after deducting 1,520,000 horse-power consumed at the pumping station, would still have a theoretical supply of 4,613,333 horse-power to dispose of.

Assuming the penstock to be built of a number of pipes, each 1 metre in diameter and carrying a volume of 628.3 litres of water at a velocity of 0.8 metres per second, loss of head may be estimated at 1 metre per kilometre, or 524 metres for the entire line, equal to 698,666 horse-power to be deducted.

Further, allowing 1,914,667 horse-power for losses from all sources, in the turbines, generators, etc. (which is extremely liberal), a net surplus of 2,000,000 horse-power of electrical energy would be left available for sale.

The plan above provides for the driving of the pumps by the electrical energy generated by their own initial action, but it must of course be understood that steam is contemplated as the original motive power at the pumping station. For example, a pumping station would first have to be installed on the edge of Lake Titicaca, at a suitable point such as Puno, driven by steam, with a capacity sufficient to force 1 cubic metre per second to a height of 800 metres. Such a pump would consume 1,520 horse-power to perform the work.

The water would be pumped into a reservoir at Crucero Alto, from which it would fall by gravity to sea level, where it would develop, as above shown, an actual net force of 35,000 horse-power of electrical energy, or more than double the power required to drive the pump at Titicaca. After supplying this power to the first pump, there would be a reserve force of 20,000 horse-power left, which could be used to drive a second pump, and so on successively, until, with adequate capacity in the Crucero Alto reservoir, one hundred pumps could be kept in automatic operation, delivering a net total of 35,000 — 15,000 x 100 = 2,000,000 horse-power, as above demonstrated.

The market for this supply of power would be in its application to the electrification of present steam roads and the operation of new electric properties, mining and agricultural industries, public and private lighting, the manufacture of carbide calcium at the coal mines, the operation of overhead conveying cables which are in general use in Peru, and for heating, household, and general power purposes.

THE QUEBEC BRIDGE FAILURE.

Referring to Mr. C. A. P. Turner's articles on the Quebec Bridge Failure, which appeared in the Canadian Engineer fo October 18th (page 387) a correspondent writes us as follows:—

The bridge could not fall otherwise than vertically unless its fall was resisted by a force greater than its own. Gravity was the force drawing it down vertically, the sole resistance was the atmosphere which in this case was practically nil. Any of the older men of the Phoenix Bridge Company's staff would gladly substantiate this statement authoritatively. No Canadian engineer has had enough experience in spilling bridges to speak authoritatively on this subject.

Mr. Turner speaks truly and wisely when he states that the design of the Quebec Bridge was an "effort" to produce a structure that "would 'approach' the perfection of the bridge builder's art." "The best possible" bridge will have to be obtained or this failure will be duplicated. Examination of the wrecked structure is about as useful in determining the cause of failure as examining last year's cornstalks in an attempt to determine the quantity of last year's corn crop. Engineers must be able to tell from plan and specification exactly what the structure will be, and do, or engineering is a delusion or worse. The writer has every reason to know that the science of engineering is well nigh an exact science, and that the engineer can establish his conclusions and inferences with certainty and mathematically prove his position to coincide with natural law. The general design of the Quebec Bridge was but little at fault, and the bridge might safely be reconstructed on the same general design except that a few of the important parts of the structure would have to be made in a radically different manner, while the method of erection requires equally radical treatment.

This bridge failure has not been useless, for it emphasizes the fact so well known to such past masters of engineering as Stevenson, Fairbairn, Arrol, Brunell, and some others, all of whom were first-class practical workmen, that the full value of technical training cannot be realized except by putting the knowledge so obtained to serviceable use in the office, and combining both with practical common sense obtained in the school of experience, by observation and study of fundamental principles. Besides possessing the above qualifications no mere consulting engineer should be entrusted with the construction and erection of so important an undertaking unless he could and did personally supervise the erection, daily and continuously. The importance and truth of this assertion is clearly established by the successful erection of the Brooklyn and East River bridges. At the former the late eminent engineer, C. C. Martin, visited the work daily, and it may be said that Mr. Buck smoked all over the East River bridge, inspecting and smoking with equal continuity and ability.

Again one might here ask is the habit of dropping bridges and other structures becoming chronic with the American company entrusted with the building and installation of the bridge at Quebec. A careful consideration, review, and answer to this question might (it should) cause those entrusted with, and responsible to the country for, its cost to see that it is high time that Canadian engineers were consulted, not only as to its design, but its erection, and all other details. One incontrovertible statement in favour of the Canadian engineer is that he never dropped anything during erection as big as the Quebec Bridge, or any other kind of structure as often as United States engineers have. Indeed had the supervision and design, manufacture and erection of this bridge been entrusted to Canadian engineers their everlasting noisiness would have stood them in good stead, which in turn would have prevented this unpardonable blunder, as well as the ever lamentable sacrifice of about eighty useful lives.

The writer is strongly of the opinion that Mr. Turner is too magnanimous in his splendid article, when loss of prestige to the engineering profession is admitted, if he means to include Canadian and British engineers. In none of these has the habit of dropping bridges during erection become chronic. We have lately learned that another blunder has developed in a United States tunnel which will cost half a million dollars to rectify. Is the engineer across the International boundary suffering from brain storm? This is a question which merits the attention of the Canadian taxpayer as well as his representative. The former will suffer in money loss in this lamentable and unnecessary blunder, while the latter will be held accountable for it.

AUSTRALIAN TARIFFS.

We have just received through Mr. D. H. Ross, Commercial Agent of Australia, a copy of the revised Australian tariff. The following items, taken from it, are those that will interest those engaged in the iron and steel industry in Canada:—

Tariff Items.	General Tariff.	Produce or Manufactures of the United Kingdom.
Iron, plate and sheet, viz.:—		
(a) Corrugated galvanized, ad val.	25 p.c.	20 p.c.
(b) Galvanized not corrugated, and corrugated not galvanized, ad val	20 p.c.	15 p.c.
Cutlery of all kinds, n.e.i., ad val....	20 p.c.	15 p.c.
Nails, viz.:—		
(a) Horseshoe nails, per cwt.....	8s. 3d.	7s. 6d.
(b) Brads (including moulders' and glaziers'); picture nails; raildogs or brobs; spikes; staples, n.e.i.; tacks, n.e.i.; wire and other nails, n.e.i., per cwt.	5s. 6d.	5s.