GERMAN MUSEUM OF MASTERPIECES OF SCIENCE AND INDUSTRY.

BY OUR BERLIN CORRESPONDENT.

Both England and France have long been in possession of a museum illustrating the evolution of science and industry and the mutual influences between engineering, scientific research work, and commerce and trade. The Conservatoire des Arts et Métiers of Paris (founded at the end of the eighteenth century), besides representing the significance of technical achievements in their relation to the factors above mentioned, is intended to propagate technical knowledge by the aid of popular lectures. The collections of the Kensington Museum (established toward the middle of the nineteenth century) on the other hand afford a comprehensive idea of the gigantic strides made by England in the field of mechanical engineering, without there being any more intimate connection between this part of the museum and its mathematical and scientific departments.

The German Museum of Masterpieces of Science and Industry, which was inaugurated a short time ago, is intended to become a national German institution of a similar kind, a special point, however, being made of the mutual influences of science and engineering. Apart from retrospective exhibits, the very latest achievements in the field of technical and scientific investigations were to be represented. Besides serving as a Pantheon to those men whose thought and work have been operative in fashioning modern civilization, this museum was thus to become a source of historical knowledge to the scientist, and a place to which both engineers and laymen could refer for fertile ideas and models.

As the Bavarian Academy of Sciences as far back as twenty years ago had made plans for extending its mathematical and physical collections on strictly historical lines, many useful instruments and apparatus of historical importance were already at the disposal of the founders of the new museum. The latter was inaugurated a few years ago (on June 28th, 1903) in provisional headquarters, the state having placed at its disposal the rooms of the old National Museum in Maximilianstrasse. As, however, these in the following years proved inadequate, an extension was granted by the Department of War, which at the beginning of 1905 authorized some collections of the museum to be installed in the Isar Barracks. The foundation stone of the definite building was finally laid a few months ago by the German Emperor. The museum comprises:

1. Collection of scientific instruments and apparatus as well as of remarkable technical products (both originals and models), which collections are well classified and provided with necessary information for the benefit of the visiting public.

2. An archive containing important documents, both scientific and technical.

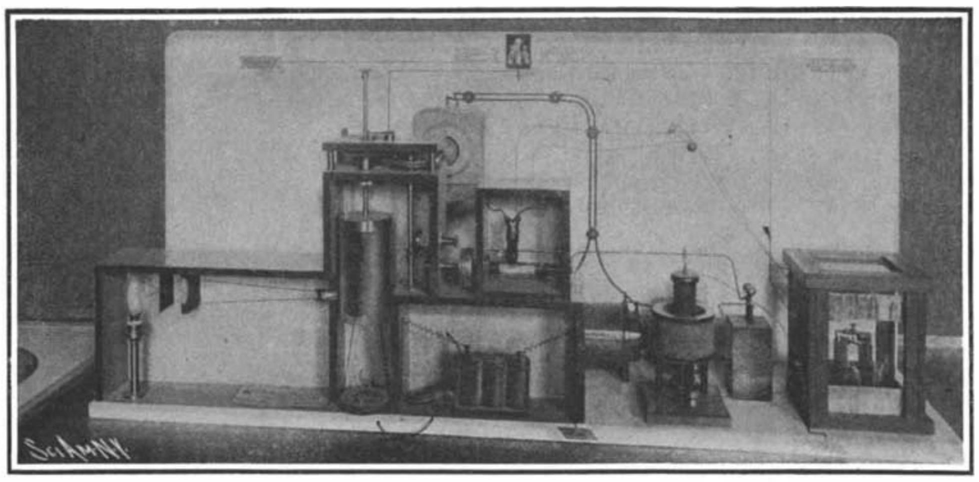
3. A technical and scientific library, containing manuscripts, diagrams, pamphlets, and books.

In order to preserve the memory of prominent workers in the field of engineering science, portraits and biographies of those Germans whose labor has been especially noteworthy in furthering the evolution of industry will likewise be incorporated with the museum.

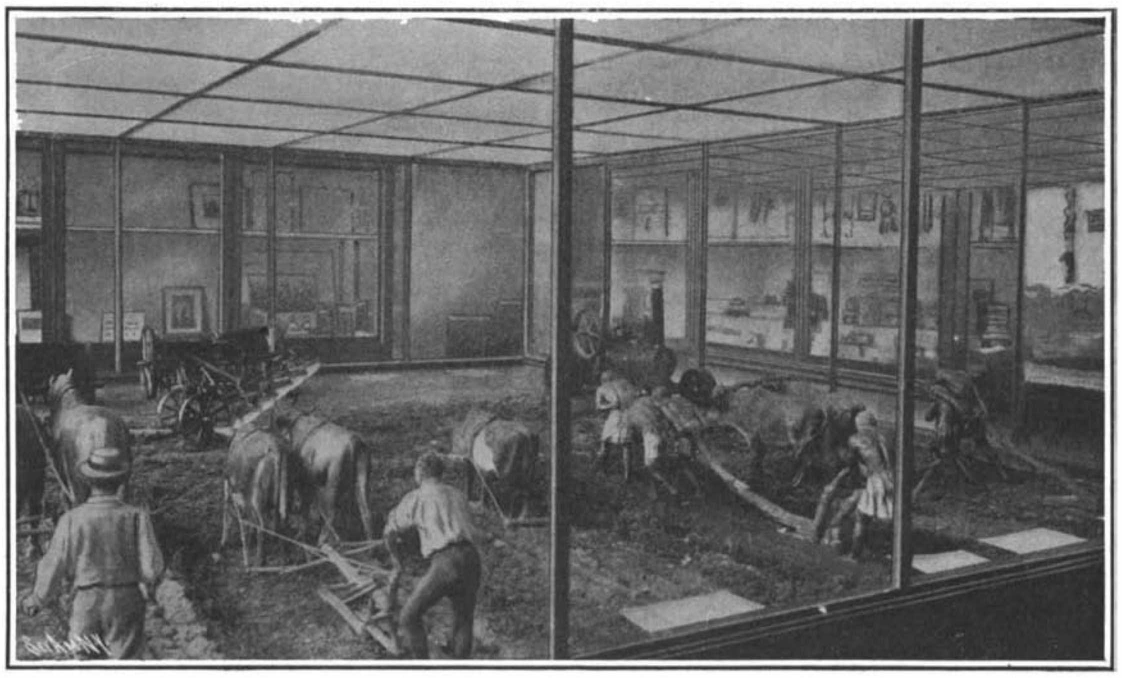
In carrying out the task laid before the museum, viz., to illustrate the evolution of any fundamental ideas and the influence of such ideas on the various economical factors, as well as to represent the ideal success of acquired knowledge and the importance of past experience, the most varied methods and means had to be resorted to. In fact, many fields, which apparently are strictly separated from each other, had to be classified and combined together, in order to afford an adequate picture of civilization as an offspring of science and engineering.

The historical aims of the museum are mainly realized by original machines and apparatus, in addition to records of the very first experiments in a given direction, and the earliest sketches and designs. These collections, in order to illustrate the achievements of science and industry in a really comprehensive manner, necessarily had to be international.

The central library above referred to, and which is intended for serving the scientific purposes of the museum, contains both ancient and modern works, pamphlets, periodical publications, etc., on subjects of engineering, mathematics, and science. While furthering historical investigation, this library is intended to make accessible to both specialists and lay people the very latest scientific and industrial achievements. An archive of maps and diagrams of unsurpassed dimensions is connected with the library, and will allow both the engineer and workman to obtain useful information on subjects otherwise inaccessible. While the collection of documents and manuscripts is of mainly historical interest, it should be remembered that the museum, so far from being merely an archive of things of the past, is meant to be primarily an organization operating to further scientific research and popularize technical knowledge. This will be best understood from the accompanying illustrations, representing a few samples of the most extensive collections of the museum. One of the illustrations shows a model of the "Santa Maria," in which Columbus discovered America. The interior of the alchemistic laboratory forms part of the exhibit and will be found espe-

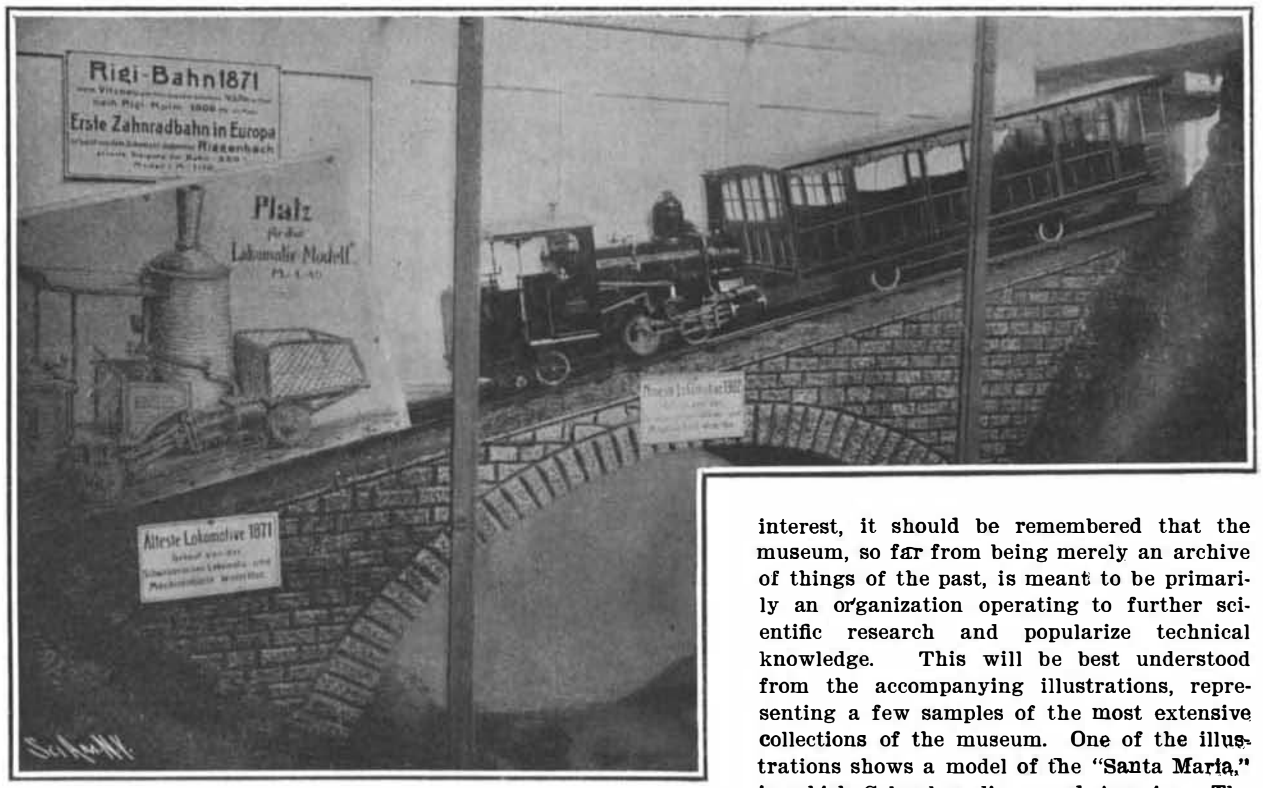


Apparatus used in Korn's picture telegraphy.



Successive stages in the evolution of the plow.

Evolution of the automobile.



Example of evolution on the Rigi railroad.

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cially instructive, as compared with the examples of chemical laboratories in the eighteenth, nineteenth, and twentieth centuries. While on one hand a most striking progress from the primitive apparatus of alchemists to the improved instruments of modern chemists will be noted, it is interesting to observe that certain apparatus still retain their original, traditional form, in which they have been used by the predecessors of present-day chemists. The evolution of plows is figured from the most primitive implement, viz., roughly shaped trees drawn first by men and afterward by oxen, to the present-day steam plows, passing through many stages which had to be traversed in various ages and centuries. Another feature in evolution pertains to the development of automobiles, from the first motor-car constructed by Daimler in 1885, to the most improved modern types. In the same hall will be found a similar retrospective exhibition, relating to the various stages in the evolution of cycles. The strides made in a special branch of railway engineering, viz., the construction of mountain railway locomotives, are graphically rendered. Side by side with the latest type of locomotive used on the Rigi railway is a model of the earliest type used on the same railway line, the latter having been constructed in 1871.

In the exhibit representing the achievements in the field of electricity is shown the outfit used in the Korn picture telegraphy, of which a description was given some time ago in the columns of this journal. To the left in the illustration will be noted the sending apparatus with an electric lamp and the cylinder on which the photographic film is wound up, while the receiving apparatus is shown at the right. Diagrammatic views and descriptions, in addition to some samples of telephotographs, further facilitate the understanding of this apparatus, the importance of which will be fully gaged only after its introduction into general practice.

Black Diamonds.

BY GEORGE E. WALSH.

The term "black diamonds" is sometimes jokingly applied to ordinary coal which we burn in our furnaces, but the real "black diamonds" of commerce are among the most unique mineral products of the world, and they serve a purpose in the industrial world that makes them of great value. The black diamonds are pure carbon, and yet in no outward appearance resemble the diamonds which we are accustomed to wear as ornaments. They are slightly harder than the crystal or gem diamonds, and in fact about the hardest substance known.

Black diamonds or carbons are among the greatest curiosities of the mineral kingdom. They are without crystalline form, and are found in irregular pieces ranging in size from half a karat up to three, four, and five hundred karats. They are dark gray, black, or brownish in color, and opaque. The real diamond of the jewelry trade is also pure carbon, but translucent and crystalline in form. Two objects so alike in composition could not be found so opposite in appearance as these two forms of carbon.

Another peculiar thing about the black diamonds is that they are found only in one locality in the world. They come from a very small section in Brazil, not more than 225 miles square in area. Outside of this limited territory, no pure black diamonds have ever been found. In the Brazilian black diamond fields the natives dive in the river beds for them, and recover them from the gravel and washings of the rivers.

What peculiar freak of nature caused the deposition of the black diamonds in this section of the world and nowhere else, is one of the mysteries which science has failed to explain. None of them has been found in the great Kimberly diamond regions, where the crystal form of diamonds have for so long been mined, and likewise no fine specimens of the gem diamond have been found in the Brazilian black-diamond fields.

The whole origin of the black diamonds is therefore a scientific enigma. Naturally, the question is raised, "Of what use is a black diamond?" No one would care to wear one of these diamonds, which resembles a piece of coal more than a real diamond, and so far no one has popularized the black gems as the black pearl has been. Nevertheless, the black diamonds serve a most important and useful function in the industrial world.

This pure black carbon is not only harder than the real diamond, but tougher and not so brittle as the gem. Consequently, it is of great value for many mechanical purposes, and particularly for boring with diamond drills. In diamond drilling, the tips of the drills are studded with carbon or black diamonds, and when the bores are deep, the pressure is so great that the gem diamonds would be crushed in the process. But the carbon resists this continued pressure, and slowly eats down into the rocks.

In diamond drill work, the carbon is set in circular pieces of soft steel or iron, called bits, and these bits are attached to tubing. Armed with these black-diamond teeth, the drills push their way down under severe pressure to a depth of five and six thousand feet, cutting through the hardest kind of rock. Some black diamonds are much harder than others, and there is no way to determine by the color the difference in the degree of toughness.

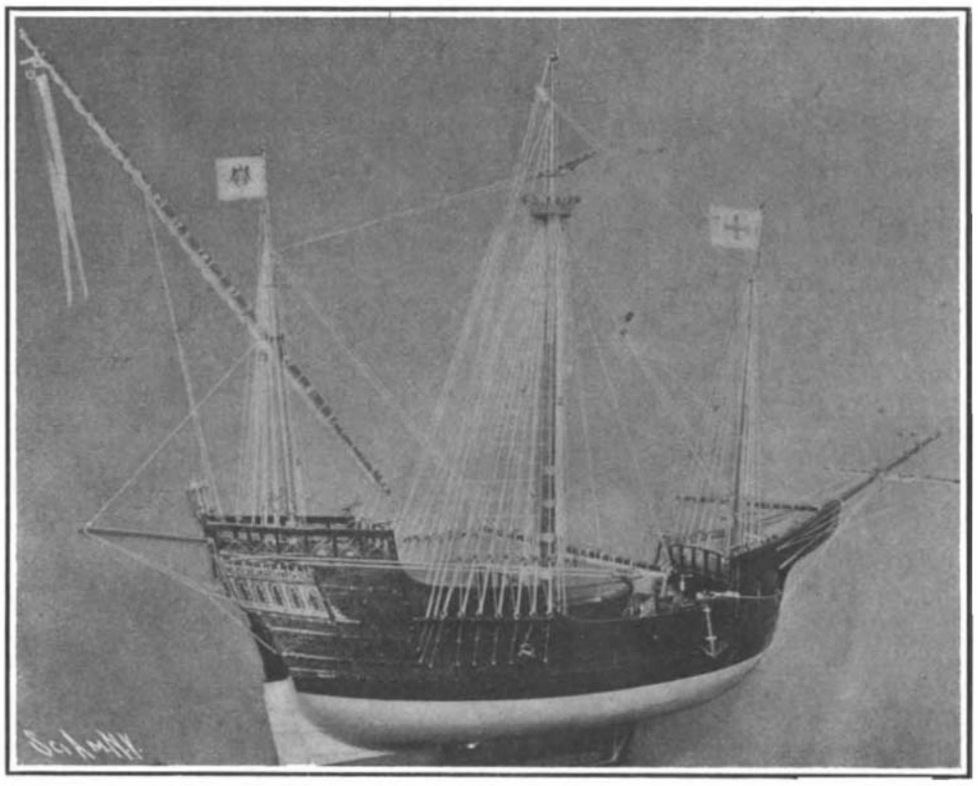
Black diamonds or pure carbon are not by any means cheap, and the owners of the mines in Brazil where they are gathered are making a good thing out of their monopoly. In the last thirty years the prices of black diamonds have advanced from $5 to nearly $85 a karat, and the tendency is still upward. The arming of a drill with diamond points is thus a rather expensive matter. Usually a set of eight stones are placed in the head of a single drill. If each diamond weighs only three and a half karats, the total cost at $85 per karat would be about $2,380 for a single bit.

Great as this expense is, however, it pays, for the black diamonds are so tough that they last a long time, and they achieve results which could not be obtained in any other way. There is no known substance that can take the place of carbon in drills in boring for gold, silver, copper, and other mineral deposits. Before the black diamonds of Brazil were discovered, it was impossible to make deep borings.

When the carbon was first introduced in our industries, it was used in diamond saws for cutting stones, marble, and similar substances. Then the price advanced so that the carbon was found too costly for such use, and bort was substituted for stone cutting. Bort is really an imperfect crystal or gem diamond, but it is too brittle for use in drills. Consequently, bort has taken the place of black diamonds for stone cutting, and the latter have been restricted almost entirely to diamond-drilling purposes.

The average size of black diamonds used in the drills ranges from two to five karats, but the larger specimens give much better results. They cost more, but they last longer. Consequently, there is a greater demand for the larger pieces of pure carbon, and the price is sometimes run up to premium figures for unusual specimens.

The fear that the supply of black diamonds may some day give out and paralyze the diamond-drilling industry has stimulated prospectors to systematic search for new deposits; but so far they have not been successful. On the other hand, scientists have been making a close study of the chemical conditions which have produced the black diamonds; but their manufacture is apparently about as difficult as the making of the gem diamonds. It is possible under certain conditions to make either, but not in sizes sufficient to be of any commercial value. Nature in some peculiar way has made these rare products, and then thrown the secret of the process away. If any man can ever unlock or find that secret, he may cause a panic in the diamond trade.



The "Santa Maria," which carried Columbus to a new world.

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The Real Value of Steam Coal.

In general, it may be said that a furnace may be designed to burn almost any kind of coal with good efficiency, and that the real value of a coal depends very largely upon the number of British thermal units which it contains. So states Mr. D. T. Randall, engineer in charge of fuel engineering department of the Arthur D. Little, Inc., laboratory of engineering chemistry, Boston, Mass., in a recent paper. He points out that tests which have been made at the government fuel-testing plant seem to indicate that the most important thing to be considered in a coal is its heating value. Following this, the size of the coal may be considered next in importance, and when the moisture, volatile matter and ash are widely different they must also be considered. The results of more than 400 boiler tests at the government testing plant show that the average drop in efficiency for a range of coals between 14,000 B. T. U. and 10,000 B. T. U. is only about 6 per cent. This difference is due to the combined influence of the size of the coal and the moisture, volatile matter, and ash in the coal. It will be seen from these figures that the probable influence of any of these constituents is not as great for hand-fired furnaces as it is often thought to be. With certain boiler equipments in which a considerable overload is necessary at times, the effects of these constituents may be much more important, owing to the reduction in capacity which may be obtained, and it is for this reason that when coal is selected for a given plant it is important that the coal supplied should not vary greatly from time to time; otherwise, the fireman may have serious difficulty in maintaining the capacity required, and in burning coal with good efficiency.

With a furnace which is well designed, there should be a close correspondence between the heating value of the coal and the water evaporated. Small variations in moisture, volatile matter, and ash should make little if any difference in the efficiencies obtained.

The size of the coal may influence the results to a serious extent. Small sizes of anthracite coal pack together closely, and strong drafts are required to burn them. This results in holes in the fire and a leakage of air in the boiler settings. The loss is often estimated to be at least 10 per cent. This is also true of many of the bituminous coals. Other coals which coke readily, forming a loose bed of fuel, do not show much loss, due to the presence of fine coal, except such as is so small as to be carried off from the grate by the draft. With any character of coal there may be a loss of fine coal, due to sifting through the grates. That this loss may be large is well known. The carbon in the ash is an important item in determining the losses in a boiler room. In many plants care on the part of the firemen has reduced this loss to the equivalent of 2 and 3 per cent of the fuel fired. Occasionally, owners of power plants have purchased for testing purposes a coal of higher grade than they usually furnish for the boiler furnaces. The results obtained have often been disappointing, and without further investigation they have declared that the plan of purchasing coal on the basis of its heating value is at fault, and that corresponding results cannot be obtained from the higher grade coals. On the other hand, it has happened that others have tried coals of lower heating value than the coal regularly burned in their plants, and they often find a greater drop in the evaporation than they expected. This has led many people to believe that there is a great difference in the value of coals for only slight variations in the composition.

Boiler tests are a rather crude method of comparing coals, especially if the fireman is not accustomed to burning the coal to be tested.

A chemical laboratory test is conducted under conditions which may readily be duplicated, and the results are therefore more reliable than boiler tests.

The averages of a number of boiler tests on each coal on which the combustion is fairly good in all cases should show results which agree quite closely with the chemical results on the coals, provided they are of the same general character. If they vary in composition, a slight reduction in efficiency may be expected for the coals high in moisture, volatile matter, and ash.

The Mexican Central plant at Aguascalientes for preserving railroad sleepers with oil, which was started some years ago as an experimental plant to develop and perfect the Ebano oil process, is now treating about a carload, of 3,500 sleepers, daily. Each sleeper takes up about three gallons of oil.