

is attached by a vertical hinge to the main frame, a flexible coupling being arranged in the steam pipe, leading from the high-pressure to the low-pressure cylinders. The high-pressure cylinders are 20 inches diameter by 32 inches stroke, and the low-pressure cylinders 32 inches diameter by 32 inches stroke. The enormous boiler has a diameter of 84 inches. It carries 5,366.3 square feet of heating surface in its tubes, and 219.4 square feet of heating surface in its firebox, making a total of 5,585½ square feet for the whole boiler. The fire-box has a total length of 108¼ inches, a width of 96¼ inches, and the grate area is 72.2 square feet. The total weight on the driving wheels, which are 56 inches in diameter, is 334,500 pounds, this being the total weight of the engine. An interesting fact is that the 436 tubes in the boiler have a total length of not far short of two miles. With a boiler pressure of 235 pounds to the square inch, and using live steam in all four cylinders (which the enormous boiler capacity renders possible, not merely at starting, but steadily when the engine is under way) this remarkable locomotive can exert a drawbar pull of 32,000 pounds, and a drawbar pull of about 71,500 pounds when she is working compound.

Now as to actual results attained. Previous to sending the engine to St. Louis, the engine was tested under the conditions of actual service at Schenectady, when she took a 63-car train weighing 3,150 tons up a one per cent grade. As to what she could do on the level, it can safely be said that she would be capable of hauling a train of considerably over twice that weight at a speed of from ten to twelve miles per hour.

Three different companies at the Fair exhibited complete passenger trains, the cars representing the very latest development of the car-builders' art. The Pull-

man Company had a train of cars in which every modern improvement and the latest ideas on interior finish and furnishing were exemplified. The N. Y. C. & H. R. Railroad Company exhibited a complete Empire State Express train, which was recently illustrated in this journal, the train being complete, even to the new balanced compound locomotive at its head. We present in our two-page group of illustrations a photograph of another complete train exhibit, made by the Mis-

and simpler style. Also, there is a noticeable tendency to increase the size of the windows, even those of the ordinary day coaches being of exceptional width, providing a long stretch of unobstructed outlook. The engine at the head of the train is a six-connected, simple engine, with cylinders 20 by 26 inches; 65-inch driving wheels; and a heating surface of 2,930 square feet. The working pressure is 200 pounds to the square inch, and the total weight of engine 183,200 pounds.

After prolonged delay the Italian government has at last introduced the measure sanctioning construction of the Apulian aqueduct. This project consists of an irrigation system for the arid tableland of Apulia. The aqueduct is to cross the Apennines by means of a tunnel 7½ miles long, and will have several subsidiary canals, so that twenty-one communes of the province of Foggia, and all those of the provinces of Bari and Lecce, will receive an adequate supply of water. These communes con-

tain a population of nearly two millions. It is estimated that the scheme will cost \$25,000,000, and will not be completed before the year 1920.

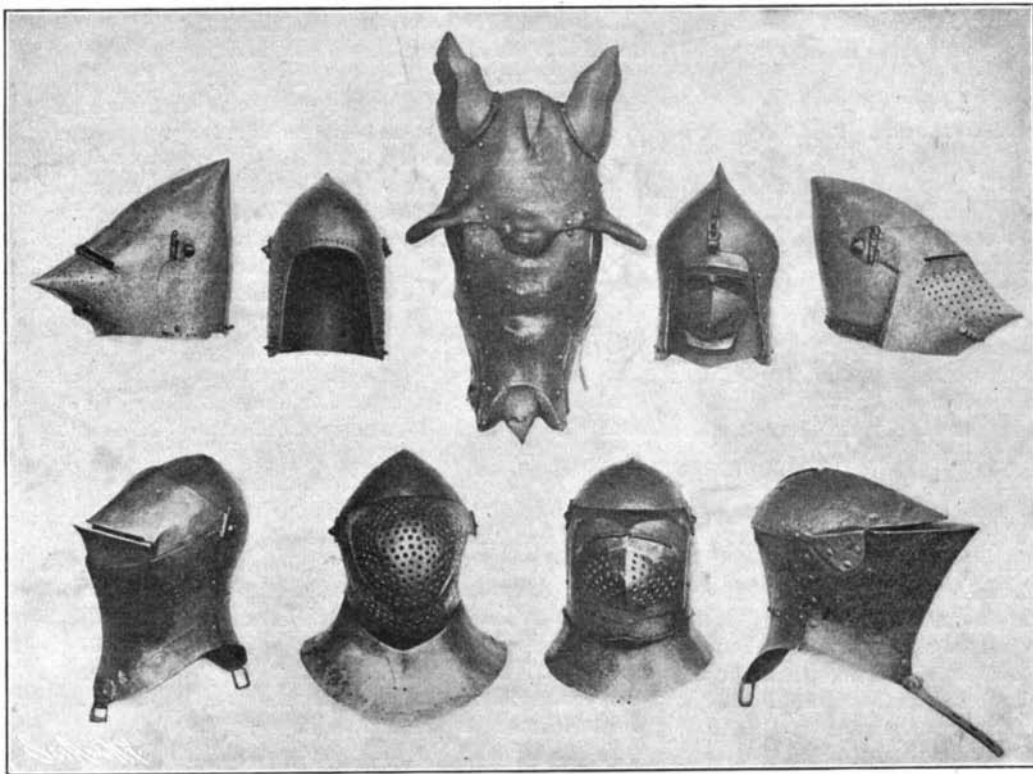
THE DINO COLLECTION OF HISTORIC ARMOR.

BY ISABEL R. WALLACH.

The collection of armor gathered by the late Duc de Dino, Marquis of Talleyrand-Perigord, and now the property of the Metropolitan Museum of Art in New York, is a revelation of the degree of beauty to which metal work may be carried, and also of the wonderful effects achieved by the medieval armorers. Truth of line, integrity of purpose, and strength of construction distinguish each piece, and bear testimony to the fidelity and skill of the craftsman. Inlay and overlay, chasing and pierced work, damascene and etching,



The Helmet and Shield of Louis XIV.



A Collection of Casques and Head Pieces; the Second Helmet from the Left in the Top Row is Supposed to Have Been That Worn by Joan of Arc.

souri Pacific Railroad Company. This train was made up of six cars as follows: First a United States railway postal car, 63 feet 6 inches long over buffers, and 10 feet wide, the framing of which is made in accordance with railway mail service specifications; then a standard baggage and express car, 63 feet 4 inches long over buffers and 10 feet wide over side sills; then two vestibule coaches, 69 feet 3¼ inches long by 10 feet wide; a chair car of same length and width; and a dining car 79 feet 4¼ inches by 10 feet in width. A special feature of this car is a private dining room, with an oval table large enough to seat six people. The whole train, which was built by the American Car and Foundry Company, is of interest as exhibiting the modern tendency to abolish extremely heavy and over-rich interior decoration and resort to a lighter

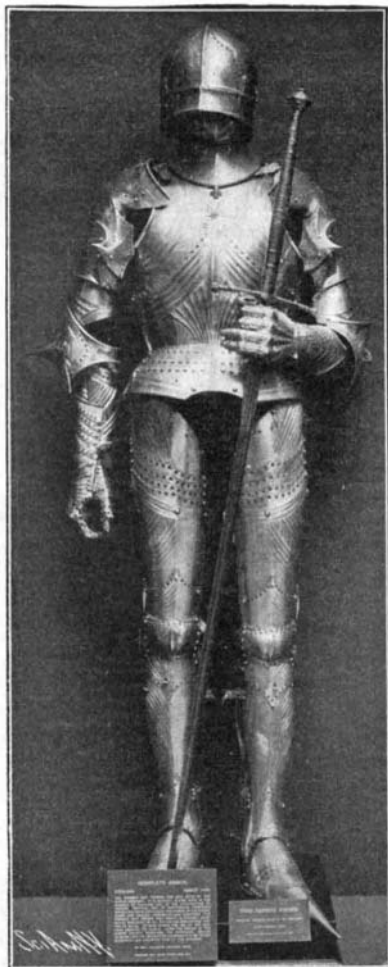
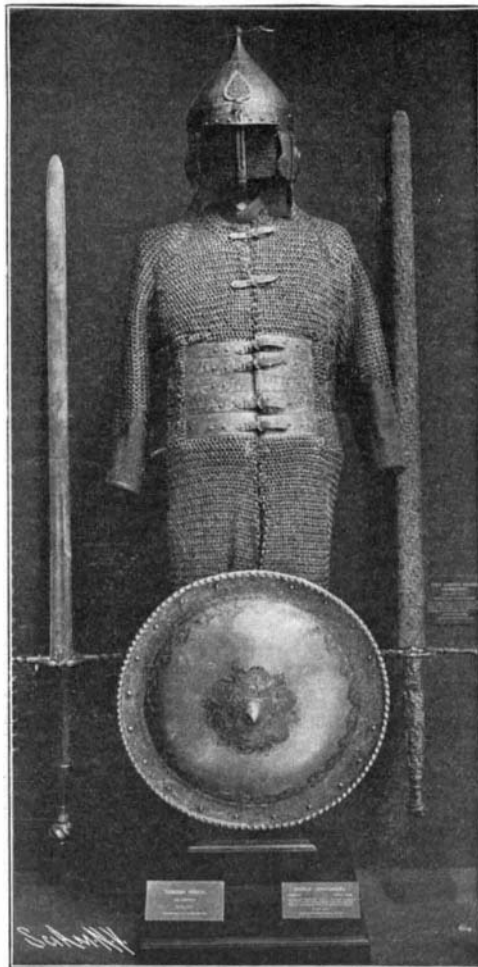


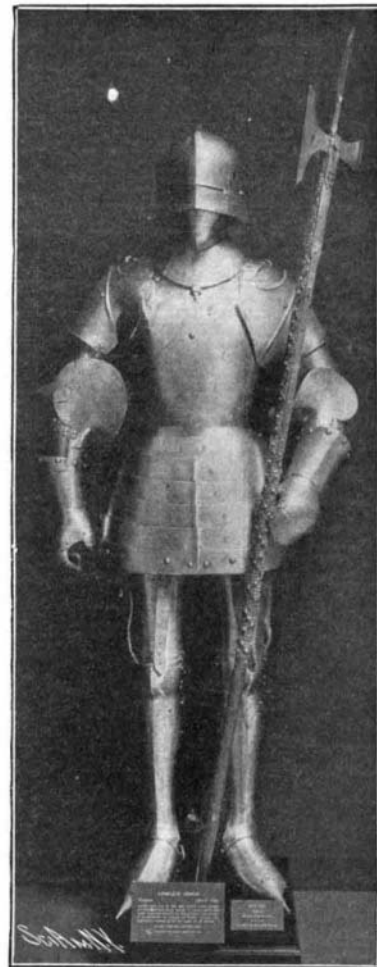
Plate Armor of Florid Workmanship (1490). Typifies the Best Work of the Gothic Armorer in the Anatomical Modeling of Steel.



Striped Armor, Black and Silver Etched, of German Workmanship. The Shoe and Gauntlet are Made of Separate Plates to Secure Flexibility and Suppleness.



A Turkish (Saracen) Coat of Chain Mail (XVI. Century). The Shield is of Contemporaneous German Workmanship, and Probably Designed for a Spanish Knight.



One of the four extant Gothic suits dating from 1450, considered the most valuable in the Dino Collection. This suit bears the marks of the armorer's proof-tests.

enamel, embossing, and repoussé, crowd every available inch of surface, yet never to the detriment of the grim business of defense.

One of our illustrations is a side view of the plate armor neck piece and chamfron that protected the war horse of Henri II. A front view of the same specimen is presented in the illustration showing a collection of head pieces. The equine neck and head piece illustrated is remarkable for the accurate modeling displayed.

The collection is particularly rich in elaborately etched and gilded head pieces. The helmet-roofs served for reinforcing guards when the marvelous temper of a swiftly-descending blade cleft the very iron, or the force of the crashing battle ax tore its way through the stoutest steel. Many of these pieces bear the emblems of royalty; others were the property of mighty rulers, among them the Medici and the Saxon electorate princes.

The armor in the collection is particularly striking, the various specimens showing clearly the influence of the different periods. One of the accompanying illustrations is a complete suit of armor of Italian make to which the date 1450 may be assigned. This austere garment of steel shows the stamp of tests which have proved its protecting qualities. The suit is one of the few (about four) extant dating from the fifteenth century. It ranks among the most valuable objects of the entire collection. Mounted on the same stand with this suit is an Italian war-ax, likewise dating from the middle of the fifteenth century.

The pierced trefoils and the curved lines in the Gothic suit bearing the date 1490, also pictured in one of the accompanying illustrations, show the influence of the Italian school. The corrugations add strength, a very important factor in a suit that weighs but forty pounds. At the time when this suit was fashioned, the armorer's skill was at its highest. The specimen shows anatomic modeling of unusual quality. Particularly is this noticeable in the armor of the hands, knees, and ankles. The flexibility, the graduated thickness of all the plates, and the remarkable temper are qualities that have aroused the admiration of those who may be considered authorities on medieval steel working. After this period, the weight of the armor rapidly increased; its flexibility became impaired, and its decoration belonged rather to the goldsmith's and sculptor's than to the armorer's art. The mailed fist of the figure shown clutches a two-handed sword, Spanish in its origin and wrought some time during the second half of the fifteenth century.

The handsome armor of alternate stripes of black and of silver damascene, also included in our illustrations, is of later date. It is of German manufacture. The shoe and gauntlet are built up of separate plates, conferring the suppleness and flexibility which the swordsmanship of that day required.

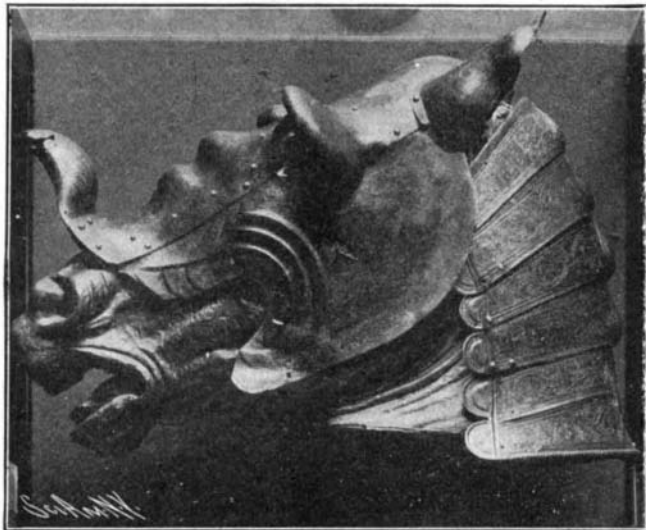
Splendid with gold repoussé is the half armor designed for the great Gonsalvo de Cordoba, presumably about the year 1590. Its gorget is ornamented with the collar of the Golden Fleece. The temper of the metal is unsurpassed. This example resembles closely that of Alessandro Farnese, Duke of Parma, preserved in the Vienna Museum. Immediately below the armor, a Milanese shield (*rondache*) likewise dating from the second half of the sixteenth century, is mounted. It represents a fierce struggle of mail-clad knights wonderfully executed.

A fitting companion piece of the same period, no less elaborate in finish and even more artistic, is the beautifully etched and gilded half armor signed by Pompeo della Cesa. The scalloped edges that peep from under the skirt and shoulder pieces belong to the velvet garment worn underneath. The shield (*rondache*) displayed beneath the armor was made somewhere about the close of the sixteenth century by an Italian craftsman.

The specimen of sixteenth century chain mail illustrated herewith and the helmet above it are Turkish. The shield below is of contemporaneous German workmanship. Both show elaborate gilding and etching. Their juxtaposition gives the student a fine opportunity for comparing the German and Saracen schools. The shield was probably designed for a Spanish nobleman—at least that is what competent authorities surmise. To the left of the armor, a German (Saxon) two-handed sword is hung, which was also made about the sixteenth century. Contrasting strongly

with the deadly earnestness of this weapon is the two-handed ceremonial sword displayed to the right of the armor. Like the former, this is of German workmanship, probably the product of some Swiss craftsman. It is of earlier date, and was fashioned probably in the second half of the fifteenth century. The handle carved in the purest Gothic style was originally in another collection. The blade, hilt, and sheath, however, date from the same period.

The exhibit of helmets in the collection is most comprehensive. From the simple iron hat, ludicrously suggestive of an inverted kettle, to the shapely and truly royal burginet of Henri II. of France, is a far



The Chamfron (Horse's Head Piece) Worn by the Charger of Henri II.

cry. Between them are a dozen different varieties, each planned to protect its wearer from the crushing weapon of a foe. Some are purely classic in shape, and show much decoration; others, like that of the Maid of Orleans, are simple to severity and almost bare of ornament. The gorgeous helmet of Henri II., its sides telling in rich relief of the victory of Hercules over the Centaurs, is part of the gilded armor he wore when, as Dauphin, he visited his royal father, Emperor Charles V., confined a prisoner of war in Madrid. Near it is the chamfron previously mentioned, that protected his horse's head, marked with his initial and the date 1539; it is one of the few of the collection that permitted the animal to use his eyes. The majority of the chamfrons utterly prevented the charger from seeing, in order to prevent his shying at the critical moment. There are helmets in the collection that were worn by the body guards of Pope Julius III., of Cosmo di Medici, of the Great Elector, and near them Saracen and Turkish casques with their distinctive domes and peculiar visors. These casques are elaborately chased and gilded, but in deference to the strict Moslem com-

mandment, there is no trace in the pattern of a graven image—only a beautiful labyrinth of arabesque and geometric lines.

Pendants and medallions that decorated the bits and bridles of the horses are displayed by the score. There are also parts of the plate armor that protected the chargers from the lances of enemies.

An important member of the Dino collection is the shield and helmet of Louis XIV. Just how these and other royal caparisons were permitted to leave their native soil is a question that must embarrass French collectors. The Louis XIV. pieces are classic, and their decoration of gilt and bronze of an unusually high order of artistic merit. During Louis XIV.'s reign it was that the use of armor was officially abolished; for that reason his royal shield and helmet fittingly close a collection of inestimable value to the student of history and of art, and to the layman who finds the living present the logical development of a no less living past.

Preventing Hydrophobia by Vaccination.

Pasteur's vaccination method for the prevention of hydrophobia in people bitten by mad dogs is employed at the institute for infectious diseases at Berlin. The "Cultus" ministry has just published a statement with reference to the cases of persons bitten by mad dogs which have come to the knowledge of the authorities during 1903, and which permit a judgment on the merits of such vaccination based upon authentic facts.

In the year 1903, 307 persons were bitten by 194 mad dogs or dogs suspected of madness; in 140 of these dogs hydrophobia was afterward proved beyond a doubt, while 13 were found to be healthy; the rest could not be examined. The 307 persons lived in eight different provinces—226 of them in eastern Prussia, western East Prussia, and Silesia, which are close to Russia. Thus Russia is again shown to be the breeding place of this plague. Of those bitten, 281 proceeded to the institute for infectious diseases and were vaccinated. Four of them died of hydrophobia and one recovered after a slight attack. Deaths took place on the thirty-eighth, fifty-sixth, one hundred and tenth, and one hundred and thirty-fifth day, respectively, after the bite.

Vaccination has not proved an absolutely certain remedy, even when applied right after the bite. The statistics show, however, that of 281 persons vaccinated only 4 died, that is, 1½ per cent; while of those not vaccinated but treated medically 6 per cent died, and of those neither vaccinated nor treated 11 per cent died.

"In view of these figures," the statement proceeds, "it is earnestly to be recommended that all persons having the misfortune to be bitten by dogs either mad or suspected of madness at once submit to vaccination. The value of such vaccination is being more and more recognized. During the last six years the percentages of persons bitten who submitted to vaccination were 29, 80, 82, 78, 90, and 92, respectively, and it is to be hoped that in the future every bitten person will avail one's self of it."

Automatic Packing Machine.

An ingenious packing appliance has been invented by Mr. Van Allen, of Paris. By means of this apparatus, which is almost human in its action, it is possible to fashion the package, charge it, and then seal it ready for transit. The appliance is a combination of a weighing machine and a packer. First the machine cuts off the requisite length of lead, paper, or whatever is utilized for the envelope, from a continuous traveling band, pastes and folds it into shape, leaving the mouth of the bag open. The package then passes along, stopping in its passage for a moment to receive its contents of tea, sugar, or cereals, through a funnel. It makes another forward movement, and an elastic pressure piston comes into action and rams down the contents to the minimum volume. By a further series of operations the bag is shaken into shape, pressed, and the ends are folded down, pasted, and then labeled. Not once during the operation is the bag or its contents touched by hands. The inventor has been engaged for three years upon his device. When perfected it will perform the work of seventy people and complete the whole cycle of operations at the speed of forty packages per minute, thus effecting a remarkable saving in time and expense.



Milanese Half Armor by Pompeo della Cesa (1590).



Milanese Half Armor Made by Lucio Piccini for Gonsalvo de Cordoba (1590).

THE DINO COLLECTION OF HISTORIC ARMOR.

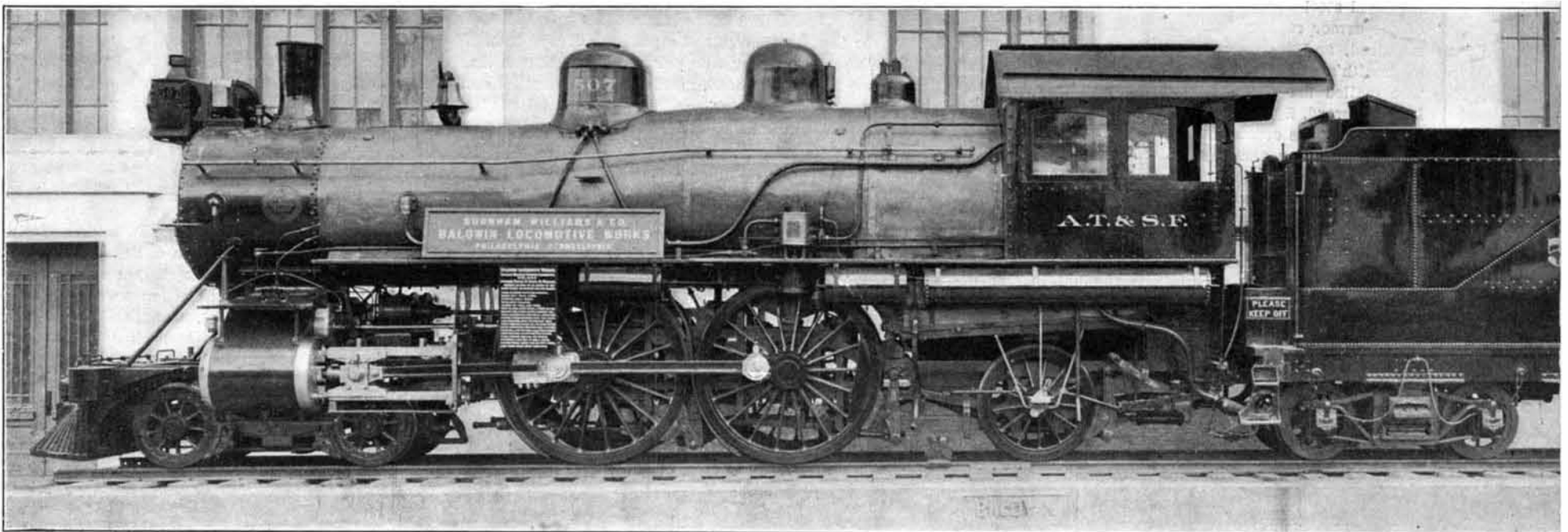


Cylinders, 20 x 28 inches. Heating surface, 2,655 square feet. Weight, 183,700 pounds.
Atlantic Type Passenger Engine.

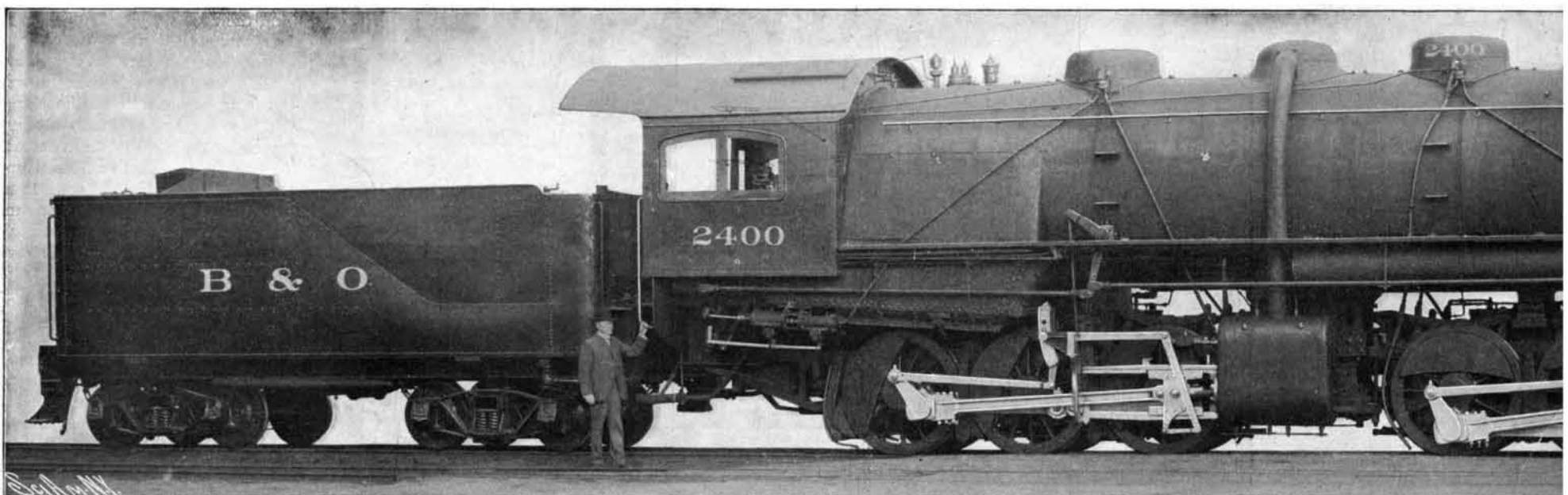
Cylinders, 19 x 28 inches. Heating surface, 2,879 square feet. Weight, 169,090 pounds.
Atlantic Type Passenger Engine.

Cylinders, 19 x 32 x 32 inches. Heating surface, 4,706 square feet. Weight, 257,240 pounds.
Compound Tandem Freight Engine.

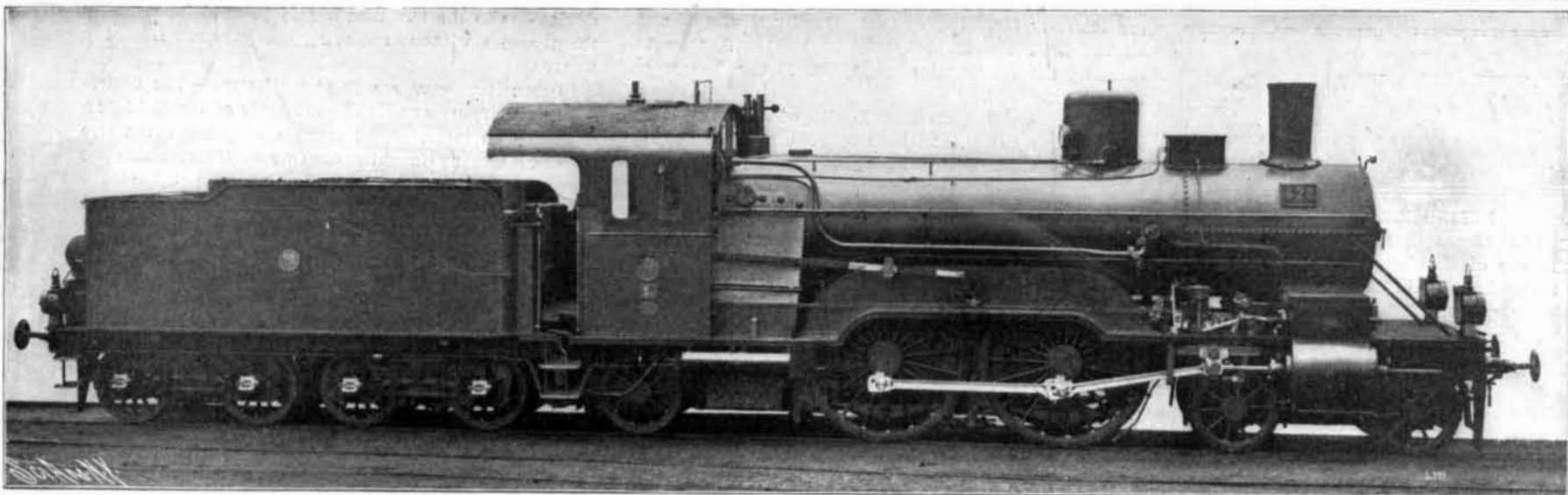
Front View of Three Lines of Modern Locomotives.



Cylinders: high-pressure, 15 inches; low-pressure, 25 inches diameter. Stroke, 26 inches. Diameter driving wheels, 79 inches. Heating surface, 3,206 square feet. Pressure, 220 pounds. Weight, 19
Four-cylinder Balanced Compound, for the Atchison, Topeka & Santa Fé Railway System.

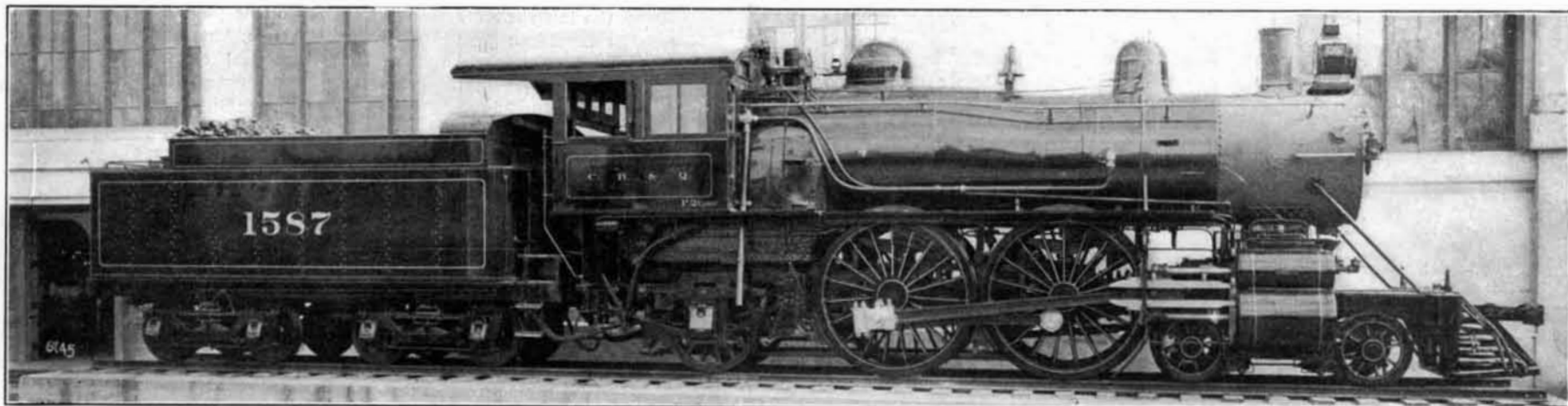


Cylinders, 20 and 32 inches diameter by 32-inch stroke. Diameter of boiler, 7 feet. Heating surface, 5,586 square feet. Working pressure, 235 pounds. Weight of engine, all available for adhesion, 334,500 pounds. Maximum tract
B. & O. Freight Locomotive, the Heaviest and Most Powerful Locomotive Ever Built.



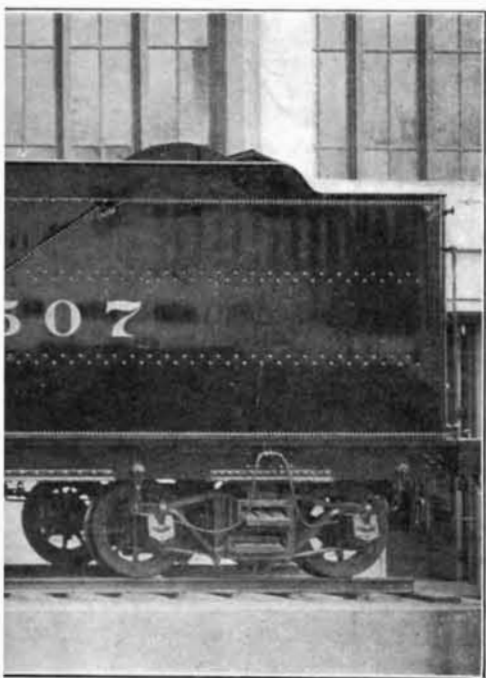
Cylinders, 14 and 24 inches by 24 inch stroke. Diameter driving wheels, 6 feet 6 inches. Heating surface, 1,022 square feet. Weight, 132,700 pounds.

Four-cylinder, Balanced, Compound. German Engine, with Superheater.

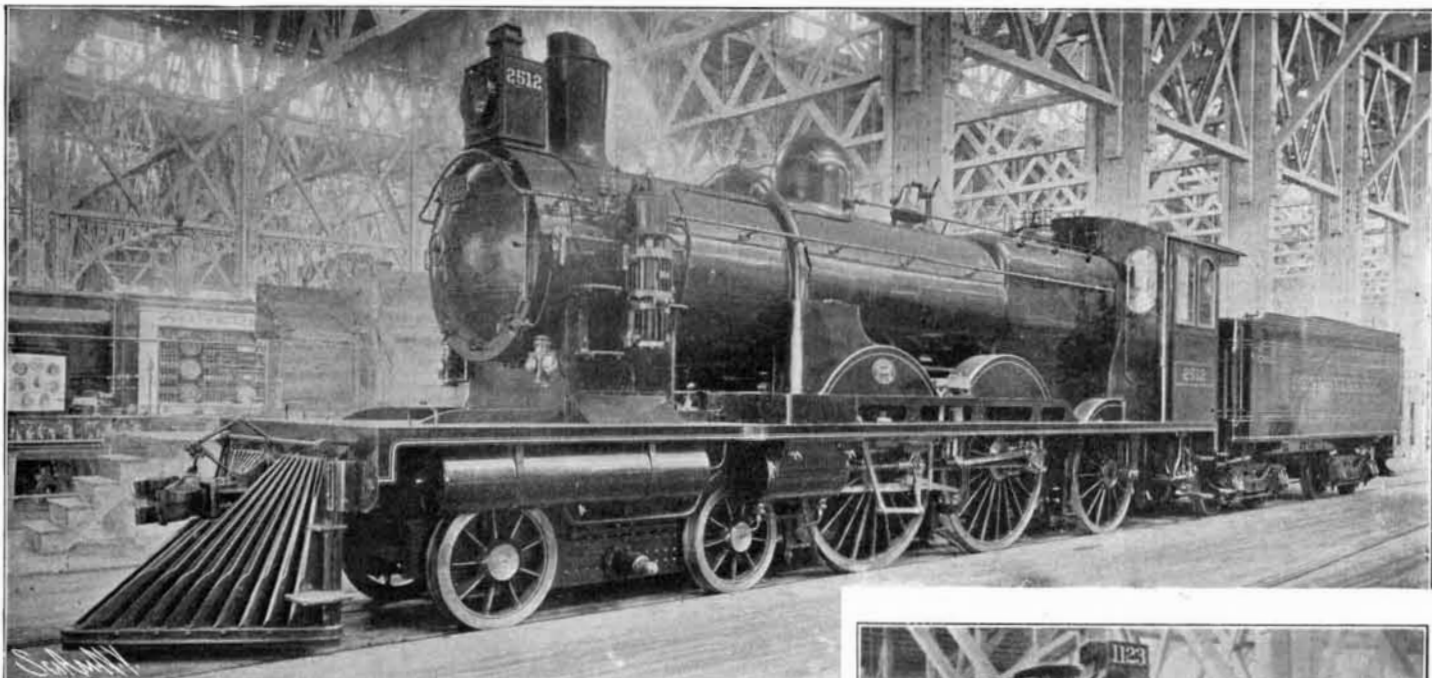


Cylinders; high-pressure, 15 inches; low-pressure, 25 inches. Stroke, 26 inches. Diameter driving wheels, 84 1/4 inches. Heating surface, 3002.5 square feet. Steam pressure, 210 pounds. Weight of engine, 183,080 pounds.

Four-cylinder Compound for the C., B. & Q. Railroad.

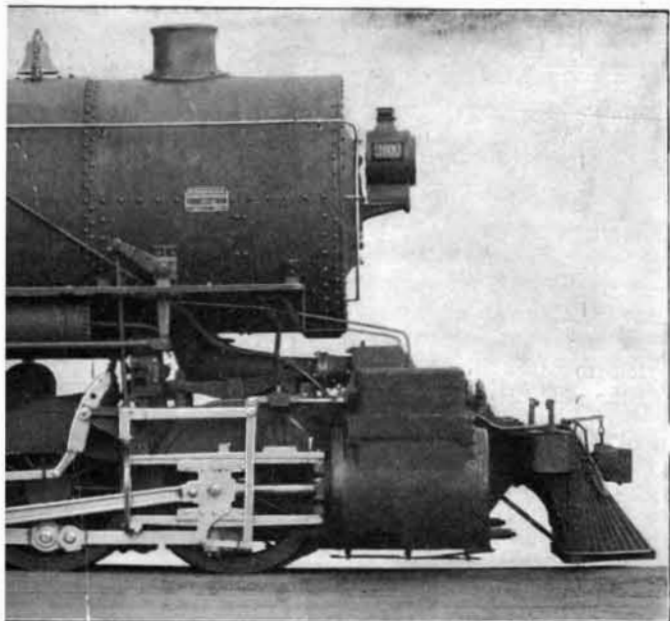


3,760 pounds.



Cylinders, 14 1/2 and 13 3/4 inches by 25 1/2-inch stroke. Diameter driving wheels, 80 1/2 inches. Heating surface, 2,617 square feet. Weight, 161,700 pounds.

De Glehn Compound of Pennsylvania Railroad.



ive power, compound, 71,500 pounds; working simple, 82,000 pounds.



Cylinders, 20 x 26 inches. Driving wheels, 69 inches diameter. Heating surface, 2,930 square feet. Working pressure, 200 pounds. Weight of engine, 183,200 pounds.

Complete Missouri Pacific Engine and Train.