willed to and was willing to pay the price of personal and social advancement in hard and patient effort, integrity of purpose, and a readiness to do his best in everything that might fall to him to do. He made opportunities to work where he found none open, and when responsibilities were laid upon him by his townsmen or countrymen he met them bravely and studied hard to fit himself for the duties to be performed. Above all, he sought to prove himself in all things worthy of his own self-respect. There was one man, he said, whose good opinion he desired before all others, for that man he had to eat with, and work with, and sleep with; his name was James Garfield.

There is not a young mechanic who reads these lines, however humble his position, however scanty his opportunities, who cannot rise in position, knowledge, and personal worth by the same means. He may not gain great learning, great wealth, or fame by the effort, buthe cannot fail to gain what is worth more than all these in themselves—a higher, truer, and more enjoyable manhood.

The failures of some men are grander than the successes of others. And while Mr. Garfield's life, tried even by conventional standards, was a splendid success in the end, it should not be forgotten that during most of his life sudden death would have found him in the ranks of the worthily inconspicuous, with those "who failed on earth great men to be, though better than the men who wore the crown."

It was a sincere, purposeful, kindly, and laborious life that made it possihle for the close of his life to be signally conspicuous and his memory revered. Any youth who will can accomplish the life, though kind Fortune may spare him the pain and the glory of so tragic a termination of it.

THE HOLY WELL AT MECCA.

When Mohammed captured Mecca, which had been regarded for ages by his countrymen as a place of peculiar sanctity, he interfered with the worship of the Black Stone (probably a meteorite) which the angels had brought from heaven, and of the Zemzem, or Holy Well of Hagar, only so far as to suppress the ancient polytheistic rites. This well is close beside the Caaba or Square House, the chief sanctuary of the Mohammedan world.

The princes of Islam maintain at Mecca keepers of the Holy Well, who annually supply them with water to be used on great occasions and in great emergencies, as when stricken with disease. Every pilgrim to Mecca—and thousands come thither from all countries—visits the well and is purified by drinking the water or pouring it over his person, or both. The water is described as unpleasant in taste and cathartic in effect—qualities which are now to be accounted for without recourse to miracle.

With Occidental irreverence the British Consul-General at Jeddah has sent a bottle of the water to the Royal College of Chemistry at South Kensington to be analyzed. Dr. E. Frankland, in his report of the analysis, says that the water is of the most abominable character. "In fact, it is sewage more than seven times as concentrated as London sewage, and it contains no less than 579 grains of solid matters per gallon. Knowing the composition of this water, and the mode of propagation of Asiatic cholera by excrementitious matters, it is not to be wondered at that outbreaks of this disease should often occur among pilgrims to Mecca, while it would scarcely be possible to provide a more effective means for the distribution of cholera poison throughout Mohammedan countries."

It would be interesting to know the composition of the waters of other holy wells of which Islam has by no means the monopoly.

STEAM BOILER NOTES.

A foreign correspondent wishes to know why locomotive boilers work satisfactorily with so much less steam room per horse power than is usually found in marine boilers. He cites good English practice to show that fully three-fourths of a cubic foot of steam room is allowed per indicated horse power in marine boilers, while only one-eighth to one-twelfth of a cubic foot is allowed in locomotive boilers, and asks, To what shall the steam room be proportioned, if not to the indicated horse power? The answer to the first part of the inquiry is, the greater pressure relatively to the power developed in the locomotive. But the subject does not seem to admit of such categorical treatment as our correspondent seems to indicate by the tone of the query. Perhaps an empirical rule might be made from a sufficient number of experiments, embracing most of the conditions of modern practice, but the factors of the problem include everything that affects the rate of evaporation and the free escape of the steam from the surface of the boiler water and the steam pressure.

The efficiency of the heating surfaces, the ratio of grate to heating surface, the rate of combustion, the circulation of the water, the quantity of water and its depth upon a unit of heating surface, the surface area from which the steam escapes into the steam space, the pressure upon that surface relatively to the power developed by the engine; and inasmuch as the number and volume of the cylinder charges for cut-off engines are determined, in some degree, by the grade of expansion for a given power, the point of cutting off enters with the other numerous factors into the problem.

An illustration in point is of a small winding engine the boiler for which was, for special reasons, made small and upright, and intended to work at about one hundred and fifty pounds of steam, but it was thought best to test the machineryat a lower pressure than the design contemplated; so, in order to get full speed, it was adjusted to work steam nearly full stroke of the piston. The foaming and priming of the water was, however, so bad as to prevent the use of the engines under these conditions; but at the higher pressure, and with a correspondingly high grade of expansion, there was no further trouble from foaming. It will probably occur to the inquirer that locomotives are worked at all grades of expansion and at considerable variations of pressure, but a little thought will lead to a correct appreciation of the difference in causes that produce priming in different types of boilers.

As a general proposition, it may be said that, other things being equal, high-pressure boilers require less steam room per unit of power than low-pressure ones.

The explosion of the boiler in Card & Co.'s sawmill, near Monroe, Jasper County, Iowa, resulted in the instant death of E. N. Garnant and the fatal injury of M. L. Card, on the 17th of September.

The locomotive of a freight train between Chetopa, Kansas, and Parsons, on the Missouri Pacific road, exploded September 21, wrecking the engine and a dozen cars, killing Geo. Adams, engineer; Simon Bailey, fireman; John Denny, and a man named O'Neil. One of the victims was blown two hundred yards and terribly mangled. Bailey's head was blown off and could not be found.

A boiler explosion occurred at the mines of the Dunbar Furnace Company, Dunbar, Fayette county, Pa., on the 16th of September. James McDonald, fireman, was fatally, and George McAnally dangerously injured, and several others were slightly hurt.

The boiler of a thrashing machine exploded at Thurlow, Ont., Friday night, September 23, killing Andrew Lloyd, Messrs. Malcolm and Anson, and Miss Caldwell, and seriously injuring three others.

The method of feeding water to steam boilers has fully kept pace with other improvements in steam engineering. The plan of serving cold water to locomotive boilers, which prevailed only a few years ago, is now a thing of the past, greatly to the advantage of the boilers. The injector in its early days was not understood, was not reliable, and it was therefore shunned by careful engineers as a boiler feeder. The difficulty has now been fully met and overcome by the Korting Double Tube Injectors, which are shown in full lines at the American Institute Exhibition. They are made to work at all pressures, and to *lift* hot or cold water and deliver it at the rate of from 80 to 4,000 gallons per hour. They are compact, self contained, and easily set up by any steam fitter, and they will start readily, operated by a single handle, without any adjustment for variations in steam pressure. The boilers of the Institute are being fed with one of them, which any one, no matter how inexperienced, can learn to put in motion and regulate while "you wait."

These fine goods, with a line of Straightway check valves are shown by A. Aller, of 109 Liberty street, New York.

Exhibition of Smoke-preventing Apparatus.

The Department of State at Washington is in receipt of a communication from the British Legation, relative to the exhibition to be held in London of apparatus of all kinds devised to prevent smoke and to consume smokeless as well as other kinds of fuel. The exhibition will be open from October 24 to 26 inclusive, and the Department has been further informed by the British Charge d'Affairs at Washington that the committee has decided to consider favorably all applications from foreign exhibitors throughout the whole of September, and they will, as far as possible, reserve space for late exhibits, so that none may be excluded.

American Awards at the Geographical Exhibition in Venice.

The following awards were made to the American Section of the Geographical Congress:

Group First.—A letter of distinction to the engineering department for topographic and hydrographic surveys of the Northern lakes, the St. Lawrence and Mississippi river internal improvements, maps of battle fields, and other geographical works; also a letter of distinction for the geographical surveys in charge of Captain Wheeler for accuracy in topographical surveys west of the one hundredth meridian.

Group Second.—A letter of distinction for the best model of the Gulf of Mexico and for the sea soundings of Commander Sigsby and other officers of the navy; also a letter of distinction for the report of Commander Green on international longitudes, hydrographical charts, American ephemerides, a publication on the solar eclipse of 1878, and other papers by naval observers; a diploma of honor of the first class for a list of lighthouses, bound sets of charts, and other publications; a letter of distinction to the engineers of the Department of Geological Natural History and for the examination for Clarence King's exploration along the fortieth parallel; also a letter of distinction for Captain Wheeler's geographical surveys and works on natural history west of the Mississippi; a similar letter to the Signal Service Department and Weather Bureau for an extended series of tidal weather maps.

Group Sixth.—A letter of distinction to the Post Office Department for a series of announcements and other publications; a diploma of honor of the second class to the Agricultural Commission, and for reports on forestry by Professor Hough; honorable mention is made of the statistics of the Treasury Department for their quarterly and other reports.

Group Eighth.—A letter of distinction to the Engineer Department for Captain Wesscher's exploration and survey west of the Mississippi.

ELECTRO-METALLURGY.

ELECTROTYPY.

In taking impressions or moulds of *under-cut* or highly-wrought work it is necessary to use a flexible substance to admit of separating the mould and model without injury to either. For these purposes gelatine—or gelatine and glue or sirup—and gutta percha are employed. Glue (of the finest quality) or gelatin is softened by soaking over night in cold water, then removed from the water and dissolved by aid of heat in a quantity of pure glycerine equal to the dry glue taken. This mixture is kept over the water batn for several hours, and is then ready to pour over the warm, well-oiled model. After standing for several hours, or until thoroughly cooled, it may be removed from the model by careful manipulation. When removed it is dipped repeatedly in a solution of one ounce chromic acid in a quart of water, each time being exposed to strong sunlight (every part), which renders the surface waterproof and non-absorbent. When dry the surface may be metallized, and a strong current with a large anode used at first in the bath. With such work much care is necessary to exclude air bubbles from the deep-wrought portions.

In using gutta percha the moulding operation is conducted either by press, by hand, or in a stove.

By hand.—After purification in boiling water, plates of various thicknesses or lumps are formed.

A quantity sufficient for the intended mould is cut and put into cold water, which is gradually heated until the gutta percha is soft enough to be kneaded like dough. After having pulled the gutta percha in every direction the edges are turned in so as to form a kind of half ball, the smooth convex side is applied to the middle of the model, then it is spread over and forced to penetrate the details of the object. The kneading is continued as long as the material remains sufficiently soft, when it is allowed to cool somewhat. While at a temperature of about 80° Fah. it is separated from the model and dipped into cold water to harden, and may then be handled without danger of impairing its accuracy.

With some models it is preferable to heat the gutta percha in a copper dish with constant stirring until it becomes a semi-fluid paste. This is poured over the pattern previously placed in an iron ring. After a few minutes it may be kneaded in with wet or oiled fingers until it scarcely yields to pressure. In removing the mould from the pattern all useless parts, especially those which have passed under the pattern and bind it, must be first removed. Then the proper position and shape of the covered pattern must be ascertained so as not to break the model or tear the gutta percha.

For moulding by sinking or kneading the following composition is preferable to pure gutta percha: Gutta percha, 2 parts; linseed oil, 1 part. Heat the oil in a copper vessel to about 212° Fah., then gradually stir in the gutta percha cut fine. When the whole is in a pasty form and begins to swell up with the production of thick fumes, throw the contents of the kettle into a large volume of cold water, where, without loss of time, the paste must be kneaded, and, while still hot, rolled upon a slab of marble and passed between mediumly warm rollers.

Gutta percha may be used an indefinite length of time.

In moulding by press.—After the object has been coated with plumbago or tallow it is put square and firm upon the table of a screw press, and surrounded with a frame or ring of iron a little higher than the most raised portions of the model. A piece of gutta percha at least the thickness of the pattern is cut so as to fit the ring or frame of iron, and then heated on one of its faces only before a bright fire. When about two-thirds of its thickness has been softened it is placed, soft portion downward, in the iron ring or frame, and the whole covered with a block of metal exactly fitting. It is put under light pressure at first, the force being increased as the gutta percha becomes harder or more resisting.

Stone moulding is resorted to with models the brittleness of which renders them liable to injury when pressure is applied—plaster of Paris, alabaster, marble, etc. The object is placed upon a plate of iron or earthenware, a ball of gutta percha is placed on the middle of the object, and the whole is set in an oven where the temperature is just sufficient to melt the gutta percha, which, as it softens, penetrates all the details; when it has sunk completely it is removed from the oven and allowed to cool off until it retains just enough elasticity to be separated from the pattern.

Gutta percha is entirely insoluble in water, weak acids, or acid salts. When moulded it is prepared for the deposition of metal by being coated with a film of graphite or bronze powder.

Grass Fired by a Meteorite.

A fire ball was seen to fall at Springfield, Ill., about 10 o'clock of the night of September 21. It resembled in appearance an electric light, and it fell with a rushing sound like that of a sky rocket. The dry grass was set on fire where it struck, and the grass burned to a wooden sidewalk connecting with fences and wooden buildings, before the fire could be extinguished with water.