

MANGANESE STEEL.*

By JOSEPH D. WEEKS.

MANGANESE has, until recently, been most highly esteemed as a good thing to keep out of steel. Its value in the process of manufacture has been fully recognized; but after it has played its part in the crucible or the converter, then the less of it the better. It is true that the mission of this metal and its influence upon the character of the steel have been a source of much controversy. Our own Holley, in one of his special reports on ferro-manganese, states: "It has been suspected by some and believed by a few, while it is still denied by many, that manganese as an ingredient in steel has not only a body-giving and toughening influence, but a positive neutralizing influence upon any excess of hardening or cold shortening substances, as phosphorus." In another paper on the same subject, he states: "It should appear from such facts as we have that manganese toughens the structural steels, increases their soundness, and prevents red-shortness." Notwithstanding these rather guarded assertions as to its value, the general belief, it will be found, is with Dr. Siemens, that manganese is "merely a cloak to hide impurities," and its presence in steel has been endured, not welcomed.

But whatever may have been the difference in opinion as to the effect upon steel of a small percentage of manganese, not to exceed say 1½ per cent., there has been a general agreement among metallurgists that any amount in excess of this would produce a metal rotten and utterly worthless. In the Terre Noire experiments referred to in Mr. Holley's report before quoted, 1 per cent. is the highest given as found in the steels reported upon. In a paper read by M. Gautier, of Terre Noire, before the British Iron and Steel Institute on the "Uses of Ferro-Manganese," this same percentage is given as the proper amount to be used in the manufacture of what this distinguished metallurgist terms "manganese steels," while in all three of the papers the analyses of the steel show the usual percentage of the manganese to be much below this. Indeed, from 1 per cent. to 1½ per cent. has been regarded universally as "high manganese," and the published testimony is, that more than this renders steel worthless.

In opposition to these views, Mr. Robert Hadfield, of the Hadfield Steel Foundry Company, Sheffield, England, has demonstrated that a steel containing from 7 per cent. to 30 per cent. of manganese is not only not a rotten and worthless product, but that in the ingot, as cast, it is harder, stronger, denser, and tougher than most steel now manufactured, even when forged and rolled, and in addition it possesses curious and remarkable properties, which, it is believed, will make this steel exceedingly valuable for many purposes for which the ordinary steels are not now used.

In the sample of steel which, through the kindness of Mr. Hadfield, I am permitted to exhibit to the Institute, the manganese is from 9 per cent. in ingot No. 10 to 19 per cent. in the ax. No samples of the higher percentage have reached me. The bent flat piece contains 9½ per cent.; ingot No. 180 and the pit car-wheel that has been so badly hammered with so little effect, 11½ per cent.; the adz, 13¾ per cent.; and ingots Nos. 20 and 21, 14½ per cent. The ax and adz are castings just as they came from the sand, neither forged nor hardened, and have been ground since I received them. These are rough specimens, the Hadfield foundry not being adapted to this class of work; but with proper care in moulding and manufacture, such articles can be made as smooth and clean as cast iron. Indeed, some of the most valuable characteristics of this steel are shown in casting. It possesses great thinness and fluidity, casts without misrunning, does not settle as much as ordinary castings, and does not draw, particularly at the junction of the thick and thin parts. It is also free from honeycomb and other similar defects.

It is evident that a metal that casts in this manner and that needs no hardening or tempering must be especially adapted not only to the manufacture of most articles that are now cast, but for a wide range of articles that are now forged, rolled, or hammered; such as the larger edged tools, hammers, picks, etc., guns, armor plate, shell and other projectiles, car-wheels in place of chilled wheels, implements, and parts of machinery, especially bearing parts, safes, steel toys, plow steel, etc. A razor has been cast from this steel, and used without hardening. It was not equal to the best steel razor, but it was a fair implement.

But perhaps the most remarkable and valuable of the properties of Hadfield's steel is its great toughness combined with its extreme hardness, two properties that are generally regarded as incompatible. The toughness will be evident upon an inspection of the fracture of the ingots. The little steel needles scattered all over the face of the fracture, forming an acute angle with the face, show the character of the rupture to be entirely different from that of ordinary steel. These needles are very tough, and, small as they are, do not break off when struck, but bend almost like native copper. It also requires a blow of considerable force to bend them. It was exceedingly difficult to break these ingots, a number of blows of a steam-hammer being required, sledges having no effect. Ingot No. 10, with 9 per cent. of manganese, was broken from a piece 2 feet 6 inches long, supported at both ends. It bent 1½ inches before breaking, though it had not been forged. Hammered samples from this ingot gave 42 tons (94,080) tensile strength and 20·85 per cent. elongation in 8 inches. The flat piece No. 180 (9½ per cent.) that has been hammered was bent cold, and does not show the least crack. This piece has been drilled. The bulging of the steel under the drill point is quite noticeable. This piece of wire was also bent cold after drawing. The small colliery wheel (11½ per cent.) was struck fifty blows with a heavy sledge, and bent as will be seen.

Notwithstanding this toughness, the steel is extremely hard. The lower percentages, say from 9 per cent. to 10 per cent., which are the toughest, can be drilled and machined, but not as readily as the ordinary steels; those somewhat higher, with difficulty; while it is practically impossible to drill, turn, or otherwise machine the higher percentages. The colliery wheel that bent so under the sledge blows shows on the tread and hub the results of attempts made in this country at my request to drill and turn them. The edges were taken off the tools instantly, hardly scratching the wheel. The ax (19 per cent.) and the adz (13¾ per cent.), as has been already stated, were sent me rough as they came from the sand, and were ground by Messrs. Hubbard, Bakewell & Co., Pittsburg. Regarding the steel, Mr. Charles W. Hubbard writes me:

"The steel ax and adz we ground for you were extremely hard. There seems to be a peculiarly close, hard, greasy nature about the material that resists the action of the

grindstone and emery wheel, as they have less effect on them than anything we have ever seen in the line of steel or iron. I would say the material has the very essence of anti-friction. A journal made of such material would run to an extreme number of revolutions in a sand-box without friction or heat." I have not tested this ax, but one made in a similar way cut through ¾ inch iron.

I have already intimated that this steel can be rolled and forged. The lower percentages are more easily worked, but steel with as much as 18 per cent. has been hammered. The higher percentages require great care, however. One of the most remarkable properties of this steel exhibits itself in connection with hammering or drawing it. When thus manipulated, it becomes exceeding hard, and loses some of its toughness. If now the steel is heated to a hot heat, yellow or nearly welding, and allowed to cool in the air, or is cooled in water or oil, it becomes exceedingly tough. The flat piece No. 140 was so heated and cooled before being bent. The wire was similarly treated after drawing, which made it extremely hard. This is virtually annealing, but it will be noticed that it has the effect upon Hadfield's opposite to that upon carbon steel.

It should be noted that this steel is non-magnetic in bulk, and a poor conductor, though fine drillings and scrapings are attracted by the magnet.

The process of manufacturing this steel is exceedingly simple. Melted ferro-manganese high in manganese (Mr. Hadfield suggests 80 per cent.) and as low as possible in carbon, silicon, and other foreign bodies, is added to iron that has been nearly or quite decarburized, or to molten steel. The manganese is thoroughly incorporated by stirring, and the steel poured into ingots or other suitable moulds. The percentage of ferro to be used, and consequently the amount of manganese in the steel, must be varied according to the use to which it is to be put. No absolutely exact proportions can be given. To produce a steel suitable for armor plates, sufficient ferro to give say 10 per cent. manganese in the steel should be added; for car wheels, axles, or railroad plant, say 11 per cent.; edge tools and steel toys, 12 per cent.

A NEW TRANSLATION OF THE LAST WORDS OF JESUS OF NAZARETH.

THE Maya language seems to have been known by some of the learned men in Judea even at the beginning of the Christian era. The last words of Jesus of Nazareth when dying on the cross were undoubtedly spoken in that language. His biographers, Matthew and Mark, tell us that, a few moments before expiring, he exclaimed with a loud voice, "*Eli, Eli, lama sabachthani*,"* and hat those who stood near him believed he was calling Elias to his rescue.

These words have been wrongly interpreted by the translators of the New Testament. Rendering them "*My God, my God, why hast thou forsaken me?*" they have done a great injustice to the character of Jesus, presenting him in his last moments despairing and cowardly, traits so foreign to his life, to his teachings; so contrary to the resignation shown by him during his trial; to the fortitude he gave proof of in his last journey to Calvary. By placing in his mouth such exclamation they make him represent to the face of mankind a sorry and pitiful role, I will not say for a god, but for a man even. Besides, at the time that they proclaim him to be a god, the Ruling Spirit of the universe, they offer the strongest argument against his divinity. If he is God, why complain that God has forsaken him? This is illogical, a nonsense that places us in this dilemma: Either to deny that he ever uttered such exclamation as that transmitted to us by the writers and translators of his biographies, and therefore gainsay the veracity and inspiration of the Gospels, or that if he gave vent to his feelings in these words, he complained to a being he knew superior to and more powerful than himself. If then we admit he was a god, he was an inferior one, and we have forced back upon us the doctrine of the plurality of gods.

Again, in order to ascribe to the words

אֱלִי אֱלִי לָמָּה שָׁבַחְתָּנִי

(*Eli, Eli, lama sabachthani*) the meaning given them by the translators, it would be necessary to suppose that the dying martyr became out of his mind at the point of death, lost his memory, and that, being unable to give vent to his despair in one language, he had to make use of words belonging to two distinct tongues—the Chaldee and the Hebrew—

since the last word אֱלִי—*hast thou forsaken me*) is Chaldean, and the others are Hebrew. That he spoke in a dialect not understood by those who surrounded him is evident. His biographers, Matthew and Mark, assert that several, under the impression that he complained of being thirsty, went and brought a sponge saturated with vinegar; others believed he was calling Elias.†

His bosom friend and cousin, John, who never abandoned him, who stood to the last at the foot of the cross, with his mother and other friends and relatives, does not report such unbecoming words as having been uttered by Jesus. He simply states that, after recommending his mother to his care, he complained of being thirsty, and that as a sponge saturated with vinegar was being applied to his mouth he merely said: "IT IS FINISHED!" and bowed his head and gave up the ghost.‡

It is finished! expresses exactly the meaning of the Maya words: *Hele-Hele-lamah zabac-ta ni*, which translated literally say, *Hele, now; Hele, now; lamah, sinking or fainting; zabac, soot or anything black; ta, over; ni, nose; freely, Now! now! I am fainting; darkness covers my face.* No weakness, no despair; he merely tells his friends all is over—it is finished—and expires.

AUGUSTUS LE PLONGEON, M.D.

THE SENSE OF TOUCH.

THE system of exact measurements and close work now being generally adopted in machine shops necessitates a higher education of at least one of the senses, that of touch. It has always been the fact that caliper work could be better

* Matthew, chapter xxvii., verse 46. Mark, chapter xv., verse 34.

† Matthew, chapter xxvii., verses 47, 48. Mark, chapter xv., verse 36.

‡ Mark, chapter xv., verse 35.

§ St. John, chap. xix., verse 30.

¶ Juan Pio Perez, Maya Dictionary. This work is for sale at the drug shop of Mr. George Shield, 896 Broadway, N. Y. Fray Pedro Beltran—Art and Vocabulary of the Maya Language.

My attention was first called to these words of Jesus, with relation to the Maya language, by my friend the Bishop of Jero, Don Crecencio Carillo y Aneona, of Merida, Yucatan, a scholar in the Maya language, a well-known student of archeology and ancient history of his country, a writer of no mean attainments, who has published various works on those subjects.

done by feeling than by seeing, and any departure from truth in diametrical circularity can be determined by the sense of feeling when the sight is of no avail to detect the fault. There is one peculiar test that is sometimes used as a gratification of curiosity—that of passing a piece of turned and finished round iron between the teeth while slowly revolving it between the fingers. No matter how small the departure from truth, it will be detected by the sensation of feeling transmitted from the teeth. The folly of file finishing in the lathe is shown by this test. It is not possible to preserve the circularity of the surface of turned work when the turning is finished by the file. The only abrasive means to finish turned work is the swiftly revolving grinding wheel of emery or corundum. Hand filing in the lathe is a delusion.

Recent experiments to determine the reach of the sense of touch for measurements seem to decide that mechanics with educated sense can determine a variation of one twenty-thousandth of an inch. But there are men of exceptionally sensitive touch who can determine differences which are less than one thirty-thousandth of an inch. The fact of these determinations was demonstrated by means of readings on a scaled rule, through a microscope. Fits and finishes of one ten-thousandth of an inch are as near as general utility demands; the more exact measurements of one fifty-thousandth of an inch being useful mainly as standards.

A CATALOGUE containing brief notices of many important scientific papers heretofore published in the SUPPLEMENT, may be had gratis at this office.

THE Scientific American Supplement.

PUBLISHED WEEKLY.

Terms of Subscription, \$5 a Year.

Sent by mail, postage prepaid, to subscribers in any part of the United States or Canada. Six dollars a year, sent, prepaid, to any foreign country.

All the back numbers of THE SUPPLEMENT, from the commencement, January 1, 1876, can be had. Price, 10 cents each.

All the back volumes of THE SUPPLEMENT can likewise be supplied. Two volumes are issued yearly. Price of each volume, \$2.50, stitched in paper, or \$3.50, bound in stiff covers.

COMBINED RATES.—One copy of SCIENTIFIC AMERICAN and one copy of SCIENTIFIC AMERICAN SUPPLEMENT, one year, postpaid, \$7.00.

A liberal discount to booksellers, news agents, and canvassers.

MUNN & CO., Publishers,

361 Broadway, New York, N. Y.

TABLE OF CONTENTS.

	PAGE
I. CHEMISTRY AND METALLURGY.—Carbonate of Potash.—Different methods of preparing potash. By E. H. EARLE. Read before the School of Pharmacy Students' Association, London.	7153
Linseed.—Its botany and chemistry. By E. H. EARLE.	7154
The Chemistry of Linseed.—By EDWARD CRILLMAN, Jr. Composition of the seed.—Fixed and Drying Oils.—Linoleic acid.—Uses.	7154
The Loss of Nitrogen in the Manufacture of Sulphuric Acid.	7155
Chlorophyll probably a Compound of Iron with one of the Glucosides.—By Dr. A. B. HARRIS.	7155
On the Constitution of Chlorophyll.—By EDWARD SCHUNCK.	7155
Manganese Steel.—Effect of manganese upon steel.—By J. D. WEEKS.	7156
II. ENGINEERING AND MECHANICS.—French Barrel Making Machinery.—The machines used successively in the process.—Engravings.	7143
Cast Steel Locomotive Driving Wheels.—With engraving.	7149
A New Speed Indicator.—2 figures.	7150
The Armored Frigate Tegethoff.—With engraving.	7150
III. TECHNOLOGY.—Bronze Casting.—A technical description of the method.—By Sir J. S. LUMLEY.	7150
Intensification of Gelatine Negatives with Silver.	7152
Egrot's Distilling Apparatus.—4 figures.	7153
IV. ELECTRICITY, ETC.—Dr. Matthiessen's Battery Compensator.—Several figures.	7156
Formation of Coloring Matters by Electrolysis.—4 figures.	7156
V. ARCHITECTURE.—The Rudolph Academy of Arts, Prague.—An engraving.	7151
The New Town Hall, Mentz.—An engraving.	7151
VI. ARCHEOLOGY.—Dr. Le Plongeon's Latest and Most Important Discoveries among the Ruined Cities of Yucatan.—With 11 engravings, showing the inner apartment of Chacmol's monument, the statue in the same, caryatides, and other details; and also illustrating manner of excavating.	7148
VII. MEDICINE, HYGIENE, ETC.—Popular Fallacies in regard to Ventilation.—By Dr. CHAS. R. DRYER.	7156
Fatty Degeneration of the Heart.—Its diagnosis and treatment.—By Dr. CHAS. R. CRANDALL.	7156
Malady from Vanilla.	7157
VIII. MISCELLANEOUS.—The New Bicycle Race Course at Leipzig.—With engraving.	7147
The Science of Fashion.—Origin of fashion.—Evolution and development.	7147
A New Translation of the Last Words of Jesus of Nazareth.	7158
The Sense of Touch.	7158

PATENTS.

In connection with the Scientific American, Messrs MUNN & CO. are Solicitors of American and Foreign Patents, have had 39 years' experience, and now have the largest establishment in the world. Patents are obtained on the best terms.

A special notice is made in the Scientific American of all inventions patented through this Agency, with the name and residence of the Patentee. By the immense circulation thus given, public attention is directed to the merits of the new patent, and sales or introduction often easily effected.

Any person who has made a new discovery or invention can ascertain, free of charge, whether a patent can probably be obtained, by writing to MUNN & CO.

We also send free our Hand Book about the Patent Laws, Patents, Caveats, Trade Marks, their costs, and how procured. Address

MUNN & CO., 361 Broadway, New York.

Branch Office, cor. F and 7th Sts., Washington, D. C.

* Read at the Chicago meeting of the American Institute of Mining Engineers, May, 1884.