

(Paper No. 2246.)

**"Note on the Government Testing-Works at Malines,  
Belgium."**

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THE great importance of the development of the network of Belgian railways of late years has necessitated the creation of a complete service of control and of experiments, for the reception of the material and the stores necessary for its working. It must likewise be considered that, owing to the terms of the Belgian law in regard to the accounts, whereby all supplies must be obtained by public contract, recourse can be had to direct purchases or to restricted contracts only in altogether exceptional circumstances. Under these conditions it can readily be understood how important it is that the numerous stores when presented for acceptance should undergo a minute examination. It is this which has rendered indispensable the establishment of the engineering laboratories about to be described. It must further be added that experiments are required for the same object by the Administrations of Ports, Telegraphs and Marine, Bridges and Roads, and Mines. Besides the trials made for the reception of the stores intended for these different administrations, the service is likewise charged with the study of a great number of special questions necessitating experiments of all kinds. Companies foreign to the different services of the State, as well as private persons, can demand its aid, which is regulated by the ministerial resolution of the 3rd of June, 1882, as follows:—

The service of trials that the Author has the honour to direct comprises three different sections:—1. Chemical tests; 2. Mechanical tests; 3. Tests of combustibles.

1. *Chemical Tests.*—In the chemical laboratory are carried out all the analyses necessary for the control of the quality of the products of such different varieties as are employed by the various services of the Ministry of Railways, Ports, Telegraphs, and Marine. The number of chemical analyses made with this object in 1886 was 6,964. This laboratory is thus called upon to give

information of the most varied character, such as photometric trials of the different systems of lighting, analyses of water, of cast-iron, of steel, of bronze, of lime, of cements, and of colours, etc. It examines industrial products with a view to their nature and their commercial value, in order to determine the place that they should occupy in the general classification of merchandize. It makes tests of the conditions of transport of inflammable materials, explosive or subject to deterioration. In a word, it undertakes all the technical researches that are allied to chemistry. The multiplicity of the tests of all kinds, and the rapidity with which they must be made to meet the wants of the service, have necessitated the establishment of a laboratory which, by its sufficiently large arrangements and apparatus of all kinds, can satisfy all requirements.

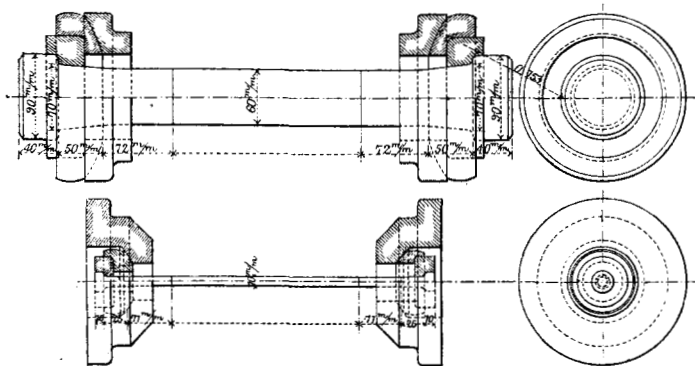
2. *Mechanical Trials.*— These trials affect materials before entering into construction, such as sheet-iron, different kinds of iron, rails, bronze, wood, stones, bricks, &c., and certain made-up articles (chains, ties, cables, iron sleepers, springs, tires, axles, &c.). Besides, certain trials of precision are made in view of special studies (determination of the coefficient of elasticity and of the resistance to the elastic limit, &c.). In the course of 1886 there were carried out 54,372 tests of all kinds. The various apparatus for conducting these tests include a ram with a series of monkeys for the trial by shock of tires, axles, rails, &c.; a spring weighing-machine on the Buckton system; an apparatus to bend sheet-iron cold; a dynamometer to test cloths, ropes, iron and steel wire up to 1,540 lbs. (750 kilograms); a dynamometer to test sheetings, string, and thread up to 154 lbs. (70 kilograms); a dynamometer to test papers and fine thread up to 77 lbs. (35 kilograms); two special machines to ascertain the strength of cements; a full-size machine for testing oil on the Thurston system; a complete apparatus for the projection of luminous rays for the study of fractures; a traction-machine of a power of 60 tons, specially intended for the trial of chains of all kinds, hooks and coupling-screws, in which the experiments can be made on a length of 23 feet (7 metres); a 500-ton testing-machine on Kirkaldy's system; Colonel Rosset's spiral multiplying quadrant; Professor Bauschinger's mirror apparatus.<sup>1</sup> The Author uses for tensile-experiments a mode of attachment in some respects analogous to that described by Professor Kennedy.<sup>2</sup> While it accomplishes the same object, it

<sup>1</sup> Minutes of Proceedings Inst. C.E. vol. lxxxviii. p. 23.

<sup>2</sup> *Ibid.* p. 35.

renders the trial of tests more easy of execution. In Fig. 1, round bars are shown, but this system serves equally well for flat test-objects. For compression-tests the Author has applied the

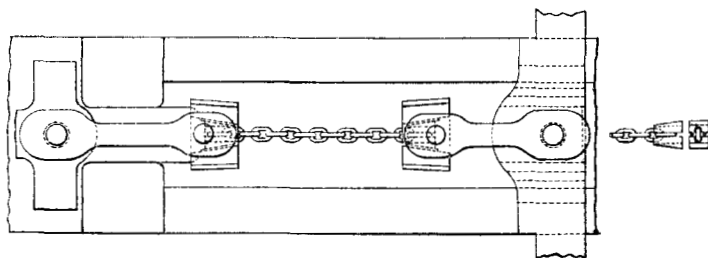
FIG. 1.



spherical joint to the face, between which the cylinders or the test-prisms are placed. In this manner the least want of parallelism of the faces of the test-piece which are subjected to the thrust of compression is corrected. This apparatus has been constructed by Mr. C. Klebe of Munich.

For testing chains the Author has constructed special wedges, as shown by Fig. 2. A link at each extremity of a portion of

FIG. 2.



chain subjected to tension is pressed over almost all its periphery, and the neighbouring links pass freely. With five sets of wedges of different sizes, chains of all dimensions can be tested.

3. *Trials of Combustibles.*—The coals employed in the locomotives of the Belgian State Railways are semi-bituminous, containing 12 to 14 per cent. of volatile matters. Non-bituminous coal is also used mixed with a certain quantity of bituminous coal

for binding it, so as to obtain a combustible which is not carried away in the smoke-box by the draught of the locomotive.

Different qualities of these coals are furnished by public contract, which are used according to the various needs of the service. The following are the requirements exacted for the supply :—

NON-BITUMINOUS and SEMI-BITUMINOUS COAL.

Designation.	Quantity of Water Evaporated per Kilogram of Coal.	Product of Evaporation for the quantity of Coal burnt per hour and per Square Metre of Grate Surface.	Depression in the Smoke-box in Centimetres of Water.	Pressure in the Boiler in Atmospheres.	Observations.
I.	kgs. 4.5	1,100	6	6	Non-bituminous.
II.	5.5	1,250	6	6	
III.	6.3	1,500	12	8	
IV.	7.0	1,600	12	8	Semi-bituminous.
V.	7.5	1,700	12	8	

BITUMINOUS COAL, SUITABLE FOR MAKING COKE.

Type I. A mixture of at least 50 per cent. of quartz-sand and 50 per cent. of finely-pulverized coal should give an agglutinated coke.

Type II. A mixture of at least 60 per cent. of quartz-sand and of 40 per cent. of pulverized coal should give an agglutinated coke.

The bituminous coals ought to yield a minimum of 18 per cent. of volatile matters, and their yield of ashes should not exceed 15 per cent. These coals should not be burnt alone in the fire-box of the locomotive; they are not submitted to evaporation experiments. In order to ascertain whether the fuel delivered really corresponds with the description, the following trials are made :—

*Evaporation Experiments.*—The bituminous and semi-bituminous coals are tested in two locomotive-boilers specially arranged to readily determine the quantity of water evaporated, the weight of coal consumed per hour and per square metre of grate-surface, and the quantity of ashes left after combustion in the smoke-box and ash-pit. The steam produced is in part carried away in the chimney to create an artificial draught; the excess escaping

freely. The intensity of this draught is regulated at will, and is measured by a water manometer in direct communication with the smoke-box. A metallic gauge gives the pressure of steam, and two injectors feed each boiler from water contained in a graduated reservoir, and special for each boiler. The fire is lighted with a quantity of coal, which is not taken into measurement in the trial. When the boiler is under pressure, the experiment is commenced by noting first the hour and the level of the water in the reservoir and in the boiler. The fire is maintained as regular as possible, and in such a manner that the draught may be indicated by a depression of the gauge, which differs according to the nature of the combustible. The last shovelful of trial coal being cast on the fire, the experiment is concluded when the pressure has fallen to  $\frac{1}{2}$  atmosphere. The level of the water in the boiler is then restored to its initial height. The difference of level of the water in the reservoir, ascertained before and after the trial, and the weight of fuel used, give the quantity of water evaporated per kilogram of coal. The coal burnt, the grate surface, and the duration of the experiment, determine the weight of coal burnt per hour and per square metre of grate surface. The average depression in the smoke-box, as well as the average pressure of steam, are known from the notes taken during the course of the trial. It only remains to weigh the ashes in the smoke-box, those of the ash-pan and the clinker, to be informed of the evaporative power of the coal and the manner in which it supports the draught.

*Laboratory Experiments.*—All the coals are tested to ascertain the quantity of water that they contain, their yield of ashes, of solid carbon, and of volatile matters. The bituminous coals likewise undergo a trial with the object of ascertaining their caking power. An intimate mixture of the coal, finely pulverized, and sand, reduced to an impalpable powder, is heated in a porcelain crucible to a bright red heat until the volatile matters have completely disappeared in a reducing atmosphere. It is thus found what is the quantity of sand that must be added to the coal, so that the mixture may give, after complete evaporation of the volatile matters, a resisting mass, which, under the pressure of the fingers, only breaks into pieces without crumbling into dust.

The Paper is accompanied by a printed list of instructions issued by the Minister of Public Works on the 3rd of June, 1882; and by two tracings, from which the Figs. in the text have been prepared.