Twenty-five buildings have been completed, and already 850 specimens have been assigned to their proper buildings or grounds.

### REPORT OF THE BUREAU OF STEAM ENGINEERING.

Limitations of space prevent our making anything more than a brief reference to the annual report of Admiral Melville, Chief of the Bureau of Steam Engineering, and our readers must turn to the current issue of the SUPPLEMENT for the digest of this publication. The most interesting parts of Admiral Melville's report are those in which he dwells upon the questions of the personnel, and the use of electrically driven auxiliaries on our warships. He regrets his "inability to see indications of the desired results, thus far, of the personnel bill," which according to his belief "contemplated most earnestly vast additions to the number of officers who would give earnest attention to engineering matters, and in no way implied a desire to augment the forces available for merely former line or deck duty." He still hopes that "the comprehensive union of the line and engineering vocations will be the result of the personnel change. . . . The only possible scheme is to insist upon the present line officer adapting himself as soon as possible to the new conditions, and increasing, where lacking, his knowledge of mechanical engineering."

In our issue of October 28, we drew attention to the fact that there was a danger of the tendency to replace the steam auxiliary by the electric motor being carried too far on our warships. Admiral Melville devotes considerable space to this question, and argues to the same effect. He shows that if all the auxiliaries on the "Alabama" were operated electrically there would be an increase of from 150 to 250 tons in the total weight of machinery. The increased space required in the generating rooms would accommodate 900 tons of coal or 3,600 horse power could be added to the propelling engines. Evidently the electric auxiliary is extravagant in weight.

### MASSES SMALLER THAN ATOMS.

At the recent meeting of the British Association Prof. J. J. Thomson, F.R.S., gave an interesting account of recent researches on the existence of masses smaller than atoms (Phar. Jour.) He showed that several lines of investigation led to a determination of the ratio of the mass of an atom to the electric charge conveyed by it—namely, ordinary electrolysis; experiments on the velocity of charged particles, and experiments on the velocity of cathode discharges. These experiments indicated that the charge carried by an atom in cathode discharges and similar phenomena is apparently 1,000 times greater than in ordinary electrolysis, consequently either the atoms become dissociated and only a portion of their mass carries the negative charges of cathode rays, or else the atom can receive a greater charge than is assigned to it in explaining electrolytic phenomena. To discriminate between these two assumptions a method was employed to determine separately the charge carried by a known number of atoms in a case for which the charge per unit mass had the greater value. The method used was described as follows:

A flat metal plate, negatively electrified, is brought near to a very large perforated metal plate through which ultra-violet radiation can pass, the whole apparatus being inclosed in gas at a pressure of about $\frac{1}{100}$ millimeter of mercury. The radiation causes a discharge of electrified particles, from the negative plate, which move in parallel straight lines to the perforated plate which receives their charge. If now a magnetic field be set up between the plates, its direction being parallel to the plane of the plates, the paths of the particles become curved; in fact, cycloids, and the particles may not reach the perforated plate if the latter is far enough away from the negative plate. There will, therefore, be a diminution in the rate of discharge, which is the phenomenon actually observed; its amount corresponds with theory if the large value of the charge per unit mass is assumed. The charge conveyed per second is the product of three quantities—the number of "atoms," the charge on each, and the average velocity of the atoms. The charge conveyed per second may be observed and the average velocity determined by a method devised by Prof. Rutherford. If the number of atoms be determined, the charge on each may be immediately found. These electrified atoms behave as nuclei on which water drops will condense when a cloud forms in the air; it is only necessary, therefore, to know the total amount of vapor condensed and the size of each drop in order to determine the number of drops, which is the same as the number of atoms. The amount of vapor condensed is obtained by suddenly and definitely expanding air of known humidity from a given higher to a given lower pressure, and the size of the nuclei is obtained from the rate of their fall, since, like raindrops, they can only attain a definite velocity.

To ascertain if the mass is collected at a point or diffused through space, the mass is allowed to impinge against a surface which is transparent to the energy carried—such as Roentgen radiation or cathode rays—but which does not allow material of infinite size to pass through it. In all the experiments the atoms possessed, negative charges; when positive charges are carried, the results of experiments agree with those on electrolysis. The amount of charge carried by an atom depends on the gas and the nature of the electrodes. From this it would appear that electrification seems to consist in the removal from an atom of a small corpuscle, the latter consisting of a very small portion of the mass with a negative charge, while the remainder of the atom possesses a positive charge.

### INTERESTING EXPERIMENTS WITH PHOTOGRAPHIC PLATES.

Mr. W. J. Russell has presented to the Royal Society of London a series of researches which he has recently made as to the action of certain substances upon the photographic plate. It has been found that a polished metallic surface, such as magnesium, zinc, etc., or in other cases a layer of oil or similar substance, is capable of producing at a distance an effect upon the sensitive plate similar to that caused by the action of light. A certain number of hypotheses have been advanced to account for this action, among others that of phosphorescence or the emission of actinic rays by the substances in question. Mr. Russell, after having made a number of interesting experiments, concludes that this action is due to the formation of hydroxyl, and finds that by its use all the effects produced by these different substances may be equally observed. In order to observe this action upon the photographic plate, the experiment may be made very easily in the following manner. Into a small glass basin or watch-glass are placed a few drops of the liquid to be examined, and the glass is covered with the photographic plate. In the case of pure water, no action is observed at the end of twenty hours, but upon the addition of a very small quantity of hydroxyl, the plate is immediately affected, as will be shown upon developing it in the ordinary manner. This action is extremely delicate, as 1 part of hydroxyl in 1,000,000 parts of water is sufficient to produce a slight effect upon the plate at the end of eighteen hours. If a piece of blotting paper is wet with a solution of 1 : 500,000, dried and placed for two hours in contact with the photographic plate, a distinct image appears upon development.

The experiments carried out by Mr. Russell seem to indicate the conclusion that the action of different metals, etc., upon the plate is due to the formation of a minute quantity of hydroxyl, which is sufficient to cause the action. The metals which are found to be the most active are, in their order, magnesium, cadmium, zinc, nickel, aluminum, etc. It may be supposed that these metals are capable of decomposing water or water vapor and cause, in the presence of oxygen, the formation of hydroxyl. Their order of activity is exactly that in which this formation would take place, as can be proved by their action upon the test paper of Dr. Wurster. These papers, when moistened and placed in contact with the first metal of the series, take a dark blue color, which is absent in the case of the non-active metals. According to this supposition, the action upon the plate should be more strongly marked in the presence of water vapor. This may be verified by the following experiment. A glass tube containing zinc turnings is traversed by a current of air which passes into a dark box containing the plate. With ordinary air the action is feeble, but with air containing a large proportion of water vapor it is strongly marked. Without the presence of the metal no action whatever is observed. In the case of organic bodies which produce the same effect upon the plate, these are found to belong for the most part to the class of terpenes, and it is well known that these substances in oxidizing give rise to the formation of hydroxyl. Another interesting point observed by Mr. Russell is that the action takes place through certain membranes, such as gelatin, celluloid, etc., but that glass or mica cuts off the action. In considering this effect, the supposition that it is caused by the diffusion of the hydroxyl through these substances is impossible; there is probably a kind of solution or combination with the membrane or one of its constituents, which permits the hydroxyl to find its way to the outer surface. The following experiment throws some light upon this action. A solution of hydroxyl, 2 per cent, is placed in a glass basin; this is covered with a sheet of gelatin ¼ millimeter thick. The sensitive plate is placed over the gelatin and left for twenty minutes; at the end of this time no action is observed. A fresh plate is then substituted and again left for the same time, when a feeble impression is obtained. A third and a fourth plate show an increase of action, but in the case of all subsequent plates the action remains stationary. It thus appears that the quantity of hydroxyl emitted by the upper surface of the gelatin increases during one hour and twenty minutes, but after that time it remains uniform. A similar effect may be obtained by using a plate of zinc or a layer of some of the essented oils. It may then be asked by what body is the hydroxyl transmitted. It is probably by means of the water contained in the membrane. This may be observed in the case of bristol board, etc. If one interposes a sheet of dry bristol board between the active substance and the plate, no action is observed, but upon moistening the bristol, a marked action takes place. Alcohol produces similar results. Thus it may be seen that the water or alcohol serves as a vehicle for the hydroxyl in some of the membranes. In the case of celluloid, the action of water cannot be assumed. In this case it seems that the role is filled by the camphor contained in the celluloid. Although camphor is quite inactive in itself, if it is placed for some time in a solution of hydroxyl or essential oil, it will cause an action upon the plate; if one interposes a thin piece of camphor between the solution of hydroxyl on the plate for sixty-six hours, an impression is obtained. It will be seen that the camphor, which is one of the principal constituents of celluloid, may thus absorb the hydroxyl and permit it to penetrate the membrane. In the case of gutta percha or caoutchouc membranes an analogous action is supposed, for although the chemical constitution of these bodies is not yet clear, it is known that they contain bodies nearly allied to camphor.

By means of these and similar experiments, Mr. Russell seems to have proved conclusively that this action of metals, etc., upon the photographic plate is due to the presence of hydroxyl. He proposes, in later researches, to elucidate the manner in which the sensitive plate is acted upon by the hydroxyl.

### COLORING BROMIDE PRINTS.

A number of processes have already been given for the coloring of bromide prints. M. Henry has obtained very good results with the use of oil or water colors as well as for pastel in the following manner:

For oil colors, a hot solution of three per cent of good white gelatine is spread upon the surface of the print by means of a wide and fine sable brush. After drying, the layer thus formed will take oil colors readily, and one may proceed to color the print as desired. For water colors, the best results are obtained by the use of a solution of 120 grammes shellac in 240 c. c. alcohol. When completely dissolved, the solution is allowed to stand for twenty-four hours, and is diluted by taking 120 c. c. of the former and 120 c. c. alcohol. This is to be filtered before using. The solution is applied to the surface of the bromide print by means of an atomizer until it appears to be slightly wet. When the print is well dried, which takes from ten to fifteen minutes, water colors may be applied as desired. If in certain parts the print does not take the color sufficiently, the process of applying the solution is repeated in these places. The fixative varnish used for charcoal drawings, etc., may be used instead of the solution of shellac. The use of pastel is especially in favor for retouching or coloring bromide prints, but it is necessary that the paper should have sufficient grain in order that the pastel may be readily applied. M. Henry has found that this grain may be obtained by the use of powdered pumice stone in the following manner: A tuft of cotton is thoroughly impregnated with the powder, and, after having applied to the surface of the print a layer of the shellac solution above mentioned, the powder is applied by tapping lightly with the wad of cotton. The print should thus be covered with the powder before the solution is dry; in this way the powder attaches itself, and is fixed during the drying of the solution, leaving below a clear image. If necessary, the operation may be repeated until the desired grain is produced.

### PRODUCTION OF HYDROGEN WITH THE AID OF MAGNESIUM.

M. Lemoine, in a communication recently presented to the Académie des Sciences, has observed the introduction of magnesium into solutions of its salts, such as chlorides, sulphates, etc., gives rise to an active disengagement of hydrogen. This action is strongly marked when powdered magnesium is used with concentrated solutions of these salts. It is well known that magnesium has the property of decomposing water, even at a low temperature, but this action takes place very slowly. The presence of its salts in solution accelerates the disengagement of hydrogen in a marked degree, the gas being given off rapidly with the formation principally of hydrated oxide. The action ceases after a time, and no more gas is given off; this, however, is simply due to the fact that a layer of the hydrated oxide is formed upon the metal, which acts as a protecting covering. If the metal is taken out and cleaned, and the solution filtered, the action goes on as before. M. Lemoine considers that this action has for its point of departure a partial decomposition, to a slight degree, of the saline solution into free magnesia and free acid, which causes the metal introduced to be attacked. In the case of a solution of magnesium chloride, he supposes that an oxychloride is at first formed, which remains in solution, but is soon decomposed with a precipitate of magnesia upon the metal. The magnesium chloride thus formed acts in its turn as before, and thus the action is continuous. It has been found that zinc and cobalt used with concentrated solutions of their chlorides give negative results.