showed that he had lost in his old age none of that controversial power for which he was famous in his prime. Mr. Weeks' address and Bessemer's reply are both extremely interesting, and we give them in full in the current number of the SUPPLEMENT, together with a reproduction of the drawings accompanying the original patents granted to Bessemer and Kelly by the United States Patent Office.

Briefly stated, the facts of the controversy are as follows: In 1847, and from that date on to 1851, when he appears to have given up in discouragement, Kelly was experimenting with an apparatus for blowing air upon fluid iron for the purpose of refining it. The apparatus was crude, and as far as the evidence goes no attempt was made to force the air up through the body of the metal itself, as the blowing was all done by one tuyere, which was "swung down into the metal" from above. Mr. Kelly would appear to have met with little success in these experiments, and this for technical reasons which we now well understand, and which are clearly pointed out by Bessemer in his reply. At any rate, Kelly does not appear to have thought it worth while to cover his apparatus with a patent.

Mr. Weeks, however, claims that, crude as Kelly's appliance may have been, the fact that he used the pneumatic process in any form entitles him to the credit of the latent possibilities which it possessed. Bessemer, on the other hand, claims that the way in which Kelly went to work shows that he was ignorant of the true principles of the production of steel by decarburization with the air blast in a separate vessel; and that his single tuyere directed down upon the surface of the molten iron was merely a modification of the old "finery furnace," in which the molten pig was slowly decarburized by blowing air from several tuyeres upon its surface. [In this, it should be noted, Bessemer does not quote correctly the description of Kelly's tuyere, which is spoken of as being "swung down into the metal," not above or "upon it."]

It is certainly significant that during this early period the public heard nothing of Kelly's experiments, and that he made no claim for a patent until after the world had been startled in 1856 by the celebrated paper read by Bessemer at Cheltenham, England, describing his steel-making process in detail.

If during these years of experiment, prior to Bessemer's announcement, Kelly was seeking to make steel by "blowing blasts of air up and through a mass of liquid iron," as subsequently to the announcement he asserted he was, and if his apparatus contained all the essential features of the invention, it is a mystery that he did not patent it. As a practical forge master he must have been well aware of the enormous value of the secret which he possessed.

Is it not possible that a clear conception of the principles of the process, and of its inestimable value, only dawned upon Kelly after its successful development and announcement by Bessemer; and that he hastened to claim (in all honesty let us admit) a substance of which he in reality had only possessed the shadow?

Mr. Weeks has brought forward his claim in good faith, and has gone carefully into the subject, and his claim for Kelly is based principally upon the interference proceedings, which were instituted at the time, and which were favorable to Kelly's claim and which enabled him to procure his patent. Whatever glory from a legal point of view Kelly obtained from the issuing of this patent, the hard facts remain that whatever apparatus he had ever constructed was of the crudest description, and the results obtained were so unsatisfactory that he did not proceed to apply for a patent until some eight or nine years after his first experiments took place.

The question as to who was morally entitled to the credit of this great invention was well thrashed out, at the time it was first agitated, now some forty years ago; and the accumulated honors which America has showered upon Bessemer showed that the public at large decided it emphatically in his favor. This tribute of the American people was the more remarkable and conclusive because it was rendered with the full knowledge that there were in existence the rival patents of their own countryman Kelly. It is abundantly evident that the people of that day who were in touch with all the facts of the case, and had access to the evidence, concluded that, whatever technical claim Kelly had established upon the invention, the moral claim belonged to the man who had put it into a practical mechanical shape.

It seems as if the true standard of invention should rest upon the broad basis of public service or utility and not upon a mere nebulous idea which the inventor has failed to develop. The object lesson taught by the controversy is that whatever the technical nature of the claim may be, the world at large is inclined to regard diligence on the part of the inventor as an essential, and to award the laurel of success to him who has been the first to confer a boon upon humanity by developing the idea into a practical and useful invention.

PASSAGE OF THE FORTIFICATIONS BILL.

The Fortifications Bill, as passed by the House on the 14th inst., is in every way an admirable measure. Its appropriations are based upon the recommendations of the Endicott board of 1885, which made an exhaustive examination of the various harbors and sea coast cities, and devised a complete system of land fortifications, whose total cost was to be $100,000,000. It is evident that such a large sum could not be immediately expended, for the reason that our plant for making guns and mounts has an annual capacity of only 10 per cent of the material represented by that amount of money.

The present bill authorizes a total expenditure of $11,384,613, of which sum $5,842,337 is specifically appropriated, and authority is given to the Secretary of War to make contracts involving the further expenditure of $5,542,276.

The amount appropriated and authorized by contract under each subdivision of the bill is as follows: Gun and mortar batteries, $5,260,000; sites for fortifications, $250,000; preservation and repair of fortifications, $50,000; plans for fortifications, $5,000; sea walls and embankments, $17,975; torpedoes for harbor defense, $100,000; armament of fortifications, $5,502,673; proving ground, Sandy Hook, N. J., $38,000; Watertown Arsenal, Mass., $43,500; Watervliet Arsenal, N. Y., $3,105; Benecia Arsenal, Cal., $4,500; Ordnance and Fortification Board, $100,000; Fortress Monroe sewerage system, $9,860.

This generous appropriation, which is even larger than the government can expend during the ensuing year, may be taken as a pledge of the fact that the country is waking up to the imperative necessity of providing for national defense by means of a system of coast fortifications.

While this appropriation was being passed by the House, Mr. Squire was speaking in the Senate in support of his bill to authorize an expenditure of $80,000,000, of which $10,000,000 are to be appropriated for the fiscal year ending June 30, 1897, and an expenditure is to be authorized of $10,000,000 for each of the seven fiscal years ending June 30, 1904.

The total sum is less than that contemplated by the Endicott board, but the number of guns, mounts, etc., provided for in the bill is amply sufficient to put our principal maritime cities in a thorough state of defense.

The total number of direct fire high power guns of all calibers provided for is 517, and of mortars, 1,056. To construct these guns and their mounts, and to build their emplacements, about eight years will be required. This is the least time in which the money could be expended to good advantage.

The bill before the Senate may be considered as complementary to that just passed by the House, and it is earnestly to be hoped that it will be incorporated with it. There are some questions which ought to lie beyond the reach of party politics, and of these the question of national defense is first. The considerations which have led to the appropriation and authorization of over $11,000,000 for immediate works of defense are equally cogent for the authorization of the other $70,000,000. These considerations are strong today, but they may be weak and futile to-morrow. We are just now involved in, or threatened with, international complications, and the views of Congress on national defense are certain to be sounder in the presence of danger than those of a future Congress that may have to consider this same question in a time of profound peace.

The passage of the Squire bill would insure the completion within a measurable time, and at a regular rate of progress, of a complete system of land defenses. The nation would be committed to it, and the necessary funds would be voted and forthcoming as fast as the government factories and engineers required it.

The Annual Exhibition of the New York Microscopical Society.

BY E. O. HOVEY.

The seventeenth annual reception and exhibition of the New York Microscopical Society was held in the American Museum of Natural History on the 14th of this month. Judging from the large number in attendance, popular interest in minute objects is not on the wane. About 4,000 tickets were issued, and fully 3,000 people came to the exhibition.

The catalogue contained a list of sixty-eight exhibits, most of which were divided up into several sections, so that the number of things to be seen was very large and comfortably filled the central and north wings of the mammal floor in the museum. Evidently no attempt at novelty was made by many of the exhibitors, for one could see such old standard objects as the head of a mosquito, the eye of a fly, arranged diatoms, and the circulation of blood in the web of a frog's foot, but there was much that was new or in the nature of advances along lines of recent research. Everything, both old and new, was received with delight by the crowd of visitors, however, and expressions of wonder and admiration could be heard on all sides during the entire evening.

One of the curiosities in the way of mechanical skill was the Lord's Prayer written with a diamond point on glass within a space $\frac{1}{100}$ by $\frac{1}{165}$ of an inch in dimensions. Under the microscope the 227 letters of the prayer were as distinct and legible as if written in the ordinary manner. This writing was done by an Englishman named Webb, and was accomplished by means of a system of levers attached to an ordinary pen. A still more remarkable feat was accomplished by the same man in writing the whole of the Bible, about 3,700,000 letters, in a space $\frac{1}{5}$ by $\frac{1}{4}$ of an inch in size. This second slide was also at the exhibition, but Stephen Helm, who exhibited them, did not bring with him a microscope adapted to displaying it. Another curiosity was the reduction of photographs to such small dimensions as to be scarcely visible to the unaided eye, and yet so clear as to come out in all their details under the microscope.

The fleas which infest mice, the grewsome mites from ordinary cheese, and the Uropoda, a mite parasitic on beetles, were some of the exceedingly minute forms of insect life that aroused the interest of many visitors. William Beutenmuller exhibited sections of trees from United States of Colombia which had been tunneled in all directions by the carpenter bee, and under a microscope near by he showed the mouth parts of the insect, the tools with which it had been able to do so much excavation. The vegetable origin of coal was demonstrated by means of a thin section of brown coal which showed the cells very perfectly. A mere glance at the microscopic beauties of which nature is lavish in the mineral kingdom was afforded by seven exhibits entered at and near the beginning of the catalogue. One set of these was a series of specimens of mica from the northern part of this city which inclosed between its lamellæ minute crystals of several other minerals. The most delicate of the mineral specimens shown was exhibited by Dr. W. G. Levison and consisted of microscopic crystals of calcite pierced and supported by extremely fine hair-like crystals of pectolite from the trap rock of the Palisades.

Some of the important applications of the microscope to the everyday life and health of man and to his business and comforts were on exhibition and were worthy of the closest study. One of these was a large number of bacteria and cultivations and photographs of them exhibited by Dr. Leteve and George Rambaud of the New York Pasteur Institute. The bacillus of tuberculosis (consumption) is so small that when magnified 800 diameters it looks to be not more than an eighth of an inch long. It was exhibited by H. B. Baldwin.

The microscopic character of iron and steel has received much study of recent years and many new facts regarding it have been learned within the past year or so.

Mr. P. H. Dudley, of New York, had a large and very instructive exhibit of micro-photographs to show the results of his work. By means of these, he illustrated the changes which take place and the compounds formed in the mass under treatment with heat. The photographs exhibited showed the results of study of the structure of 0·02, 0·14, 0·45 and 1·25 carbon steels.

At different temperatures different compounds of carbon and iron are formed, and steel is by no means a homogeneous material. Beginning with the normal ferrite or pure iron, with its admixture of carbon, increase of temperature produces molecular changes and recrystallizations, four stages of which are sufficiently definite to have received provisional names. These are, in the order of their appearance, troostite, cementite, martensite and sorbite (earlier called perlite). The relations of these to each other are of the highest importance in determining the adaptability of a steel to a particular use. Up to within a very few years it has been supposed that chemical composition determined the strength or desirability of steel for any use except in tools (where tempering was understood), but now the importance of structure as obtained by proper heat treatment, rather than composition alone, has begun to be appreciated for gun metal, armor and boiler plates, and even for steel rails. Mr. Dudley's work has lain especially in the last department, and has shown that it is possible to temper the heaviest steel rails and thus improve them greatly in every respect. His photographs showed that rails manufactured according to his system presented almost absolutely the same amount of deflection under the "drop test" for all the samples from very large lots, and such deflection can be calculated in advance. The steel is prepared for study by careful polishing and then by etching by weak nitric acid. The temperature is regulated and determined by means of electricity. Reflected light only can be used, of course, since iron is perfectly opaque.

One feature of the evening was the lecture by the retiring president, Dr. Edward G. Love, on the use of the microscope in the examination of textile fabrics for the detection of fraud in material, overweighting, and so on. The lecture was highly interesting and instructive and was illustrated by numerous lantern slides. In the main collection a series of microscopic preparations of various textile fabrics was shown to illustrate the lecture more fully. The series comprised wool, silk, cotton, and linen, and showed what materials are used in their adulteration by the manufacturers.

The officers of the society for 1896 are: President, Edward G. Love; vice president, Frank D. Skeel; secretaries, George E. Ashby and Rev. J. L. Zabriskie; treasurer, James Walker; curator, G. E. Ashby; librarian, Ludwig Riederer. The committee in charge of the annual exhibition was George W. Kosmak, George H. Blake and William B. Tuthill, and to them is due in large measure the credit for the success of the affair.

Why We Are Right Handed.

There is a general belief that the greater strength and dexterity of the right side of the body is based more on habit and imitation than on any inherent difference between the two sides. In an interesting article in Chambers's Magazine Dr. R. A. Lundie tells us that this is not exactly the case. It is often the case that when the body possesses two similar organs, one of them shall do most of the work, while the other is perfectly capable of being trained to take its place, should the occasion arise. He advises the training of the left hand, therefore, at the outset, although he acknowledges that the preferential use of the right is based on natural reasons. Says Dr. Lundie:

"In all communities lefthanded individuals seem to occur, in somewhat varying proportions. Among ourselves, about one in fifty is said to be lefthanded. There is no doubt, from frequent experience, that the peculiarity is hereditary; so that we could not be much surprised if a race were met in which lefthandedness was the rule and not the exception. Yet the reversal of so general a law as that of prevalent righthandedness would need to be established by very conclusive evidence; and, though statements have been made as to a preponderance of lefthanded individuals in various parts of the world, none of them are supported by such careful and prolonged observation of facts as would be necessary for their unhesitating acceptance.

"One of the prevailing ideas about righthandedness is that it is merely a matter of training, and that lefthanded individuals have become so either from want of care on the part of nurses and parents or from imitation of some older person. In many children, the preference for one hand is shown from a very early age, before the child has learned to handle anything but the very simplest toys, and therefore before training can have caused a preference at all. More than this, the experience of lefthanded persons is on record in whom the peculiarity has been early noticed and combated, but without the slightest effect.

"It is well known that, though our external configuration is so nearly symmetrical, the arrangement of the internal organs is very different. The heart lies obliquely in the chest, and more to the left side than the right; the liver, by far the heaviest of the internal organs, is on the right side; the two lungs are differently shaped; and, moreover, the blood vessels supplying the two sides, especially in the upper regions of the body, are differently disposed. It is natural that these irregularities of arrangement should have been thought, in some way or other, to supply the explanation."

After describing a number of theories of righthandedness, based on the lack of physical symmetry in this and other respects, Dr. Lundie goes on as follows:

"There is, however, one extremely curious and interesting instance of want of symmetry in the bodily functions, which is not merely analogous to righthandedness, but closely linked with it. The nervous machinery normally connected with speech is situated on one side of the brain only. So intimate is the relation of this subject to righthandedness that we must consider it in some detail.

"It is well known that each side of the brain is connected with the movements and sensations mainly on the opposite side of the body; the right brain moves the left arm and leg, and vice versa. Now, cases are not infrequent in which, with or without 'a shock,' or at least some degree of obvious loss of muscular power on the right side of the body, the faculty of recalling and reproducing spoken words is totally or almost totally lost. Such loss of speech is technically called aphasia. It was first shown some thirty-five years ago, by a French physician, that this particular symptom is associated with damage to a limited and very definite part of the brain substance on the left side, which has since been known, in honor of its discoverer, as Broca's convolution. When the power of speech has thus been lost, it is possible, if the mental faculties are not otherwise damaged, to acquire it again, by just such a course of training and practice as the child passes through in learning to speak at first, even where Broca's convolution has been so damaged as to be quite incapable of performing its functions. In such a case, the portion of the brain on the right side corresponding to Broca's convolution is capable of taking up its work; but only by being educated to do so, just as the damaged portion of the brain had been originally. If after this the power of speech is lost again, by damage to the right side similar to that which had impaired the left, there is no hope of its being restored a second time.

"It is thus clear that there are two organs or portions of the brain capable of controlling speech; and that under ordinary circumstances only one of them is trained to do so, the other lying fallow. All the education is given to one favored side, and all the work is done by it; but the neglected one, if called by necessity to undertake the work, can be trained to do it, and to do it, apparently, as satisfactorily as the other. . . .

"Here, then, is a singularly complete analogy to the preferential use of the right hand: there are two sets of organs, either of which may be used for speech, one on each side of the brain, but only those upon one side are trained; only they have the education carried out which makes them effective. Yet if the educated centers are so damaged as to lose their functions, the others can be trained to take their place. So we have two hands, either of which may be trained for the performance of delicate movements: yet in most of us only one of them has been so trained; the other remains comparatively awkward and inactive, unless accident compels it to try to take the place of the educated hand.

"A striking analogy; but it is more than an analogy. We have said that the active speech center is that on the left side; and this is the case in the great majority of individuals. But occasionally it is found that the right, and not the left side of the brain has been educated as regards speech. When this is the case, it is always found that the individual has been lefthanded. Whatever then is the cause of righthandedness, it is closely associated with leftbrainedness, if we may use the expression, not only for the comparatively coarse movements of the hand, but for the fine adjustments of windpipe, tongue, lips, etc., which produce articulate speech, and the far finer machinery within the brain itself which registers our stores of words."

But although Dr. Lundie thus connects righthandedness and lefthandedness with anatomical and physiological facts, instead of regarding it as an accident or a result of training, he does not recommend that we should leave the other hand altogether helpless. He gives the following excellent advice on this point:

"When a child displays a decided preference for the use of the left hand, it is, as we have seen, useless to make forcible efforts to suppress it. By all means let the right hand be trained in writing, in using knife and spoon at table, and in as many actions usually righthanded as can be easily superintended. But the use of the left on other occasions should not be prevented; this will only diminish its training and its aptitude without greatly increasing the dexterity of the right.

"There seems to be no good reason why righthanded people should not attain some of the ambidexterity which is usually the privilege only of the lefthanded. A little trouble expended in practicing with the left hand, as well as the right, throwing, drawing, and other common movements requiring skill, would be rewarded by a much increased usefulness of that generally neglected member. If there is a natural preference for the right hand, it is probable that no amount of practice would make the left equally expert in actions that have once been well acquired by the right. But the experience of the lefthanded seems to show that it is well worth while for the righthanded to give more attention to their despised left hands than they usually do."

VESUVIUS is again in eruption and visitors climb no higher than the observatory. Liquid lava is flowing from many little outlets in the crater opened last July. The appearance of the mountain is very picturesque at night.