Correspondence.

Multiplication of Minus Quantities.

To the Editor of the Scientific American:

As some of your readers are puzzling over the question why *minus* multiplied by *minus* gives *plus*, and *plus* multiplied by *minus* gives *minus*, I wish to explain thus:

In multiplication, it is all the same which of the factors you call the multiplicand and which the multiplicator: $2\times3=3\times2$ and also $3\times-2=-2\times3$. Now multiplication means to take one factor as many times as there are units in the other factor: -2×3 is therefore *minus* 2 taken 3 times, thus: -2

-2

-2

-6, and by the above 3 multiplied by *minus* 2 must be the same. This shows how *plus* multiplied by *minus* gives *minus*.

Again: -2×3 being $=-6$, -2×2 being $=-4$, -2×1 being $=-2$, -2×0 being $=0$, we see that the product increases by $+2$ for every unit of decrease in the multiplicator. If we then decrease the multiplicator still farther by single units, the product must continue to increase by *plus* twos, namely: $-2\times-1=+2$, $-2\times-2=+4$, $-2\times-3=+6$. Nothing seems simpler or clearer.

But if there is any one who yet fails to see how the product of multiplication can increase in proportion to the decrease of the multiplicator, let him look at it in this way: It is a negative quantity (-2) which we multiply. The negative product decreases with the multiplicator.

Three times *minus* 2 $=$ *minus* 6, twice *minus* 2 $=$ *minus* 4, once *minus* 2 $=$ *minus* 2, no times (0) *minus* 2 $=$ nothing (0).

We have here the products of -2 multiplied by $+3$; $+2$; $+1$; 0; each multiplicator being one less than the preceding one; each product is -2 less than the preceding one. Minus one (-1) is one less than nothing (0). The product of -2×-1 must therefore be one *minus* two less than nothing (0), that is, $+2$. But how does -2, taken away from nothing, leave $+2$?

To make this clear you have only to substitute $+2-2$ fof 0. Of course if I have two less two, I have nothing. But ir from this nothing thus expressed, $+2-2$, you take away the -2, does it not leave you $+2$? C. F. ERHARD.

The Alluvial Lands of the Mississippi.

To the Editor of the Scientific American:

The reclamation of the alluvial lands of the Mississippi river can be accomplished simply by allowing sufficient breadth between the levees or banks on each side of the river for the water to escape through at flood hight. This can be done by straightening the levees, running from bend to bend, and allowing a breadth of from four to six miles from levee to levee, which will allow a flow of water across the neck of points in the case of extreme high water, which gives a more direct and regular current than is attainable with the present levee system, from the fact that the current across the neck meets and counteracts the force of the channel current, and prevents its rolling with so much force into the bends and against the portion of the levee that is most exposed. Besides, it would facilitate the escape of water through the Valley to the Gulf. Straightening the false banks and widening the distance between them will allow of closing the side channels without danger to the levees, and will lower the flood water mark one or two feet.

The levees, once established on this basis, will seldom need repairs. But the present system of leveling in the points confines the water at flood hight within the limits of its banks; and as the water rolls away from the point, it throws the current into the succeeding bend with its undivided weight, until the levee is forced in, and crevasse and overflow ensue. HORATIO F. HICKS.

St. Paul, Minn.

The Centennial on Sunday.

To the Editor of the Scientific American:

Correspondents of some of your cotemporaries are advocating keeping open the Centennial Exhibition on Sundays, for the benefit of working men who may be poor or too occupied to lose a working day to go and see the show. Americans generally attend some church or pass the day with their families, believing six days' labor in the week to be sufficient. Now why should several hundreds be compelled to work all day on Sunday at the exhibition buildings, in attending upon the visitors, running the railroads, etc., for the accommodation of a throng of sight-seers? It seems to me it would be better for the limited class of persons that are unable to visit the exhibition on a week day to subscribe for the SCIENTIFIC AMERICAN, and read the accounts of what is exhibited, and study the illustrations accompanying the descriptions, rather than impose needless labor upon those who prefer and need one day of rest from the arduous labors of the week.

A MEMBER OF THE SOCIETY OF MECHANICS AND TRADESMEN.

The Demand for Labor.

To the Editor of the Scientific American:

Your correspondent in Harlem, in speaking of the troubles of a tool maker, seems to overlook the fact that at the present time the supply of labor is in excess of the demand, which, of course, puts the workman or the seller of labor in the power of the purchaser or employer of labor. The remedy which he suggests, that each man should have a certificate of his skill, is right enough for some purposes; but what is the use of a certificate when there is no situation? If two men with certificates of equal merit apply for work from the same employer, who requires but one, and stern necessity compels one man to accept any terms, he that will work for the lowest wages will of course get the preference. These men should say to each other: "There is not work for us both, but, by each working half time until there is more demand for men, we shall each not only have a fair share of what wages there are earned, but prevent the employer from pitting one against the other in the struggle to live." This remedy, I believe, should be applied at all times when the supply of labor is in excess of the demand. Of course, to those at present fully employed, it would create a slight stringency in the money market; but it would drive absolute want from many a fireside.

Toronto, Canada. ONE OF THE EMPLOYED.

How Strikes may be Prevented--Free Trade the Remedy.

To the Editor of the Scientific American:

In the edition of your paper for March 18, a correspondent complains of the fact that certain parties, after advertising for tool makers, were unwilling to pay more than $2.50 *per diem* for competent men. He thinks that the state of affairs which enables an employer to hire a skilled man for that sum is not right, and he proposes to rectify matters by having the trade "legally recognized, so as to have a complete and perfect registry kept of all men who pretend to be skilled workmen," the wages being regulated by a mixed board of employers and employees. The first thought that occurs to me on reading such letters is to wonder that a man of sufficient ability to write a letter at all, or make tools requiring intelligence in their construction, should have so little acquaintance with the laws which control wages and kindred matters, as is exhibited by D. In expressing his disbelief in the efficacy of strikes to smooth the way of the working man, D. shows that his is not as hopeless a case as others; but he has a longing for governmental interference between employer and employed that savors too much of communism to be acceptable to working men of self-dependent power. He condemns strikes, but attributes the prevalence of those organized acts of folly to the fact that employers get men to work for the lowest wages they will take. Why will not D. and men who argue in his train of thought consult their own action, and learn the true explanation of the labor troubles? Does D. ever pay $10 for a pair of boots when he can get as good ones for $5? If he does not, how can he expect an employer to act on different principles, and pay $4 a day to workmen when other men of equal skill ask to be employed at $2.50? "But," says D., "they are not of equal skill, and the employer does not get as profitable return from the $2.50 as he would from the $4 00 one." Will not D. see that the employer, in the majority of cases, knows his own business best, and that it is better that he and the workman should make terms on which to exchange money and labor rather than call in the assistance of outside parties to settle it for them? Would D. maintain that it would be better to make him give A $ 10 for the boots than get them of B. for $5, or exchange four days' labor for what can be had for two days'?

Men will be better off when they learn to look facts in the face, and not delude themselves with sentimental longings for a Utopian state where "everything is lovely." This wages and labor question is simply a continuation of the fight for existence which Science shows to have gone on in the past among all living things, and still goes on.

The present writer is a working man, and as anxious as anybody to get the best price for his labor; but he has had the good fortune to have read works by the working man's best friends, the writers on political economy, and he has become convinced that the truth, as established by Nature and confirmed by experience, is what should guide working men in their efforts to improve their general condition. It is unfortunate in the extreme that elementary works on political economy are not studied in the public schools. From the halls of Congress to the humblest workshop in the land, profound ignorance reigns on subjects of vital importance to the public welfare. When grave and reverend senators eloquently advocate excluding the products of foreign countries, so as to reduce competition with the interests they represent, there can be no consistency in the bosses of those factories condemning the principle of strikes. But both are wrong. The striker is wrong, not in refusing to work if he does not like the wages, but in obliging others to desist from working for the wages he refused. The protectionist is worse than the striker; for while looking solely to his own interest, he pretends to have the welfare of his working men at heart, and besides uses the public money and officials to secure himself against competition, that is, he can sell dear where but for them he would be obliged to sell cheap. The labor problem is so complicated that no one can, in newspaper articles, explain and make clear every point of the subject; but a vast deal of good can be accomplished by directing the attention, of those most interested, to sources where the subject is discussed in full. If every working man, and every employer too, in the country would read Bastiat's little book on political economy, I think that it would do much to put an end to strikes and disagreements among employed and employers. It would show both parties how dependent on each other they are, and teach them the folly of quarreling. It would also open the eyes of working men to the mistake they make on the whole, when they sustain the doctrine of protection and monopoly. Capital is simply preserved labor, pickled down for future use The workman's capital is his skill and strength; he ought to be allowed to exchange it at will, and where he can do it to the best advantage; but the striker and protectionist deprive him of that right. When justice comes to rule the world, protectionist and striker will have no advocates. In that day it will be admitted that perfect freedom is the condition most conducive to general and individual prosperity, and that, although competition and the introduction of machinery may occasion temporary suffering, the cause of virtue, happiness, and progress is best promoted by free trade.

Rochester, N. Y. E. R.

The Great Engineer for President.

To the Editor of the Scientific American:

Your nomination of James B. Eads for President was a happy thought, whether it will amount to any thing or not. There are many, who now never go to elections, who would go if there were any hope of electing a man of his intellect, who could not be corrupted. "But," says one, "what evidence have the people at large of his great intellect, or of his incorruptibility?"

By his works we know him to be a man of great intellect; and by his dealings with men, as well as with Science, we know that he is not liable to be led astray. The choice of his education in the exact sciences shows that he was born a lover of truth; and his success in mastering and applying them indicates an intellect which will not easily turned into uncertain ways.

What could produce a happier Centennial event than to elect such a man President, one who has never been soiled by politics, whose great intellect has always been on the track of truth, with such universal success?

Lyons Falls, N. Y. D. S. HOWARD.

[For the Scientific American.]

ARTIFICIAL ICE.

BY P. H. VANDER WEYDE.

It has been explained in the previous article, published on page 177, current volume, that when, without the aid of heat, water is evaporated by means of a vacuum, aided by the absorbent action of sulphuric acid on watery vapor, the latent heat needed for the formation of this vapor will cause the abstraction of so much heat as to freeze five eighths of the remaining water. In a liquid more volatile than water, this evaporation takes place more readily; and hence many attempts have been made to produce cold by the evaporation of very volatile substances, such as alcohol, various ethers, carbon bisulphide, liquid ammonia, and even nitrous oxide and carbonic acid. Among the partially successful attempts, I may mention those made some 15 years ago by Professor Twining, of New Haven, and Siebe, in England; they used common ethylic or so-called sulphuric ether. More recently, about 10 years ago, Tellier, in France, used methylic ether, of which the effectiveness was supposed to surpass that of the ethylic ether in proportion to the lowness of its boiling point, which is at about 0° Fah., while the common ether boils at 90° Fah. It was, however, soon found out that there is no advantage in using liquids of such very low boiling points, as part of the power used has to be employed for working powerful compression pumps to reduce the obtained vapors to the liquid condition, as of course economy of the process absolutely requires the use of the same liquid over and over again. The use of two other liquids was patented some eight years ago: one, carbon bisulphide, by Professor Paersh, of New Orleans, and chymogene (petroleum ether), by myself. The first of these liquids boils at 112° Fah., while the latter has the advantage of being cheap and abundant, being a by-product of petroleum distillation, where it can be obtained in various degrees of volatility, varying in its boiling points from 20° to 50° or more Fah. It ought to be stated that the vapor of the substance is quite dense, being 4 times heavier than atmospheric air, while in its fluid condition it is decidedly the lightest of all liquids, its specific gravity being 0 6. So that while water, when evaporating, expands to 1,728 times its volume, forming a vapor of which the specific gravity is about half that of the atmosphere, the expansion of the liquid, when assuming the state of vapor, is only equal to $1{,}728\div2\times4=216$ times. As the amount of expansion which various liquids undergo, when evaporating, bears a close relation to the amount of latent heat absorbed by the vapors, this small expansion may appear disadvantageous to the use of light liquids producing heavy vapors, for the purposes of refrigeration; however this ise especially in the case of chymogene, compensated for by the fact that, in displacing vapors by the air pump, we have only to do with volumes; and as the figures representing tht latent heat of vapors have only relation to equal weights, ir is evident that a heavier gas will, for the same bulk, contain an amount of latent heat proportional to its specific gravity, and will therefore withdraw, during its formation, a proportionately large amount of heat from the material to be cooled. As an offset to this, the latent heat of gases is almost in inverse proportion to their specific gravity; so that after all, the amounts of latent heat for equal bulks do not diffe, widely, but vary only slightly from just under 400 to a little over 600 Fahrenheit units of heat.

Chymogene possesses one special advantage in its boiling point, which is not so high as to require so great a degree of exhaustion to evolve the vapors as is the case with water, and even alcohol, carbon bisulphide, and ether, nor so low as to require extraordinary pressure to recondense the vapors to the liquid condition, as is the case with ammonia, methylic ether, and especially nitrous acid and carbonic acid.

In regard to the two last named substances, they were thoroughly tried, in their liquefied condition, as to their adaptability to produce cold and refrigeration. The first, nitrous acid, boiling at 130° below 0° Fah., was tried by me; and in 1864 I applied for a patent for the invention, but soon withdrew and abandoned the same, becoming convinced of the serious disadvantage of having to employ machinery calculated to withstand pressures of 700 or more lbs. to the square inch, which this liquefied gas exerts at the common temperature of 65° Fah. Professor Lowe, of balloon fame, in attempting to use the pressure of carbonic acid gas (when liquefied by powerful pumping machinery, under a pressure of 600 lbs. to the square inch) as a source of power for flying machines, was struck by the evolution of great cold during the evaporation of this liquefied gas; and he obtained patents for its use for making ice, and for refrigeration in general. Notwithstanding that he spent many thousands of dollars to put this scheme in practical operation, and kept to its pursuit for several years, it finally utterly failed; and all attempts in this line were given up, the stumbling block being the same as was found in using liquefied nitrous acid, namely, the difficulty of keeping the joints tight under the enormous pressure required; for even the solid metals themselves showed, under the extreme pressure, such porosity that the gases passed through as through a sieve.

The process of Professor Paersh, of New Orleans, using carbon bisulphide, was abandoned for a contrary reason. Its boiling point being 112° Fah., more than 22° above that of ether, it was even less successful than the common ether, the process for which has never been quite satisfactory, as fully proved by the results of the labors of Siebe, in England, Twining, in New Haven, and others afterward.

Liquefied sulphurous acid boils at 14° Fah., and at the increased temperature exerts a pressure of 60 lbs. per square inch, or 4 atmospheres; and thus it appears well adapted for the purpose, and some years ago it was proposed to use it, and, if I am not mistaken, its employment was patented by Professor Seely, of New York city; but its corrosive effect on the metals of which the machine was made forbade its practical application.

The methylic ether machine of Tellier, in France, was at first said to be a great success; and about 10 years ago one of the apparatus was imported from France and exhibited in operation at the Morgan Iron Works in this city. There appears, however, to have been great difficulty in procuring the pure methylic ether required, notwithstanding that its preparation had been minutely described in Tellier's patent. The ignorant persons who had charge of the machine became possessed of the idea of cutting short all trouble, by using ammonia, which was easily procured; and, as any well informed person could have warned them, within 24 hours the whole beautiful machine, a credit to the Parisian workshops whence it came, was utterly ruined, the ammonia having destroyed all the brass parts. Machines using ammonia are therefore always built entirely of iron.

PRACTICAL MECHANISM.

BY JOSHUA ROSE.

NUMBER XLV.

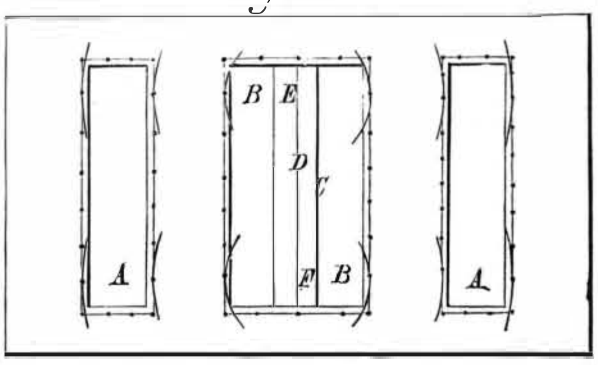
MARKING OFF SLIDE VALVES AND CYLINDER PORTS.

If, in marking off a set of cylinder ports and a slide valve for the same, we are provided with a detail drawing, we have no option, of course, as to their proportions; but if, on the other hand, we have liberty to proportion the same, we have to consider the following: If we make the slide valve to cover the ports without having any steam lap, the exhaust will not be sufficiently free, and there will be a back pressure upon the engine. The amount of steam lap necessary to prevent back pressure will be an amount equal to one quarter of the width of the steam port in a slowly running engine, and equal to about three quarters of the width of the steam port in a fast running engine. If it is incumbent that the valve have no steam lap, or an amount of such lap equal to or less than one quarter of the width of the steam port, we may make the cylinder exhaust port about one and three quarters as wide as the steam port, which will be sufficient to maintain, at all parts of the stroke, an exhaust opening in the cylinder exhaust port equal to that obtaining in the steam port acting (at the same point of the stroke) as an exhaust port: the object of narrowing the cylinder exhaust port in this case being to keep the valve narrow, so that its friction upon its seat may be kept as small as possible, in consequence of its reduced area for the steam to act on, pressing it to its seat. The best results are obtained from a slide valve by giving it sufficient steam lap to cut off the steam supply when the piston has traveled about three quarters of the length of the stroke; if more than such an amount of steam lap be given to the valve, its action becomes distorted, that is, unequal at and during one stroke as compared to the ther

The area of the steam ports should be proportioned by the following rule, which is given by Mr. John Bourne in his "Catechism of the Steam Engine:" "Multiply the area of the cylinder in square inches by the speed of the piston in feet per minute, and divide the product by 4,000. The quotient will be the area of each cylinder port in square inches." This rule is a much better one than any which gives a definite and fixed proportion between the area of the cylinder and of the steam port, because it takes into consideration the quantity of steam required to pass through the port in a given time, and increases the area of the port in proportion as the speed of the engine is increased.

Having determined the dimensions and proportions of our ports and valve, we proceed as follows: Beginning with the cylinder, we place in the exhaust port a center piece, as shown in Fig. 231, in which A represents the steam port, B B the cylinder exhaust port, and C the center piece wedged or fastened therein. In the center of the position intended for the ports, we mark upon the center piece the center line, D, and from the points, E, F, we mark with the compasses the segments of circles from which the width of the steam ports, exhaust port, and bridges are marked, the lines being drawn by the aid of a straight edge. We mark the ends of the ports by the aid of a straight edge and square. To mark off the valve, we may either plane up two of the edges and

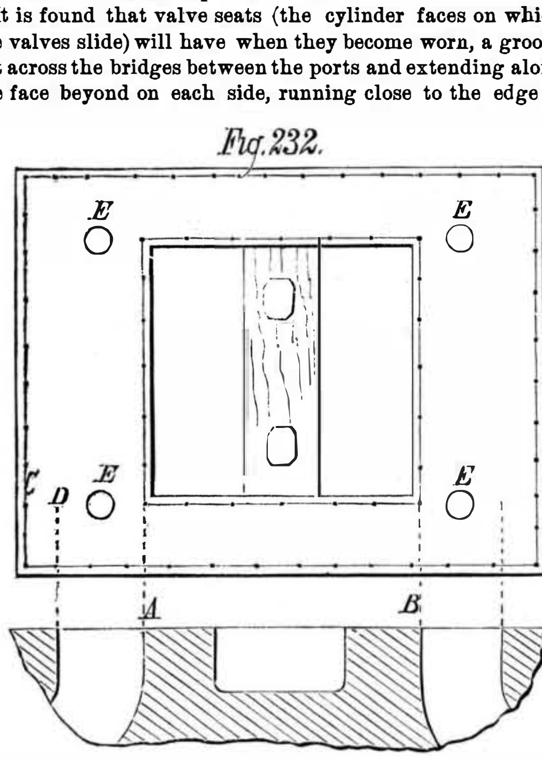
Fig. 231.



mark the lines by the aid of a square, allowing an equal amount to be taken off each side of the exhaust port, or we may place a centerpiece in the exhaust port of the valve, and perform all the marking-off before any of the planing is done, the operation being shown in Fig. 232. From A to B is the width of the exhaust port of the valve, and from C to D on each side is the lap of the valve.

It is found that valve seats (the cylinder faces on which the valves slide) will have when they become worn, a groove cut across the bridges between the ports and extending along the face beyond on each side, running close to the edge of

Fig. 232.



the ports, and at right angles to the lengths of the ports. To prevent the formation of this groove, it is found necessary to drill in the face of the valve the four small holes (say of ¼ inch diameter) shown in Fig. 232, at E, E, E, E, their depth being about half the thickness of the valve.

To mark off the back of the valve where the slide spindle frame fits, we must stand it on the marking table, with the face standing perpendicularly and at a right angle to the face of the table, and draw a center line on the back of the valve, from which line we may mark off the back of the valve to the necessary conformation.

PROGRESS OF THE CENTENNIAL EXHIBITION.

The exhibition buildings and grounds are fast approaching completion.

THE MAIN BUILDING

is completed internally, the painting and gas pipe connections having just been finished. Show cases are rapidly appearing, that of Devlin, the clothier, being especially notable, both for its style and size. The floor is strewn with packages, prominent among which, on account of their size, are those sent by J. D. Burchall and Co., woolen manufacturers, of Leeds, England, containing woolen goods, and cases of terra cotta from Messrs. Doulton, of England, who are erecting four elegant show cases in which to exhibit pottery and porcelain. Among the exhibits forwarded by the Secretary of State for India, London, England, is a fine muslin, into which threads of gold are interwoven. This material is made exclusively for the rajahs in India, and is so fine in its texture that 50 yards of it can be doubled up and passed through a lady's finger ring.

INDIAN COURT.

The exhibits for the Indian court are nearly all in the building, having been transported from the Indian Museum, London, England.

The Egyptian, Norwegian, Chilian, Spanish, and other courts are all graceful and nationally characteristic edifices, and are fast approaching completion. They promise to be among the most attractive parts of the exhibition. The Norwegian goods are mostly on the ground.

MACHINERY HALL.

In the Machinery Hall, the workmen are busy erecting the shafting and laying steam pipes for the Corliss engine, all the parts of which are on the spot, and most of them erected.

Messrs. Mirrelees, Tait, & Watson, of Glasgow, Scotland, are erecting an engine and sugar mill, the total weight of which is 180 English tuns. It is a compound beam engine, of the parallel motion order, with Corliss valves, the high pressure cylinder being of 24 inches bore and 56 inches stroke. The top roller of the mill weighs 24,780 lbs. The entries of the above firm also include 26 and 36 inch centrifugals and two smaller engines, one driving a small mill and one driving a centrifugal. One of these engines is a valveless engine, which takes steam through the head of the piston, which is a very long one, having in it ports arranged to operate with ports in the bore of the cylinder, and not at the ends thereof.

Messrs. Wm. Sellers & Co., of Philadelphia, have their slotting, planing, vertical, and horizontal boring, drilling, and punching and shearing machines, as well as several large and small engine lathes, in position. J. Mitchell, of Philadelphia, is erecting a column composed of English, French, German, American, and Austrian grindstones, of various grades. J. P. Morris, of Port Richmond Iron Works is erecting a vertical column compound engine of the following description: High pressure cylinder, 50 inches in diameter, of 84 inches stroke; the low pressure cylinder is in line with it, so that both piston heads are fast upon one rod. The valves are constructed under Wanock's patent, and are balanced. The (two) fly wheels are each 24 feet in diameter, and of 21 tons weight, the whole engine weighing 110 tuns. This engine will drive a blower (for blast furnaces) of the following description: The cylinder is like an ordinary steam cylinder, and is provided with a similar piston, save that the piston rings are composed of maple wood, and are cut in segments to accommodate their being set out. The blower valves are of the griddle order. The size of the blower cylinder is 90 inches in diameter by 7 feet in stroke.

The floor spaces are all marked off, and many foundations for the various entries are being laid. Some few of the exhibitors who have their entries all ready are delaying the placing of them in position in the hopes of being able to obtain space in more prominent locations, provided the owners of such latter space shall be dilatory enough to warrant the commissioners in disposing of the space now allowed to them. The fears of the latter are, however, having the effect of hastening the forwarding of entries; hence it is improbable that any reallotment of space will take place, save in the case of those who are very much behindhand.

THE GROUNDS.

Swarms of workmen are busy leveling roadways, removing *débris*, and laying out the grounds and planting additional shrubs, evergreens, etc., notwithstanding the unpropitious weather. The railroad men, both steam and horse car, are at work in full force, giving promise that their preparations will be completed in ample time.

AGRICULTURAL HALL.

The above hall is the most backward of all the buildings but the rate of progress is proportionally rapid, every day making a noticeable difference in its appearance. The working force is here exceptionally strong; and there is evidence that it will soon be ready for the reception of entries

THE FOREIGN EXHIBITORS.

As a rule, the foreign exhibitors have more goods upon the ground than is the case with the American entries, a fact to which their representatives point with a feeling of pride. There is no doubt, however, that the arrival of American goods will, during the coming week, be very large. Representatives of foreign governments who were present at the Paris and Vienna Expositions give it as their opinion that the vista of the main building at Philadelphia excels, in general design, lightness, and airiness, that of any previous international exhibition.

A Metric Treaty.

The President has recently sent to the Senate for ratification a treaty, the object of which is to establish an international uniformity and precision in the standard of weights and measures. The treaty is between the United States and the governments of Austria, Argentine Republic, Belgium, Brazil, Denmark, Spain, France, Italy, Peru, Portugal, Russia, Sweden and Norway, Switzerland, Turkey, and Venezuela. It contains an agreement between all the parties to maintain in Paris, at the common expense, a permanent bureau of weights and measures, to be under the control of an international committee. The bureau is to be charged with the following duties:

1. All comparisons and verifications of the new prototype of the meter and kilogramme. 2. The custody of the international prototypes. 3. The periodical comparison of the international standard with the international prototypes and of test copies, as well as comparison of the standard thermometers. 4. The comparison of the prototypes with the fundamental standards of non-metrical weights and measures used in different countries for scientific purposes. 5. The standarding and comparison of geodesic measuring bars. 6. The comparison of standards and scales of precision, the verification of which may be requested by governments, scientific societies, or even by constructors or men of science.

WE are indebted to Mr. R. O. Morris, Secretary of the Rod and Gun Club, Springfield, Mass., for a very attractive pamphlet containing a list of premiums and rules to govern the dog show which takes place on April 26, under the auspices of the abovenamed club. Many very handsome premiums are offered, and it is expected that the exhibition of pointers and setters from all parts of the country will be especially large and fine.