the same level of water maintained in both. Previous to an experiment the boiler was heated for several hours, and communication was then cut off between it and the experimental tube. During the trials the pressure in the boiler was kept at about 60 pounds. The fire was stoked as usual, the consumption of coal noted, and the total evaporative power of the boiler determined.

With different intensities of fire, the consumption of coal per hour per square foot of grate varied from 16 pounds to 48 pounds. The author, however, does not advocate such excessive duty, and considers that any consumption of coal above 30 pounds per square foot of grate represents a rate of firing inconsistent with the safety of the boiler. As a rule, with stationary boilers having the above proportions of heating to grate surface, from 1.6 pound to 2.4 pounds of water are evaporated per hour per square foot of total heating surface. Here the maximum evaporation was 94 pounds, and the minimum 19 pounds, or from two to four times as much as in a locomotive boiler. Evaporation was extremely active from the portion of the boiler surface covered by the tube, varying from 30 pounds to 49 pounds of water per hour per square foot of heating surface with moderate firing, and from 40 pounds to 48 pounds with strong firing. The forced draft increased combustion but not evaporation. The author concludes that, with stationary boilers working under ordinary conditions, evaporation at the part most exposed to overheating ought not to exceed 20 to 28 pounds of water per square foot of heating surface per hour, and never attain to pounds in practice.

NEW TECHNOLOGICAL BUILDINGS, MONTREAL.

The new Technological Building in connection with McGill University, Montreal, is a most substantial structure, and its perfect adaptability to its purpose, evidences the painstaking thought bestowed upon it by the designer. The various parts of the building are isolated from one another by fire-proof doors. They include draughting rooms, pattern rooms, machine shop and blacksmith shop, each fitted with the appliances necessary for imparting instruction of a practical character to the students, and one of the best equipped testing laboratories in the world. This laboratory contains two testing machines, representing the most perfect English and American patterns, each with a capacity of 100,000 pounds. These machines are operated by means of a small electric motor. They are capable of determining both the tensile and crushing strength of materials. The laboratory also contains a chemical balance capable of weighing 125 pounds or the fraction of a grain, a *fac simile* to a small scale of the Montreal water works, by which the head of water necessary to supply a given population may be determined; apparatus for measuring the volume and rate of flow of water in a running stream, etc.

Here may also be seen the only standard cement testing department in Canada.

Other features of interest are the electrical department, which contains a 250 h. p. dynamo driven by a sixty h. p. engine. There is not a belt in the place, the dynamo being driven straight on end. There are two engines each 500 h. p., and the space occupied by each engine is only 5x9 feet. The bottoms of the engine beds are hollowed out, which has the effect of preventing rocking. This department is in charge of Prof. Workman, and possesses every facility for imparting electrical knowledge of a theoretical and practical character.

One of the most interesting and valuable features of the institution is the library, which contains 6,000 volumes of scientific books, being one of the most complete libraries of its kind in the world.

At the top of the building, enclosed in glass, is a museum of mechanical models, which for completeness is said to be unequalled anywhere in the world. These models are the work of a celebrated German maker named Releaux, and were many of them made expressly for this institution. They illustrate almost every conceivable mechanical movement, and will be of great service, not only to the students of the school, but also to manufacturers and inventors. They are valued commercially a $8,000.

The Physics building, which is as yet incomplete, seems likely to be as perfect in its arrangement and appointments as could be desired.

TESTING DYNAMOS.

By Forbe Bain.

Electric business generally is done in a most unbusiness-like way. A purchaser orders of the manufacturer a dynamo of the desired capacity; the purchaser gets the machine into position, puts the belt on, turns the switch and off she goes—that is, if she goes at all. If the dynamo does not start off immediately and bring all the lamps and everything else in the circuit up to the expected point of excellence, or if, from some similar cause, the dynamo doesn't "generate," it is at once condemned. The cause of the trouble may be an open circuit, or it may be the connections are not made correctly.

There are a great number of reasons why a dynamo will not always start up at once and all of the reasons should be looked into before judgment is passed. I have seen engineers spend weeks to find the "pound" in their engine and they did not "damn" the man that made the engine because it pounded. An engineer knows that there is a reason for it, and sets to work systematically to find the cause. But let a dynamo get out of order, and this same man will lose his head at once. I once went 150 miles to put a brush down on the commutator of a dynamo. An engineer of a certain plant in a large establishment in a sister city had been running a 1200-light incandescent plant for more than a year. Finally when he started up one night one of his dynamos would not "generate." He had "looked everywhere for the trouble," and gave it up. I was sent for, and in a few moments, by a little systematic testing, discovered that the upper brushes did not touch the commutator by a small fraction of an inch. The stem on which the brushes were mounted had become slightly loose and had turned back enough to lift the brushes from contact with the commutator. The brush holders were of the kind having a limiting stop each way. The remedy was, of course, very simple. The trouble could have easily been found by the engineer had he used a little "horse sense" and as I have before said a little systematic testing; I do not always mean by this, a series of guesses, but tests based upon sound judgment. Go off in a corner and think it out, but do not hop around and try a dozen different things without knowing the reason why you are doing them. It is seldom that trouble of this kind is cured accidentally.

I went to Milwaukee one time to find the trouble with a large Brush Arc machine. The dynamo man said he had not been able to find the trouble, and that it had not worked for three days. It seems incredible when I relate the cause to have been that one section of the commutator had been removed and was missing. How the man in charge could have failed to discover it is more than I can understand, but he was ignorant of the fact until I pointed it out. If I thought it would make interesting reading I could relate, I venture, at least, one hundred as ridiculous cases as these, where a little thinking and a general knowledge of the machines in charge could have saved time and money to the owners. I will not attempt in this article to describe how these tests should be made in order to locate trouble, for there are hardly any two cases alike. It will therefore be necessary to adopt a systematic method which I will endeavor to present at another time. There are two sides to every story and the engineer or dynamo men are not always to blame. The owners of plants should not look to them for all the trouble that occurs until they have first performed all they should before the plant is given into their hands.

Every plant that is put in should be tested, "received" and accepted by an independent and competent electrical engineer, one who is in business for himself and expects to remain so, so that he could give a fearless and honest opinion to his employer. He should closely examine the dynamo for capacity, insulation, continuous run, efficiency and an important and often overlooked quality, mechanical construction. And then come in a number of minor features which should be looked after: inductive velocity of the armature—it may be greater on a drum than in a ring armature; rise of temperature on full load should receive close attention; hysteresis and foucault currents are much more noticeable in badly constructed and proportioned machines than is usually suspected. I have known a case where these two ever present evils have absorbed more than ten per cent. of the power of the dynamo. The heating of switch contacts and other joints should be noted, the resistance of the circuits as a whole, and in sections, should be measured. In fact, every condition should be carefully noted. If the dynamos are compounded, see that the rise with load corresponds with this loss in line, also be careful to note if there is more than one compound dynamo, whether the equalizer is large enough. The resistance of the equalizer should not be less than one-half the resistance of the larger armature.

There are numberless points of this kind that should be carefully inspected by a competent man before a plant should be accepted, and I believe that if owners understood more of the importance of these seemingly little points—but, in fact, very important factors to the success and economical maintenance of every plant—that there would not be so many butchers in the business manufacturing electric light apparatus to-day.—*Electrical Industries.*

The blue glass insulators, heretofore used on telegraph wires, have always had an attraction for the stone throwing boy, and in consequence, a considerable loss has been entailed on the companies. The experiment has been tried of substituting for the blue glass, insulators of an inconspicuous shade of color, and the result is highly satisfactory. The breakages have thereby been reduced by about 50 per cent. As the result of the experience thus gained, the companies will hereafter use only insulators of the kind last mentioned.