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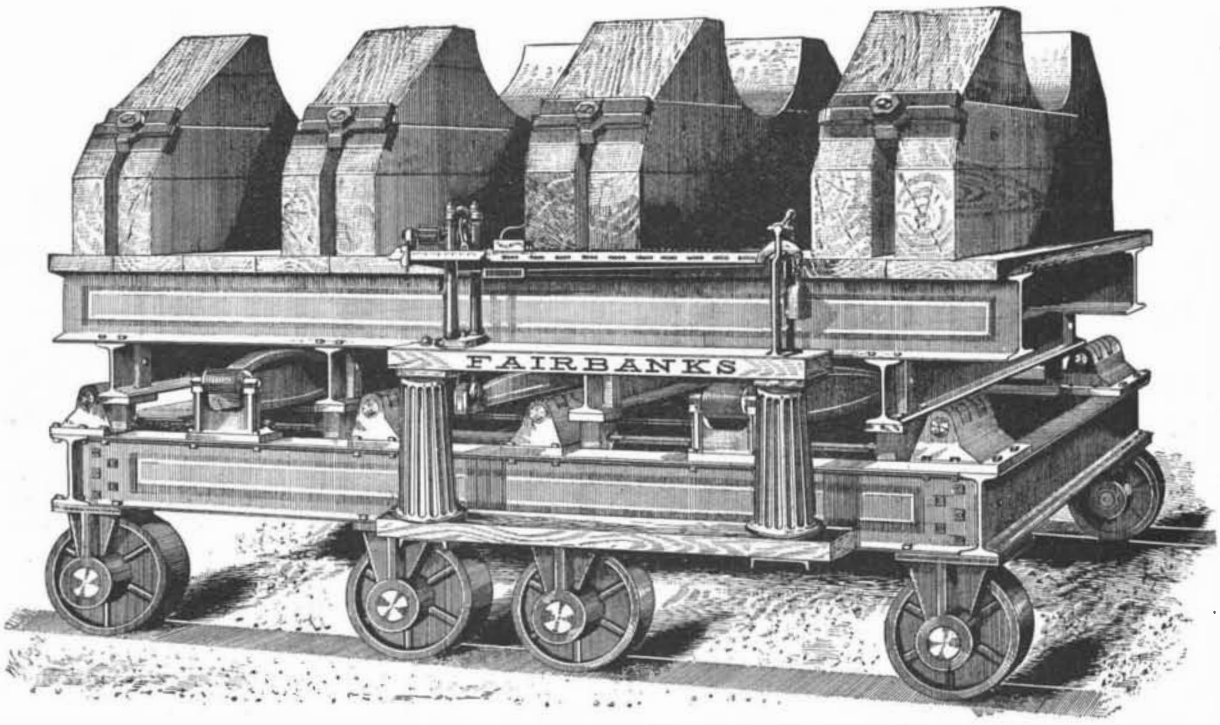
## THE ONE HUNDRED AND FIFTY TON PORTABLE GUN SCALES OF THE WATERVLIET ARSENAL.

It is a trite saying that all modern science is built upon the balance. Modern chemistry developed its possibility of growth only when chemical balances began to be used in the laboratory. In physics, which is one of the sciences of measurements, the same truth holds. All the modern developments are due to the exact determination of weights and measures. Of late years the same fact has begun to hold in the case of the mechanical arts. The charges of flux and ore for the blast furnace and of steel for the crucible are now accurately weighed and precise results in metallurgy are obtained by the aid of scales. The same is true for many other branches of the arts. We illustrate in our present issue a portable platform scale, furnished by the Fairbanks Company, of New York, which is probably the largest of its class in the world. It was designed and built by the firm of E. & T. Fairbanks & Co., of St. Johnsbury, Vt., for use in the Watervliet Arsenal, near Troy, N. Y. It has a total capacity of 300,000 pounds.

The scale is carried on eight 20 inch wheels, four on a side. These support the lower bed frame built up of 12inch I-beams. Directly over each wheel is a link, the aperture in whose bottom forms the fixed fulcrum for one of the scale levers, there being eight of these main levers, four on each side. Above the cen-



DETAILS OF THE BEAM AND CONNECTIONS OF THE SCALE.

THE ONE HUNDRED AND FIFTY TON GUN SCALE OF THE WATERVLIET ARSENAL.

ter bearing or knife edge of each lever is an 8 inch I-beam running transversely, and 12 inch longitudinal I-beams, each 15 feet long, rest upon these 8 inch beams. There are, therefore, four transverse beams, each beam resting on two of the scale levers. The other ends of the scale levers, provided with knife edges, communicate by vertical links with a transverse lever, one of which levers answers for two main levers. For each pair of transverse levers, which nearly touch in the center longitudinal axis of the scale, is a second lever, this time a longitudinal one, of which there are two. The two ends of these levers, almost touching, operate a single transverse lever, which runs out to the weighing beam and is connected thereto in the usual way by links and knife edge pivots. From the original scale levers, which directly bear the weight of the platform to the weighing beam, there is, therefore, a series of three separate multiplications.

The weighing beam is of the peculiar type used only on the largest scales. The sliding poise reads directly to the large units, whose designations are engraved on the beam. On the poise is a subsidiary weighing beam, with its own smaller sliding weight, by which a reading to divisions of ten pounds is obtained, by inspection, which can by the eye be still further divided if desired.

Links are applied to prevent oscillation of the platform in either direction, but allow it perfect freedom of vertical motion.

The platform is 12 feet wide and 15 feet long. When loaded to its full capacity the scale undoubtedly represents the greatest concentration of weight under the circumstances on any portable scale ever built in this country. The platform is made of 3 inch oak, and on it are placed four chocks or blocks for the gun to rest on. Each chock has cut out of it a portion of a circle of 60 inches diameter. These chocks are spaced equally distant, each of them coming directly over one of the transverse I-beams, and, therefore, directly over the central knife edges of the scale levers. This is of itself a very interesting feature, and it has been found that however the weight of the gun is borne, whether by any pair of chocks or by all at once, the weight is given with precisely the same accuracy. To test the capacity, three guns were placed on it at once, making a total of 150 tons, which it weighed without difficulty.

As a practical illustration of what the scale would do once when a gun was resting on it and had been weighed, one of the officers of the Arsenal stepped upon the platform and while there he was weighed. Although the scale was loaded with thousands of pounds in the shape of the gun, the officer was weighed to within one pound of his known weight. A paper dollar bill placed on the end of the scale beam, when the scale is adjusted, is sufficient to disturb its equilibrium.

The object of making the scale so short was to enable it to be run across the building and off the main division of the floor, behind the row of columns seen on the left of the cut. A pair of channel beams, flat sides upward, are laid across the building for it to roll on. As we illustrate it, the scale holds a 12 inch gun weighing 52 tons.

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### Paints for Ironwork.

At a recent meeting of the Association of Engineers of Virginia, Mr. S. Wallis gave the members some interesting and valuable hints respecting the protective painting of structural ironwork. He recommended that the first coat should be of red lead ground in raw linseed oil, used within two or three weeks after mixing, and kept thoroughly mixed while in use. This coat dries in from 24 to 30 hours. If the finish is to be black, the next two coats should be made up from a paste composed of 65 per cent of pigment and 35 per cent of raw oil. The pigment is to consist of 65 per cent of sulphate of lime, 30 per cent of lampblack, and 5 per cent of red lead as a drier—the whole thinned to a proper consistency with pure boiled oil. If the finish is to be in red or brown, the paste should be composed of 75 per cent of pigment and 25 per cent of pure raw oil: the pigment to consist of 55 per cent of sulphate of lime, 40 per cent of oxide of iron free from sulphur and caustic substances, and 5 per cent of carbonate of lime as a drier. The sulphate of lime is to be fully hydrated. At American prices, this paint will cost, ready for use, about 60 cents per gallon. Lead paints are not recommended for finishing coats, on account of chalking; neither is zinc, on account of cracking. Graphite paint does not dry well in linseed oil, and is not impervious to water. Its color is steel gray.

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### Coloring Lantern Slides.

At a recent meeting of the Royal Society of Dublin, Sir Howard Grubb in the chair, Dr. J. Alfred Scott described a method, which he said he had devised, for coloring lantern slides, referring to that class of slides that are produced on photo-gelatine plates. The description of his method is in close accordance with that of Mr. G. M. Hopkins first published in the SCIENTIFIC AMERICAN of March 11, 1893. Dr. Scott will no doubt be glad to award the priority to Mr. Hopkins.

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### Contents.

(Illustrated articles are marked with an asterisk.)

## TABLE OF CONTENTS OF
# SCIENTIFIC AMERICAN SUPPLEMENT
## No. 960.

**For the Week Ending May 26, 1894.**

Price 10 cents. For sale by all newsdealers.

### ELEVENTH ANNUAL MEETING OF THE INSTITUTE OF ELECTRICAL ENGINEERS.

The American Institute of Electrical Engineers held their eleventh annual meeting in Philadelphia, beginning Tuesday morning, May 15, under the chairmanship of Prof. Edwin J. Houston, who was elected president of the society. The president's address was devoted to "A Review of the Progress of the American Institute of Electrical Engineers," and traced the work of the society during its decade of existence. Prof. Wm. A. Anthony spoke on "Light Distribution and the Use of Lamps." After the proceedings of the day were over, receptions were tendered the society by the Manufacturers' Club, by the Engineers' Club, and by the Electrical Section of the Franklin Institute. On Wednesday other papers were read and discussed. One was on "Some Storage Battery Phenomena," by Prof. W. W. Griscom. He maintained that in this country storage batteries were worked to too close a margin. In Europe they have succeeded; here they have failed. Prof. Francis B. Crocker and C. Howard Parmly, of New York, presented a paper on "Unipolar Dynamos for Electric Light and Power." "Tests of Closed Coil Arc Dynamos," by R. B. Owens; "Relative Advantages of Toothed and Smooth Core Armatures," by Alton D. Adams, were among the papers read. In the evening the annual dinner was given. Thursday was devoted to various excursions and pleasure trips. The meeting was largely attended, nearly one hundred members sitting at the dinner. The papers were printed and copies distributed among the members, so as to enable better discussion to be given each one. The standing of the institute and the permanent form given to its volumes of proceedings operate to make its annual meeting one of the events of the year.

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### THE BICYCLE AS AN EXAMPLE FOR IMPROVEMENTS IN TRANSPORTATION.

For many years man has attempted the construction of a successful road machine to be propelled by the rider. The first signs of real success came in the application of crank propulsion to the old velocipede. The next development was the introduction of elastic tires of India rubber. Then came the last and greatest improvement, the pneumatic tire. Meanwhile the proportions and details of the machine were constantly changing, until the wheel of to-day was evolved, with its ball bearings wherever possible, and with air-inflated tires. The mere business of making and selling bicycles will soon be, if it is not already, one of the leading industries of the country.

Where he has to propel himself, man naturally has done everything to facilitate the work. The principle bearings of a bicycle, all except those of the chain gearing, work on hard steel balls, running with a minimum of friction and readily adjustable for end shake. The old solid rubber tire enabled the average rider to make high speeds; the modern pneumatic tire adds three or four miles an hour more to his rate. But while man has effected these improvements where his own individual exertions are concerned, does it not seem as if he had neglected to extend his ingenuity to horse, steam, and electrically propelled vehicles? An impression that the bicycle has engrossed all the time of the constructor and inventor of improvements in vehicles is created—the carriage and the rail car seem awaiting their turn.

The lessons of construction taught by the bicycle are valuable as much in their exclusion of the unsuccessful as in their lessons of achievement. It has been found that a machine with some twelve finely adjusted, apparently delicate ball bearings can, without repeated oiling or attention, be driven for hundreds of miles through dusty roads. It has been found that lightness of structure is made possible by the pneumatic tires, which prevent destructive jarring; every time a bicycle noiselessly glides past a rattling carriage, whose wheels rotate on thickly greased axles, and where every stone and inequality in the road opposes progress, seems to tell the story of the superior construction of the bicycle. Yet we are content to rest with the development of the man-propelled vehicle. It certainly is time something was done for the other.

A few solid rubber-tired carriages, still fewer pneumatic-tired vehicles, are seen upon our roads and streets. The pneumatic sulky used on the race track is a side issue. Roller or ball bearings are a rarity among carriages and on railroads. It is unquestionable that if it could be done, a veritable revolution in steam and electric transportation might be brought about by the further application of these improvements. It seems absurd to suggest a steam railroad car on pneumatic tires. But light short cars could certainly be carried on elastic tires of some kind, which would do away with the greater part of the noise and injurious jarring of iron wheels against steel rails.

The friction of car wheels is greatly diminished by roller or ball bearings. By every improvement in the direction of preventing jarring, lightness of construction would be favored. The whole system of transporting passengers in vehicles operated by steam or electricity is subject to radical modifications. The