hand drawing. A few strokes with a piece of chalk or a lead pencil, performed by a trained hand will often do more towards imparting a clear idea of what is desired than an hour's talk; and a sketch of this kind has moreover the advantage that it can be left as a permanent guide, when mere oral instruction would be forgotten, and require repetition. Such sketches are for many purposes as good as more elaborate drawings; but the good foreman ought also to be able to prepare these when required. Without more or less skill in drawing there will always be more or less difficulty in the interpretation of drawings, and a good foreman ought never to be at a loss to do this readily and accurately when drawings are properly prepared.

We cannot too emphatically urge upon all young mechanics the importance of the early study of drawing, if they are ambitious to rise in their profession.

A foreman should be able to systematize labor and distribute it to the best advantage, so that the largest results shall be obtained at a minimum cost to his employer; and while able to enforce discipline, he should also have the faculty of conciliating and commanding the respect and good will of those under his charge. To do this, he must cultivate habits of self-restraint, a love for justice, and due regard for individual rights. He must be firm without being obstinate, decided without arrogance, and capable of administering reproof without loosing control of his temper.

Finally, he should be well informed in all facts immediately or remotely pertaining to the industry which he assumes to direct, and should keep himself thoroughly posted in current information pertaining to it. With such qualifications success cannot fail to attend the efforts of any superintendent or foreman who possesses the other essential of a business man—industry and integrity.

DIVING AND DIVING APPARATUS.

No operation in submarine engineering is more important or attended with greater personal risk than diving. This art has, however, been so far advanced, and apparatus for diving has been so far perfected, that divers now descend to depths of over one hundred feet, and not only remain there with impunity, but actually perform work. It seems sufficiently marvelous that human beings can, without performing any useful work, remain at such extraordinary depths, not only carrying upon their persons an armor which weighs one hundred and forty pounds, but subjected to a pressure of nearly nine atmospheres; but when we reflect that under such trying circumstances, the diver is frequently called upon to perform operations of considerable nicety—as, for example, leveling—the feat becomes one far more wonderful than an ascent into the air by the most daring aeronaut.

In an aerial voyage the passage is made through an element congenial to animal life, and in the broad light of heaven. The body is unencumbered, and perfect freedom of movement exists in an emergency. In diving all these conditions are reversed. The descent is made into an element inimical to life; into isolated depths where the light of day does not penetrate, and where the mighty weight of water grips as in a vise, frequently benumbs, and renders more difficult the use of the already encumbered limbs.

Only individuals of peculiar temperaments can withstand the effects of great pressure in diving. A person of full habit would generally be attacked with bleeding from the lungs. His head would snap and ring with strange noises, and his copper helmet, with its little plate-glass windows, would be illuminated with more stars than Lord Ross' telescope reveals in the milky way. Individuals of the lean and hungry kind, provided their viscera are all sound, can undergo such compression with the least risk.

There are about thirty professional divers in the United States, and the annual mortality has been on the average about four of this number.

Such risks are, of course, taken only under the stimulus of high wages. The compensation of expert hands is four or five times that obtained by the same class of men in other occupations. The necessary risks are, however, sometimes increased by the reckless habits of some divers. The gang of men employed by Mr. Geo. W. Fuller, of Norwich, Conn.—one of the most scientific and accomplished divers in this country—which has been selected with great care, has never met with any fatal accident.

This is not, however, to be wholly attributed to the careful selection of men, but is also, in great measure, to be ascribed to the extreme perfection which Mr. Fuller's experience and skill have imparted to the apparatus employed by him. This gentleman has made diving a special study for years, and being gifted with great inventive talent as well as superior mechanical skill in executing his designs, he has yearly applied the experience of a large practice, in submarine engineering, recovery of property from wrecks, surveys of marine bottoms, etc., to the improvement of his apparatus.

He now employs a four-cylinder air-pumping engine to supply air to the submerged divers, which in beauty of finish, accuracy of workmanship, and perfect freedom from all possibility of leakage, we have never seen equaled. The packing of the plungers, while pressing against the walls of the pump cylinders so lightly that any plunger will descend by its own weight, is still so absolutely tight that not the slightest leak can be detected under the heaviest pressures.

This packing is the invention of Mr. Fuller, who has also made great improvements in the shoes worn by divers. These he now makes with toe caps of bell-metal, and the edges of the soles and sides of the shoes are also protected by the same material. The soles are weighted with lead, the bottoms being also armed with the bell-metal to protect them from wear. These improvements render the shoes far more durable and serviceable than the old style.

The attachments of the weights to the back and front of the armor have also received their share of improvement, which renders them much more secure and more quickly performed.

The lantern is a beautiful piece of workmanship, and we shall not attempt a minute description of it. It is fed by air from the surface precisely as the diver's lungs are supplied by an air tube from the pumping engine above. In descending its flame becomes brighter and brighter, until at the depth of a hundred feet it glows with the whiteness and brilliancy of the calcium light. This result is attributable to the condensation of the air, which increases the amount of oxygen contained in a given volume.

The hoisting apparatus has also been so far perfected by the efforts of Mr. Fuller that it is now generally adopted by all the heavy wrecking companies in the country. The Coast Wrecking Company assert that this machine has never yet found its equal.

It is safe to say that the advancement in the art of diving achieved by Mr. Fuller could only have been accomplished by a man combining the practical experience of the diver, with intelligence and skill as a practical mechanic.

So far as we are aware, he is the only man in the country who combines these requisites. Every part of the apparatus employed by him has received the closest study, and a minute of any suggestion arising from new exigencies or requirements in practice is always made on the spot where it occurs for future careful consideration. In this way Mr. Fuller has accumulated a large mass of interesting information upon which we have liberally drawn for the substance of this article. At some future time we may return to the subject, which cannot by any means be exhausted in a single article.

TUNNELS VS. BRIDGES.

The East London Underground Railway is now running its trains regularly under the Thames river through the celebrated Thames Tunnel. This gigantic work was constructed at an expense of $4,000,000, greenbacks; and although originally designed for an ordinary carriage way, such is its massive character that it was found strong enough to support the heaviest locomotives. The length of this tunnel is 1,200 feet; the hight of exterior walls, 38 feet; width, 22½ feet. Two tracks are laid, and the running of the trains gives great public satisfaction.

In the face of such a successful example of subaqueous railway, which is an improvement of the most unquestionable character, always solid and secure, we behold the public spirited men of New York and Brooklyn at this moment engaged in trying to establish communication between these great cities by means of a single span suspension bridge, which, to say nothing of the immense cost and years of labor involved, will never be free from danger of falling, and can never satisfy the public wants. Every storm that blows will try its foundations; every change of temperature will weaken its wires.

The tunneling of the East River is just as practicable as the Thames. A strong and capacious tunnel can be built between New York and Brooklyn for less money, and in less time, than the suspension bridge; and when the tunnel is complete, nothing short of an earthquake can impair its safety.

Gentlemen of the bridge, we advise you to get an amendment to your charter; convert your caisson excavation into a well, from which to bore a tunnel under the river. Your bridge, if ever built, will be a monument of your stupidity in adopting the poorest method of communication, when you might just as well have selected the best—to wit, the tunnel.

WHAT IS SAID OF OUR PRIZE ENGRAVING.

We have sent out large numbers of premium engravings to those who have succeeded in getting up clubs in accordance with our terms; and it is gratifying to us to receive so many testimonials of its high quality as a work of art. We make a few extracts from letters of our correspondents, showing how they appreciate the picture.

E. L. Keeler, of Allegheny, Pa., writes as follows:

"With the greatest thanks, I take the earliest opportunity to inform you that I have received the beautiful engraving you sent me. I and my family prize it very highly. It is an engraving that every American citizen should have. It should adorn the walls of the most humble cottage. Such a group of benefactors cannot be too highly prized. Think of the thought, meditation, trials, and privations that most of these men have passed through, and the thousands now blessing what their genius has given to the world; then say who would not be proud of such a prize. I received my papers; the members of my club are highly pleased with them also. I enjoy reading them very much."

J. S. Atkinson, of Ormsby, Pa., who has already received four copies of the engraving, writes as follows:

"Please inform me how many further additions to our list would entitle us to another copy of 'The American Inventors,' and further, how many additional would entitle us to two copies? We admire them so much that we desire to procure one or two for complimentary presentation."

Henry Wheeler, of Silver Creek, N. Y., says: "'Men of Progress' reached me safely. It is a beautiful picture." Alonzo D. Lamson, of Shelburne Falls, Mass., acknowledges the safe arrival of the picture, and says "I am much pleased with the picture." F. W. Sinclair, of Mottville, N. Y., says: "The premium picture reached me in perfect order, and fully repays me for the time spent in getting a club, to say nothing of the satisfaction of introducing your valuable journal to so many of my neighbors."

We shall continue to offer this splendid engraving as a premium for clubs, at our publication rates, or if any single person wishes to procure a copy, he can do so by remitting $10, which will also entitle him to a year's subscription to the SCIENTIFIC AMERICAN.

The Atmospheric Germ Theory.

In a lecture upon the above subject by Joseph Liston, F. R. S., Professor of Surgery in the University of Edinburgh, he gives the following interesting account of one of M. Pasteur's experiments, which proves that the gases of the air cannot of themselves occasion the growth of organisms even in a very favorable nidus for their development; and also that, in the regions inhabited by plants or animals, whether in cities or in the country, each cubic inch of atmosphere really does contain living germs floating in it. "A flask was prepared having its neck not only drawn out into a pretty narrow tube, but bent at various angles. The fluid is then boiled as in the former experiments; but the end of the neck, instead of being sealed, is left open, so that air passes into the flask on withdrawal of the lamp. The vessel being then left undisturbed, the diurnal changes of temperature, involving alternate expansion by day and condensation at night of the gases in the flask, necessitate a daily interchange between the air in the body of the flask and the external atmosphere. Yet the fluid, though exposed in this way to air perpetually changed, remains for an indefinite period quite transparent, without trace of organic development. There can be but one interpretation of this fact. The oxygen, whether in its ordinary condition or that of ozone, with all the other atmospheric gases, including many which may exist in such small quantities as to be undiscoverable by the chemist, must pass, each in its own proportion, unchanged into the body of the flask. It is impossible that a dry glass tube, can stop any gas. For, though the tube is moist from condensation of aqueous vapor in the first instance, it is soon dried by the air that passes in and out through it. It is therefore inconceivable that any atmospheric gas can have been arrested by the tube. But it is conceivable, considering the very gradual character of the movements of the air in consequence of the diurnal changes, that dust, even though very fine, may be arrested by the angles. We may perhaps wonder that particles of such extreme minuteness as the germs of atmospheric organisms should be so detained; but no one can say it is impossible, and no other possible explanation presents itself. The experiment proves with certainty that the gases of the air, however abundantly supplied, are of themselves unable to originate the growth of torulæ and other minute organisms which appear in a decotion of yeast freely exposed to the atmosphere, and also that the essential source of such development must be suspended particles or germs. But in order to render the experiment, if possible, still more conclusive, the committee of the Academy completed it by sealing the end of the flask after the fluid had remained clear for a sufficient length of time to show that no organism could grow in it, and, inverting the flask, shook it until some of the liquid passed into the angles of the bent tube, after which the vessel was again left to itself. And now, occurred something which you may perhaps be disposed to regard as too good to be true, but which is true nevertheless. In the course of no long time, the fluid in the angles of the tube exhibited indications of organic growth, demonstrating that the sources or germs of of such development had, as a matter of fact, been arrested there."

Successful Experiments With a New Explosive at the Hoosac Tunnel.

Capt. Von Schelika and Lieut. Von Dittmar, both of the Prussian army, and the latter the inventor of the explosive known as "dualin," have been giving a practical illustration of its quality at the Hoosac tunnel, which has proved very successful. The experiments included trials of its power upon rocks, simply placing a few ounces on the surface and covering it with dirt—upon a boulder in the open field, the hole being drilled in the usual way and the dualin lightly "tamped" in, and in the regular work of the tunnel, at the west and central shafts. In every instance the explosive did all that is claimed for it, and proved itself a most powerful agent for breaking things. The same weight of the dualin is more effective than nitro-glycerin, while it is also considerably cheaper, and absolutely safe in the handling. Its obvious advantages over nitro-glycerin are so great that a considerable quantity of it has been ordered already, and it is probable that it will soon be exclusively used by the Messrs. Shanly in their work on the tunnel. Its great advantage is in the safety with which it can be used, even allowing for accident or carelessness. While possessing many of the properties of nitro-glycerin, it is so prepared and combined with other substances as not to be exploded by concussion—indeed, when not confined and fire is applied to it, it does not explode, but simply burns. Lieutenant Dittmar brought over with him, from Germany, 100 pounds of dualin in a carpet-bag, and we are sure he would not have treated nitro-glycerin in that confident manner. There have already been numerous fatal accidents from nitro-glycerin, at the tunnel, and any explosive that will be equally effectual, and yet safe to handle, will be a real boon to the workmen, if to no one else.—*Springfield Republican.*

COFFEE HULLING.—H. H. Houghton, U. S. Consul at Lahainee, Sandwich Islands, wishes to obtain some information about machinery for taking off the outside pulp from coffee, and also for taking the inside hull from the berry.