the best of each kind is wanted. Exhibitors must furnish attendants, and feed their own stock, for which ample accommodation and good forage at cost price will be provided. Animals will be inspected by a competent veterinary surgeon before admission, and those which become sick subsequently to entry will be isolated and carefully treated. Applications for space must be made at once (address the Chief of the Bureau of Agriculture, Philadelphia), in order to enable the officials to form a proper estimate of space, etc., required. We would remind farmers generally that the liveliest interest is taken abroad in the subject of stock-raising in this country, as witness the large attendance of foreign buyers at the great sale at which the famous $60,000 cow was diposed of, a year or so ago, and that without doubt the representatives of the Earl of Leicester, Colonel Towneley, the Earl of Radnor, the Dukes of Bedford and Rutland, Mr. Bakewell, and in fact of all the great English sheep and cattle breeders, will be among the most critical visitors and perhaps future purchasers of the animals displayed.

The entries which will represent the labor and skill of our agricultural population, as well as the products peculiar to our soil, are so numerous and varied that it would be impossible even to summarize them here. Cotton, corn, and tobacco, the marvelous fruit and vegetable productions of the Pacific coast, the yield of the maple trees of New England and of the orange groves of Florida, will be prominent in the general exhibit, and the lumber from our Northern States will be placed side by side with that from the vast Scandinavian forests. The necessity of a very complete display of the timber of all districts of the country may be especially urged. Samples of trees of all kinds are asked for by the Commission, and it is suggested that the bark of one or more of the giant trees of California (*Washingtonia gigantea*) be taken off the trunk in segments and sections, to be placed on arrival on a skeleton frame of the same dimensions as the original. The Agricultural Hall, having an extreme elevation of seventy-five feet, will afford ample room for at least a partial exhibit of one of these monsters of primeval forests. Thus also with other trees of the Pacific coast, hardly secondary to it, as *abies Douglasii* and *nobilis*, *librocedrus decurrens*, *pinus Lambertiana*, the white pine and hemlock of the North, the yellow pines in their several species, the live oak, the cypress (*taxodium distichum*) of the South, and a long list from every section of our broad territory.

In addition to specimens of trunks of trees should be exhibited timber and lumber in all forms; as samples of masts and spars, large and small; knees and square timber, as prepared for naval purposes; planks and boards exhibiting unusual breadth and character of cell and fiber: in brief, every description, quality, and form of wood used in construction and decoration.

We are gratified to note an increasing interest on the part of all classes of the public in the Centennial everywhere. Several prominent business houses have given generous subscriptions. A popular movement in New York toward the furtherance of the enterprise is about to be made. It seems to us that some grand representative structure from the metropolis, typifying its growth within a century from a mere village to one of the greatest cities in the world, would be appropriate and in harmony with the general surroundings, and might at the same time be a means of arousing a greater local interest. Boston is busily engaged upon something of the sort in the shape of a tower, which will be built wholly of iron and will rise to a hight of 200 feet, or 540 feet above the river level. It is to be used as an observatory, and elevators will transport visitors to the summit. The contracts for the iron work are already awarded, and the edifice is to be completed on July 4 of the present year.

THE MANAGEMENT OF BOILERS AND ENGINES.

Extensive as is the literature connected with the steam engine, there is very little in print in relation to the practical management of steam machinery. It is not difficult to discover the reason for this omission. The practical details are so varied, for the different cases that may arise, that it is almost impossible to classify them. It is impossible so to foreseethat the remedy for any emergency which arises can be prescribed in advance; and it is not desirable that the engineer should trust implicitly to a set of formal rules, which will save him helpless to provide for a case which is not covered by the directions. At the same time, there are a number of general principles, which every engineer learns by experience, and their publication may be of use to those whose experience has yet to be acquired. Many steam users, recognizing the importance of having their machinery carefully managed, are in the habit of sending engineers and firemen to be examined in regard to their qualifications before engaging them. We give below an abstract of an examination recently conducted by a well known expert. The engineer who was examined was unusually well qualified for his duties, and a record of his replies may therefore prove very useful. Omitting the questions, the following summary gives a fair idea of the scope and character of the examination.

THE ENGINE AND BOILER.

"I have not examined the engine and boiler very carefully, but there is a horizontal engine, with plain slide valve, diameter of cylinder, 12 inches, length of stroke, 26 inches. There is a horizontal tubular boiler, set in brick, diameter, 4 feet, length, 11½ feet, steam dome, 24 inches in diameter and 15 inches high, number of tubes, 65, each three inches in diameter. I have not examined the connections of the boiler, but I can tell you what they should be, if the boiler is properly set. There should be a feed pipe, 1 inch in diameter, with globe valve and a check valve, the former being nearest the boiler, so that the check valve can be examined at any time, if necessary. There should be a blow-off pipe, distinct from the feed pipe, with a plug cock, outside of the brick work. This pipe may be tapped into the boiler if attached to one of the heads; but if secured to the shell, it would be better to use a flange. There should be a safety valve, 2 inches in diameter, attached to the top of the steam dome, and a 2 inch steam pipe leading from this connection to the engine, with a stop valve close to the boiler. There should be 3 gage cocks, the bottom one about 3 inches from the top row of tubes, the distances between them being from 3½ to 4 inches. There should be a water gage, attached direct, if possible; but if this is not possible, the connecting pipes should be arranged so as not to be in contact with the flame or hot gases. There should be a steam gage, connected with the upper part of the boiler, and arranged with a siphon and drip cock. The grate bars should have a side play between each other, when cold, of from $\frac{1}{16}$ to $\frac{1}{8}$ of an inch, and an end play of between $\frac{3}{8}$ and $\frac{1}{2}$ of an inch. The heating surface of a boiler is all the surface exposed to the flames and the hot gases, including that part of the shell in the furnace, the ends of the boiler, and the interior surface of the tubes.

THE ENGINEER'S DUTIES.

"The ordinary daily duties of an engineer are as follows: On coming in the morning, he should first ascertain the amount of water in the boiler; and if that is all right, proceed to raise steam, either cleaning and spreading the fire, if it has been banked, or making it up, if it has been hauled. A fire is kindled in a boiler in essentially the same manner as in a stove, wood and shavings first being ignited, and then covered with coal. In starting the fire, it is a good plan to cover the back of the grate with coal, to prevent the passage of cold air through the tubes. In getting up steam, the safety valve should be raised a little, to permit the escape of air from the boiler. Having got the fire under way, the engineer should wipe off the engine, fill the oil cups, and make any adjustments that may be necessary, such as tightening keys, and screwing up joints or glands of stuffing boxes, and should see that the cylinder cocks are open. When steam is raised, he should open the stop valve, and start the engine; after which, if a part of his duty is to attend to the shafting, he should examine and oil it. Then he should get out the ashes, provide a supply of coal, and screen it if necessary, and proceed to make everything tidy around the engine and boiler. Throughout the day, he should keep a watchful eye on the fire, the water, the steam, and the engine. In managing the fire, care should be taken to have the furnace door open as little as possible; and if steam is formed too rapidly, the fire should be regulated by closing the damper and ash pit doors. In regulating the hight of the water, it is a good plan to keep a steady feed, and maintain the hight constant. If it is found that the water is falling, the engineer should discover whether it is caused by a leak, or by the refusal of the pump to work. He can tell whether the pump is working by the sound of the check valve falling after each stroke, or by feeling the feed pipe or check valve. A pump will not feed when the temperature of the water is very high, unless it is specially adapted for pumping hot water; and if it refuses to work from this cause, the temperature of the water should be reduced. A pump will not deliver water if the proper valves are not opened, if its passages are choked, or if its packing is defective. It would be necessary to examine the pump at once, and endeavor to discover and remedy the difficulty. If the water falls in the boiler on account of a leak, it can sometimes be temporarily repaired with a plug, or the pump can be run faster, so as to keep up the water until stopping time. If this is not possible, the fire should be hauled, and the engine allowed to run as long as there is sufficient steam pressure. In case the engineer finds that the pump is not feeding, and he has a fair supply of water in the boiler, he should at once examine the pump, and endeavor to remedy the trouble without stopping the engine. If he does not succeed, however, before the water falls below the level of the lowest gage cock, he should haul the fire, and let the engine run as long as the steam pressure is sufficient. If he has been called away from the boiler, and on his return finds that the water is below the level of the lower gage cock, he should immediately ascertain the steam pressure, and if it is rising rapidly he should haul the fire at once. If the steam pressure is about the same as usual, he should examine the pump; and if it is not delivering water, he should haul the fire. If the pump is feeding, he may run it faster, watching the steam gage carefully. If the pressure does not fall, he should stop the pump, and haul the fire. In any case the engine should not be stopped until the steam pressure is considerably reduced. The engineer should be very particular, on finding the water low, to examine the steam gage at once; and if the pressure is unusually high, he should haul the fire without delay.

"A boiler foams or primes, either because it has insufficient steam room, or on account of dirt or grease in the boiler or the feed water. The trouble is often experienced with new oilers, and disappears when they become clean. Priming is dangerous, if much water is carried over with the steam, as it is difficult to maintain the water level constant, and the engine is liable to be broken by the water in the cylinders. If the trouble is caused by insufficient steam room, it can sometimes be partially overcome by increasing the steam pressure, and throttling it down to the ordinary working pressure in the cylinder, but the only effectual way is to provide more steam room. If the priming is due to dirt or grease in the boiler, the engineer should blow off frequently, and clean the boiler every few days. In blowing off, it is well to raise the water level in the boiler by putting on a strong feed, and then blow down below the level that is ordinarily maintained. It is very often the case that the water level is higher, when the engine is running, than it is when none of the steam is being used. The engineer should ascertain how much higher the water rises in such a case, so as to have a proper quantity of water when the engine is stopped.

CLEANING THE BOILER.

"The flues or tubes of a boiler should be cleaned about once a week, with a brush or scraper. In case incrustation has formed in them, they can be cleaned by a jet of steam from a rubber hose. A boiler should be blown down and cleaned, under ordinary circumstances, about once a month. The fire should first be hauled; and then, if possible, it is best to let the boiler stand until the water becomes tolerably cool, say for 12 hours, after which the water may be allowed to run out. Then remove the man and handhole plates, enter the boiler, and clean it with scrapers and brushes in every part that can be reached. It should then be washed out with cold water from a hose, and this washing with a hose is the only means of cleaning those parts of a boiler that cannot be reached by hand. There are many boilers into which a man cannot enter, and of course these can only be washed out. When the fire is hauled, all leaks in the boiler should be repaired. Leaky parts that are exposed to the fire must have patches riveted on; in other places patches secured with bolts can be used, each pitch having a lip around it, and the joint being made with a putty composed of red and white lead. Leaky rivets or seams can sometimes be made tight by caulking. Small leaks around the ends of tubes can often be stopped in the same way, but as a general thing a leaky tube must either be replaced or plugged. To plug a tube, drive a white pine plug tightly into each end, and cut it off even with the tube heads, then pass a bolt through the tube, with cup washers on each end, and screw it up tightly, putting putty under the washers.

WATER AND STEAM GAGES.

"When a boiler is in use, the gage cocks should frequently be tried to see that they are not choked up, and the glass gage should often be blown out. After ascertaining the proper place for the weight on the lever of the safety valve, a stick should be secured to the lever with wire, so that the ball cannot be moved out any farther. A cord should be secured to the safety valve lever, within easy reach of the engineer, so that the valve can be opened by hand if it sticks, and the safety valve should be tried at least once every day to ascertain whether or not it is in working order.

"A steam gage should be tested at least once a year, and the engineer should frequently try its accuracy by allowing the steam to raise the safety valve, and noting the pressure shown by the gage. The hand of a steam gage sometimes sticks, and the engineer should tap the face of the gage lightly several times a day, to assure himself that it is in working order. He may also shut off the steam from the gage pipe, and open the drip cock, noting whether the hand goes back promptly to 0, and returns to the former reading when steam is again turned on.

"In testing a boiler, warm water should be used, and a better test, when this is possible, is to enter the boiler and make a thorough internal examination.

"In leaving a boiler for the night, the fire may either be hauled or banked. If it is to be banked, it should first be cleaned, and then pushed back and covered with coal, the boiler being left with the furnace door open, and the damper closed.

"The principal derangements of engines are hot bearings, loose keys, and leaky joints. If a bearing heats continually, when properly adjusted and well lubricated, it is too small, Sometimes bearings heat, on account of dirt or grit, because they are set up too tightly, or are out of line. A hot bearing can often be cooled without stopping the engine, by mixing sulphur or blacklead with the oil, or by turning on a stream of water from a hose. If a joint blows out, it can sometimes be wedged, so that the engine can be run until stopping time. An engineer should exercise all his ingenuity to overcome a difficulty without stopping the engine, except in cases where it would be dangerous to continue to run. If keys or bolts become loose, it will generally be indicated by a thump in the engine. To prevent the freezing of pipes and connections in exposed situations, they should either be thoroughly drained, or the water should be kept circulating in them."

Our readers will scarcely need to be told that a man who could pass such an examination as this understands his business pretty well, and we think that the foregoing remarks will be read with interest and pleasure by all who manage engines and boilers.

Photography of the Electric Spark.

Mr. Leo Daft, photographer, of Troy, N. Y., has sent us several photo stereos, recently made, of electric discharges between the terminals of the Holtz static electrical machines. In some of the examples, the picture shows the electrical flow divided into ten streams, which have the appearance of ten fine, white, zigzag wires, sharply defined and arranged in the form of an elliptical framework. It is probable that the metals used in the terminals had something to do in giving the remarkable actinic power to the sparks which these photo impressions indicate. Mr. Daft intends to continue his photo-electrical experiments, which are certainly very interesting.

Live fish (pickerel or trout) will keep a cistern free from worms and bugs.