MEETING OF THE BRITISH ASSOCIATION.

The annual meeting of the British Association took place September 17, at Bradford, Eng., and was opened by a very able address by the President, Professor Alexander W. Williamson. He discussed the importance and value of the atomic theory in chemistry, paid an excellent tribute to the memory of Liebig, traced the pathway and the difficulties that attend the chemical investigator, showed the importance and value of chemistry in its relations to education, and expressed his opinions upon the proper methods of developing and encouraging the young in the study of the sciences. He thought that our schools and colleges should be far more abundantly supplied with professors and assistants able to teach the sciences, so that the young should be constantly surrounded, as it were, by influences which should lead their tastes in that direction. Secondary schools, he thought, ought to be established, wherein the children of the poor might receive scientific instruction, which would make them more useful, in whatever industrial occupation they might afterward be employed.

In the great task of promoting scientific education and original research, he thought the government ought to take a prominent part, and contribute liberally for the erection of buildings and the endowment of professorships.

STEEL.

In the Mechanical Section, the opening address was delivered by W. H. Barlow, C. E., upon steel, relative to which he presented a large amount of useful information.

The tensile resistance varied in the different qualities of steel from twenty-eight to forty-eight tuns per inch, and experiments established conclusively that the relation subsisting between the several resistances of tension, compression, and transverse strains is throughout practically the same as in wrought iron; that is to say, that a bar of steel whose tensile strength is 50 per cent above that of wrought iron will exhibit about the same relative increase of resistance under the other tests. They further showed that the limit of elasticity in steel is, like that of wrought iron, rather more than half its ultimate resistance.

The series of experiments recorded in the book published by the committee gave the results of tempering steel in oil and water. They were made by the officers of the gun factory at the Royal Arsenal at Woolwich, and show a remarkable increase of strength obtained by this process. This property of steel is now fully recognized and made use of in the steel which forms the lining of the largest guns. The third series of experiments was made by the committee upon bars 14 feet long, 1½ inches in diameter, with the skin upon the metal as it came from the rolls. The object of these experiments was specially directed to ascertain the modulus of elasticity. In these experiments sixty-seven steel bars were tested whose tensile strength varied from thirty-two to fifty-three tuns per inch, and twenty-four iron bars varying from twenty-two to twenty-nine tuns per inch.

These experiments, which were very accurately made, showed that the extension and compression of steel per tun per inch was a little less than wrought iron, that the extension and compression were very nearly equal to each other, and that the modulus of elasticity of steel may be taken at 30,000,000, which result agrees with the conclusion arrived at by American engineers on this subject.

The fourth series of experiments were made by the committee on riveted steel, and show clearly that the same rules which apply to the riveting of iron apply equally to steel; that is to say, that the total shearing area of the rivets must be the same, or rather must not be less than the sectional area of the bar riveted. In applying steel to engineering structures, we may dismiss from consideration those superior qualities which are of high price and made in comparatively small quantities. I propose, therefore, to confine my observations to the mild steels, such as are made by the "Bessemer," the "Siemens-Martin," and other processes, having a tensile strength varying from thirty-three to thirty-six tuns per inch, a material which is made in large quantities and at moderate cost.

Following the same rule as is adopted for wrought iron, namely, that the maximum strain on the metal shall not exceed one fourth of the breaking weight, we may consider steel of this quality capable of bearing at least eight tuns per inch, instead of the five tuns per inch estimated for like purposes in iron. We know from established mechanical laws that the limiting spans of structures vary directly as the strength of the material employed in their construction when the proportion of depth to span and all other circumstances remain the same. We know also that, taking an ordinary form of open wrought iron detached girder (as, for example, when the depth is one fourteenth of the span), the limiting span in iron, with a strain of five tuns to the inch upon the metal, is about 600 feet; and it follows that a steel girder of like proportions, capable of bearing eight tuns to the inch, would have theoretically a limiting span of 960 feet. This theoretical limiting span of 960 feet would, however, be reduced by some practical considerations connected with the minimum thickness of metal employed in certain parts, and it would, in effect, become about 900 feet for a girder of the before mentioned construction and proportions.

Assuming a load in addition to the weight of the girder of one tun to the foot, the relative weights under these conditions would be as follows:

Span.	Weight of steel girder. tuns.	Weight of iron girder. tuns.
200	57	100
300	150	300
400	320	800

It is not alone in the relative weight or in the relative cost that the advantage of the stronger material is important, but with steel we shall be enabled to cross openings which are absolutely impracticable in iron. Steel is used in the Illinois and St. Louis Bridge in America, a bridge of three arches, each of 500 feet span.

There is no doubt of the fact that steel is made and sold which is cold-short, and not reliable for use for engineering purposes. This irregularity appears to arise mainly from the difference in the chemical constituents of the metal or ores employed, or in the process pursued by different makers.

Where large castings and metal of great solidity are required, as in making large guns, there is the method pursued by Sir J. Whitworth, whereby the metal is intensely compressed while in a fluid state. The pressure employed is twenty tuns per inch, and its effect in producing solidification is such as to shorten the ingot about 1½ inches for every foot of length. The treatment by compression is especially important where metal is required in large masses and of great ductility, because the larger the mass and the greater the ductility, the larger and more numerous are the air cells, and the effect of the pressure is to completely close these cells and render the metal perfectly solid. By this process, mild steel can be made with a strength of forty tuns to the inch, having a degree of ductility equal to that of the best iron. The more highly carbonized qualities, whose strengths range from forty-eight up to seventy-two tuns per inch, show a decrease of ductility somewhat in the same ratio as the strength increases.

As to strength and toughness, there are small arms made entirely of steel, of wonderful range and accuracy, capable of penetrating thirty-four ½ inch planks, which is about three times the penetrating power of the Enfield rifle. Secondly, there are the large guns, also entirely of steel, throwing projectiles from 250 lbs. to 310 lbs. in weight, and burning from 40 lbs. to 50 lbs. of powder at a charge, with which a range of nearly six and a half miles is obtained. In both cases the degree of strength and toughness required in the metal is much greater than is necessary for engineering structures. It is unnecessary to occupy more time in multiplying examples of the toughness of steel. It is well known to manufacturers, and must also be well known to many others here present, that steel of the strength of thirty-three or thirty-six tuns per inch can be made and is made in large quantities at moderate price, possessing all the toughness and malleability required in engineering structures.

THE BURLEIGH ROCK DRILL IN GREAT BRITAIN.

This drill, like many other excellent devices of American origin, is now extensively used in Great Britain. In a paper read by Mr. J. Plant before the Association, he said that the Burleigh drill has been working daily at one of the Cambrian quarries since March, 1872, and during that period had given satisfaction; and with the exception of new piston rings and some trifling repairs by the blacksmith at the quarry, no breakage of any kind had taken place. The quarrymen were not prejudiced against the drill, but on the contrary they had voluntarily made an offer to the company to drill them holes at the same price per foot as they were paid themselves for boring by hand, and deduct the amount due for such boring monthly from their contracts. This was the plan adopted in all the galleries of the quarry. The actual cost of working the drill was most accurately kept, and comparison showed that the work of untopping the slate rock could be done in two thirds of the time required by manual labor. The cost of boring with the drill during the past twelve months had been at the rate of 5¾d. per foot, including steam, oil, attendance, repairs, etc., the same being 2¼d. per foot below the cost of the manual labor employed to execute the same work. Another important point was the increased rate of progress.

We shall in our next give extracts from other interesting papers read before the Association.

RARE CHANCE TO ADVERTISERS.

About one year ago, it may be remembered, we announced our intention of printing, during the month of November, 1872, a special edition of the SCIENTIFIC AMERICAN, distinct from our regular weekly issue and consisting of 50,000 copies, the same to be devoted to gratuitous circulation. Although, at the outset, this large number seemed sufficient, we found it in the end to be inadequate for the purpose in view, and accordingly fully seventy thousand papers were printed and mailed from this office, gratuitously, to manufacturers, machinists, engravers, chemists, and in fact to representatives of every calling whom we conceived would find an interest in scientific, mechanical, or technical intelligence.

Many of our regular advertisers, recognizing the advantage of so widely circulated a medium, hastened to secure place for the announcements of their products; patentees inserted descriptions of their inventions; while others, comparatively strangers to our columns, followed a like course. As a result, so far as we have been able to learn, extraordinary returns were obtained by these enterprising business people.

We intend to repeat the experiment, and as will be seen from our advertisement of the fact, elsewhere in this issue, we propose, on the 15th of November next, to print another of these special issues, the first edition of which will be *sixty thousand copies*. The paper in itself we shall endeavor to make more interesting and attractive than any we have yet produced.

We are now collecting names of all persons engaged in manufacturing pursuits, of railroad officials, contractors, engineers, mechanics, machinists, chemists, inventors, and men of science generally throughout the entire country; and we may safely assert that there will not be a single village or town in the United States, into the hands of some of the inhabitants of which this special number of our journal will not find its way. It should be remembered that this is no random list of names selected from publications printed for the purpose; but in a great measure a category of persons and firms who have come to our notice during our long experience and intercourse with the industrial and inventing population of the land: so that advertisers will understand that they reach the very people from whom they can expect the most substantial returns, and to whose combined notice they can hope to introduce their products through no other medium extant. Our rates, as stated in our advertisement, remain the same as for a regular weekly issue, thus completing the advantages of an offer, the value of which, we consider, needs no further demonstration.

A few engravings of useful inventions with descriptive matter will be admitted, subject to the approval of the publishers, and upon favorable terms, which can be concluded by letter or otherwise. Patentees of novel devices, desirous of effecting their introduction to the public at large, will thus be afforded an opportunity of presenting them in the most attractive form, and to a class which it would unquestionably require no small outlay in time and expense otherwise to reach.

A VALUBLE DRAFTING INSTRUMENT.

Professor Josiah Lyman, of Lenox, Mass., has recently brought to our notice a very ingenious and accurate mathematical instrument, in the shape of a protracting trigonometer, which, he informs us, he has made a subject of study and experiment for some fifteen years. He considers (and from an examination of his device, we think, with excellent reason) that he has made an apparatus by which all angles and distances may be put down upon paper with accuracy equal to that of the best field instruments; by which even their errors may be corrected and results obtained (in determining areas, for instance) reliable to one twenty-millionth part of the whole; and of corresponding exactness in the solution of all trigonometrical problems. Traverse tables and in most cases logarithms will be, the inventor believes, thus rendered unnecessary, and hence a large amount of time and labor saved.

Drawing instruments are so frequently imperfect that there is a clear necessity for a device of this description, and we have no doubt but that draftsmen generally will find it of great utility and value.

The Most Powerful Gun in the World.

The new reinforced siege guns lately added to the German artillery, of 21, 28, and 30½ centimeters rifled bore, are said to be the most powerful guns in the world. Their performances are truly remarkable. The last mentioned gun, with 120 to 130 lbs. of prismatic powder of from 1·74 to 1·76 specific gravity, fires a chilled cast iron shell of 600 to 610 lbs. weight with an initial velocity of 1,607 feet per second, which is said to have never been attained before by any rifled gun. At a distance of 1,200 paces, or 988 yards, it sends the shell clean through a 14 inch armor plate and backing. The gun is very handy and easily manœuvred; it requires one man to handle the breech piece, two to lift up and insert the shell by means of a davit lift, two men to give it its greatest elevation of 17 deg. in 16½ seconds, or its greatest depression of 6½ deg. in 11 seconds, and two men to give it its lateral direction by means of a chain running over jack pulleys.

New Field Guns for the French Army.

The new French field gun, the *canon de sept*, which is constructed by Colonel Reffye, and likely to be adopted as the principal field gun of the army, is, says *Engineering*, made of bronze, with a bore of 8·5 centimeters, length of barrel 187·5 centimeters, and contains 14 grooves, 1·5 millimeters deep, these being twisted from right to left at an angle of 8 deg. 32 minutes, or of 2√2 calibers to a complete twist. The breech closing apparatus is a screw, which fits in a steel nut that is inserted in the end of the barrel, flush with its end face. Screw and nut have their threads cut out at three sixths of the circumference, so that the former may be inserted in the latter by simply pushing it inwards, when it is fastened in it by a turn to the right of ⅙ of its circumference. The screw rests in a kind of swing door, similar to the first Prussian model of field gun with piston breech, which supports it when drawn out of the barrel, and facilitates its insertion. The inner head of the breech screw has a slightly concave surface, and bears on the side three twist grooves, which arrangement is intended for extracting the metallic cartridge shell, which serves as gas check. This shell consists of a thin brass bottom, which is provided with a perforated ignition cup, while the cylindrical part is made of tinned sheet iron. The touch hole is bored at an angle through the breech screw and opens at the center of its inner surface in the gun just where it meets the ignition cup, so that the fire ignites the cartridge centrally. The latter consists of 5 disks of compressed gunpowder, each weighing 0·226 kilogramme, and provided with a central canal of 5·2 centimeters in diameter; their total weight is 1·13 kilogrammes. The projectile is an elongated shell, 3 calibers long, weighing 6·9 kilogrammes and is provided with two lead rings as guides. The first trials with this gun, at the Polygon of Vincennes, date back as far as 1870; but only in 1872 was it tested again at Calais in its improved form, and its chief merit seems to be its low trajectory, though it may leave something to be desired with regard to range, accuracy, and durability.

AN underground railway has been constructed in the city of Constantinople, Turkey, and the contractors are now finishing up the termini. It will soon be open for traffic.