retary of the Treasury for service at St. Louis. He has been engaged for nearly nine months in Europe in collecting late-type units for the machinery department, and more power, we learn, was turned in by foreign manufacturers than could be used at St. Louis.

While the John Cockerill Gas Engine will represent the largest gas engine in service up to the spring of 1904, Lieut. Carden informs us that when he was at the works of the Gasmotorenfabrik-Deutz, Deutz near Cologne, Germany, he found that that establishment was engaged in completing designs for a 6,000-horse power gas engine, and that the statement was made to him that by 1905 gas engines of this unprecedented size would be put on the market. When one considers the relatively small units in which gas engines are built in America, the advanced stage of the gas engine industry in Europe must be at once apparent. In addition to the John Cockerill engine there was secured a 1,600-horse power gas engine of the Oechelhauser type, the product of the house of A. Borsig, of Tegel, near Berlin. The Borsig engine will be attached to a Crocker-Wheeler electric generator, and the gas producer will come from the German house of Julius Pintsch, of Berlin. The Pintsch gas producer will have a capacity sufficient for developing 2,400 engine horse power. The total weight of the shipment from Tegel will approximate 660 tons.

A 1,800-horse power gas engine of the Nuremberg type will also be put in service at St. Louis. The drawings of this engine show a length over all of 60 feet and a breadth between extremes of 19 feet 4 inches. The flywheel will measure 18 feet, and at 1,800 horse power the number of revolutions will be 92 per minute. Large as this flywheel is, it will be exceeded by that of the John Cockerill engine, which will be 26 feet 3 inches in diameter.

Aside from the gas engines displayed at St. Louis the exhibit of high-speed steam engines is bound to attract great interest, for it must be admitted that in the matter of high-speed engines of large powers, we have not made so much progress as foreign manufacturers. The house of Delaunay-Belleville, of Saint Denis (sur Seine), France, will send to St. Louis a complete unit of 1,500 horse power, embracing a high-speed vertical triple-expansion engine, with boilers and generator complete. This engine will operate ordinarily at 325 revolutions per minute. Another high-speed engine is a 1,200-horse power unit of the Williams & Robinson, Rugby, England, type. Among the famous foreign engine builders who have made offerings for the St. Louis power plant are Franco Tosi, of Legnano, Italy, a 2,500-horse power steam engine; Carels Frères, Ghent, Belgium, a 2,500-horse power steam engine; Augsburg-Nuremburg, Nuremburg, Germany, a 2,500-horse power, vertical triple-expansion engine; Greenwood & Batley, Leeds, England, a 300-horse power turbine engine; Société Alsatienne de Constructions Mécaniques, Milhausen, Germany, a 1,000 horse power tandem engine with direct-connected dynamo.

The Machinery Hall of the St. Louis Exposition is already applied for several times over, and with the great power plant, aggregating 40,000 horse power, installed in the center of this building, there is every reason to believe that the machinery display at St. Louis will exceed in completeness, extent and in the up-to-date features presented, anything of the kind in the way of a machinery exhibit the world has ever seen.

## THE MANDATORY BLUE PRINT.

BY EGBERT P. WATSON.

From some experiences of my own and cases where I have been called in, I am led to believe that departures from the absolute readings of blue prints are quite common. That is to say, persons who undertake to construct machines or apparatus of all kinds from them permit themselves to act as judges as to whether the proportions laid down are correct or not, and whether other forms than those shown would not be better. If the designer of the machine were consulted previously concerning the proposed changes there would be no harm done, for he would have an opportunity to decide whether the so-called improvements were such in fact, or only mere impertinences upon the part of those who suggested them. In one case an inventor had designed a machine which had a peculiarly appropriate movement which he had covered in his patent claim; when he examined his machine he found that this had been disapproved of by some one connected with the works, and a monstrosity of their own devising inserted in its place. As a consequence, he rejected the machine and demanded that his device be put in its place; the constructors refused to do this, for the machine would have to be practically rebuilt to get it in, and suit was brought to recover, the result being that the builders had to pay heavy damages and costs.

It is important that all persons accepting blue prints as guides to work from should bear in mind that they have no responsibility whatever if they reproduce line for line and figure for figure, and adhere closely to the dimensions; failing this, they assume all the liabilities of the slightest omission or change, no matter whether the same is an improvement or the reverse. Under some interpretation of shop ethics, it is supposed to be a "neighborly" proceeding to make changes and alterations without consultation. After an exhibition of such "neighborliness" a constructor recently said to his customer: "Your machine is all right now; we had to go all over it, for it wouldn't have worked the way you had it"; and great were his surprise and chagrin on learning that several machines were already at work upon the identical plans he had condemned as impracticable. As in the previous case mentioned, the contracting party refused to accept the job.

It has been decided by the courts that the acceptance of a blue print from contracting parties is in itself a guarantee that the machine constructed from it shall be an exact duplicate in metal or other material, and no explanations as to failure to follow the print will absolve the contractor from neglect to perform his part of the agreement. In plain words, a blue print is mandatory.

Within a very short time I have been asked to compare the work upon a certain boiler with the blue prints furnished by the contracting parties. The departures from it found were many, the curious part of the execution of the work being that the changes made were of no pecuniary benefit to the boiler makers. In one case a pipe was inserted which was one inch diameter only, the drawing calling for one and a quarter inches; the contractor decided that this last was too large, and made the change without consulting the owners. Consultation is always necessary in constructing work where changes that are imperative have been overlooked by the designer, for the most expert men are not infallible. Clerical errors, also, are not unknown, where different dimensions are put on detail sheets for the same members. When a difficulty of this class is encountered, the duty of a contractor is to ascertain which is the right one before proceeding with the work. A word as to the procedure with blue prints may not be amiss. How many are there who sit down to inspect them carefully—peruse them is a better word—before handing them to a subordinate to execute? The number of such persons is fewer than might be supposed. A common practice is to send them directly to the shops, but before this is done the chief draftsman should have his will of them, where no one can molest or make him afraid; for, be it known, the average blue print is far from perfect in its entirety. Scale drawings are a necessity to give an adequate idea of the finished machine, and the relations of parts one to another, but no man can work from an unmarked scale drawing, because the truth is not in it. The great printer, the sun, has looked askance at it, and the measurements, or the scale sizes, are distorted amazingly. There is no size on it which can be trusted to measure from and reproduce in metal; the draftsman who made it is human and prone to err. Nothing but the absolute figures is reliable, and of these there is an alarming scarcity in some drawings. For these and for other considerations, before construction is commenced, all blue prints should be carefully studied by an expert.

## N-RAYS DISCOVERED BY M. BLONDLOT.

In a recent issue an account has been given of the new form of radiation discovered by M. Blondlot. He finds, in fact, that most of the artificial sources of light and heat emit radiations which are capable of traversing metals and a great number of bodies which are opaque for the ordinary rays of the spectrum. In a paper read before the Académie des Sciences he describes some later researches upon this new form of radiation. The rays were first discovered by using a Welsbach burner, but he wished to see whether they are given off from other sources. A circular gas flame emits them, but the chimney must be removed on account of the absorption of the glass. A Bunsen burner does not appreciably produce them, but a piece of sheet iron or a silver plate heated with a Bunsen burner behind it will give off the rays almost as well as a Welsbach burner. A plate of polished silver inclined at 45 degrees and heated to a cherry red by a Bunsen burner was found to emit rays which are quite analogous to the former. A horizontal beam of this radiation, after passing through two sheets of aluminium or a total of .01 inch, as well as black paper, etc., was concentrated by a quartz lens. By using a small electric spark as an explorer, as before, the existence of four focal regions is shown. He also finds that the action on the spark is much greater when it is placed vertically or in the plane of the emission, than when it is perpendicular to this plane. This shows that the rays coming from the plate are polarized, as are those of the light and heat which it emits at the same time. When the plate is covered with lampblack the intensity of emission is increased, but now the polarization disappears. M. Blondlot uses the term N-rays* to designate the new radiation. He remarks that they include a great variety of radiations; in some cases the index of refraction is greater than 2 and from other sources it is below 1.5. Up to the present a spark is used as a detector, but if considered only as incandescent gas, the spark should be replaced by a flame. He used a small flame formed at the end of a metal tube with a fine bore. This flame, which is entirely blue, can be used instead of the spark, and, like it, when it receives the rays becomes whiter and more luminous. By the variations in brightness he finds four foci in the beam traversing a quartz lens, the same as with the spark. He also finds a new effect of the N-rays. They are incapable of exciting phosphorescence in bodies which acquire it by the action of light, but when such a body, for instance sulphide of calcium, has been previously exposed to the sun and rendered phosphorescent, if now it is exposed to the N-rays (especially at the focus through a quartz lens) the phosphorescence is seen to increase in brightness considerably. This phenomenon is one of the easiest to observe in the case of the N-rays. This property is analogous to that of red or infra-red rays as noted by M. Becquerel and also analogous to the action of heat on phosphorus. It seems certain that the new rays have points in common with the known rays of great wave length. On the other hand, the property which they have of traversing metals differentiates them from all others known. It is very probable that they are to be found among the fine octaves of the series of radiations which remain unexplored between the Rubens rays and the shortest electro-magnetic waves, and this he proposes to verify.

In another series of researches he finds that the new rays are given off by the sun. A chamber which is completely closed and dark has a window exposed to the sun, and closed by thick interior shutters of ⅝-inch oak wood. Behind one of the panels at 3 feet distance is placed a tube of thin glass containing phosphorescent sulphide of calcium which has already been slightly exposed to the sun. If in the path of the rays from the sun which are supposed to reach the tube through the wood, a lead plate or simply the hand be interposed, even at a great distance from the tube, the brightness of the phosphorescence is seen to diminish. When the screen is removed the brightness is restored. The great simplicity of the experiment makes it easy to repeat; the only precaution to take is to operate with a low initial degree of phosphorescence. The variations of brightness are especially easy to observe at the contours of the luminous spot which is formed by the phosphorescent body against a dark background. When the N-rays are cut off these contours lose their sharpness, but resume it when the screen is removed. These variations do not seem to be instantaneous, however. The phenomenon still takes place when several plates of aluminium, cardboard, or an oak plank 1 inch thick are placed in the path of the rays. All possibility of the action of radiant heat properly so-called is therefore excluded. A thin layer of water is found to stop the rays entirely, and even light clouds passing over the sun diminish the action considerably. The N-rays which are given off by the sun can be concentrated by a quartz lens, and with the phosphorescent body as a detector he observes the existence of several foci, but expects later on to determine their position more accurately. The rays undergo a regular reflection from a plate of polished glass, and are diffused by ground glass. In the same way as the N-rays which are given off by a Crookes tube, flame, or incandescent body, those given off by the sun act on the small spark or flame and increase its brightness.

*From the University of Nancy, where most of the experiments were made.

## LANGLEY'S AERODROME EXPERIMENTS.

Prof. Langley's 12-foot aerodrome was tested on August 8, with results considered decidedly encouraging by its inventor. The model flew a distance of 600 yards and then sank in 22 feet of water. When it was finally recovered, all that was left was a tangled wreck of twisted wires. The time consumed in flight was not more than 45 seconds. The course described was a semi-circle. According to accounts which have been published, the motor of the machine and the rudders failed to work properly. The altitude of the machine at the time of the fall was not greater than 50 feet. From the meager reports which are thus far available, it seems that the airship was driven by an 8 horse power hydrocarbon engine connected up with two two-bladed propellers located one on each side of the machine at about its middle point. One four-bladed wind vane rudder was mounted behind the engine; then came the rudder proper. On each side the airship was supported by a pair of white silk wings, 4½ feet long by 2 feet in width. The propellers were located on the side between the wings and turned toward each other. The wings, rudders, engine and other running gear were fastened to a central cylindrical tube of aluminium 18 inches in length and about 4 inches in diameter and tapering at both ends. It is said that the test of the small model will be followed at an early date by a trial by the 60-foot aerodrome which is owned by the government, and which cost $70,000.