sure; and the question, of course, arises whether we shall put the entire system of the city under the highest pressure required to force a supply to these higher levels, thereby placing a large portion of the mains and fixtures under an unnecessary strain, while operating under wasteful conditions of pumping power; or whether we shall isolate the higher levels and handle the smaller percentage of water by itself.

The application of electrical energy to the pumping of the main supply of a city of considerable size, although presenting many attractive features as far as the actual operation of the pumps is concerned, is not yet within the possibilities on account of the absence of inexpensive methods for producing the necessary current; so that apparently, in pumping large quantities for some time to come, the compound, the triple, and the quadruple steam pumping engine will hold their sway. To-day it is beginning to offset very forcibly the proposition that it does not pay, in the present state of perfection of the steam engine, to go very far out of the way of regular commerce, to get the cheap power afforded by a falling stream.

To bring the problem of high service pumping down to figures and familiar terms, supposing that a city's total supply is 10,000,000 gals. per day, and only 1,000,000 gals. are needed for a district which would make it necessary to deliver its supply under a pressure of 125 lb. per square inch if delivered from the main pumping station; while the remaining 9,000,000 only needed a pressure of 75 lb. for distribution. Then the difference in power would be as follows: The entire 10,000,000 gals. under the 125 lb. pressure represents 500 horse power, while the 9,000,000 under 75 lb. pressure represents only 270 horse power; and the 1,000,000 under the high service pressure of 125 lb. represents only 20 horse power. The economy of power then would be $500 - (270 \times 20) = 210$ horse power saved by dividing the service.

How convenient it would be to generate an electric current at the main pumping station, with the boiler plant used for pumping the main water supply, then run the wires up to a point adapted to the high service pumpage and operate an electrically driven pump. Of course a high service steam pumping plant could be installed at the proper point, but that would mean expensive attendance, hauling of coal, ashes, and supplies; and last, although by no means least, large quantities of smoke and dust dispensed broadcast over what is generally a residence district. There are cities wherein pumping plants are supplied with anthracite coal at double the cost of bituminous coal, to quiet the complaints of dwellers and the owners of lawns and trees.

Glance for a moment at the saving in fuel shown by dividing the service as set forth above. The case supposed is extreme, but extremes illustrate forcibly, and there probably cases in actual practice the full equal of the one supposed. Allowing that an economic duty of 1,000,000,000 is obtained at the pumping station, or say 2 lb. of coal per horse-power hour, then the 210-horse power saved represents $5,475 per annum, which would pay 5 per cent. interest upon $109,500.

Even if it should not be desirable to install an electric generating plant at the main pumping station, power could often be obtained from street railways, or lighting plants already in existence in many cities. When we consider the inconvenience and cost of sometimes providing mains for different districts, simply to convey the water supply from a central high-service pumping station, the possibility of a small electrical station for each district begins to hint at the economy in first cost and maintenance of such an electrical system.

The method of switching on and off the electric current by means of the water-level or pressure is one of the details that will occur to the hydro-electrical engineer. In using the term hydro-electrical engineer, I simply follow the tendency to specialize which has taken strong hold upon modern science and practice. At the start, the hydraulic engineer thought that there was nothing to do but harness up the electric dynamo and motor to a pump, and the task was accomplished of pumping by electricity. The electric engineers imagined there was nothing to do but harness up a pump to his motor, and behold the result was obtained. But after a few attempts it was discovered that the pump handling such a stubborn and inelastic element as water was subject to inertia, shock, and variable power within short limits, quite at variance with the steady uniform operation desirable for the best electrical results. The pump man turned his attention to securing a steadier flow of water, while the electrical man was, apparently, inclined to adopt the convenient but wasteful methods involved in the process of wasting power instead of controlling it. Hence the "hydro-electric" engineer, whose office is to reconcile the extremes of the case into the most benefit to all concerned, precisely in effect as the modern steam pumping-engine designer has evolved a machine which, operated by a highly-elastic fluid at one end, smoothly delivers an obstinate unyielding fluid at the other.

If the steam pumping-engine taking steam from the boiler at a pressure of 150 lb., and sending this steam to the condenser at a pressure 8 lb. below the atmosphere, can deliver without shock, and with a fairly close approach to theoretical economy, a steady stream of water, there is every reason to believe that the "hydro-electrical" engineer will eventually be able to bring the items of short-circuiting, resistances, ampères, and volts into a reasonably close approximation to the results demanded.

* Abstract of a paper read before the Atlanta meeting of the American Waterworks Association, May 28-30, 1895.

Cannel Coal as an Enricher.—The *Progressive Age* of April 15th has an article on this subject by Graham Macfarlane. In view of the strong competition of petroleum products, any cannel coal which does not yield a coke which is of some value to the gas-works is shut out from general use by gas companies, except such as are in the immediate neighborhood of the mines producing such cannel. As to how cannel coal was deposited there have been various ingenious theories proposed. Having professionally examined nearly all of our American cannel mines, the author was inclined to the belief that cannel coal was derived from a highly resinous vegetation, either distinct from that from which came ordinary bituminous coal, or more likely the lighter and more resinous part of the general forest of the carboniferous age, which in a gelatinous condition was finally deposited either in little separate seams, or as a part of the many bituminous seams. In almost every instance the cannel coal seams are extremely sporadic and treacherous, and now, with the lower prices forced by oil competition, the lot of the cannel coal operator is not a happy one. Most towns use cannel coal as an enricher.

Coal Washing Plant, Powell Duffryn Company's Elliot Pits.—The *Engineer* of May 3rd describes and illustrates the coal washing plant at the Powell Duffryn Steam Coal Company's Elliot Pit, Aberaman, near Aberdare, South Wales, and erected in the years 1891-92 by the makers, the Humboldt Engineering Works Company. This "washery" is intended to wash provisionally 350 tons, and later 500 tons of nuts and small coal, including dust, per day of nine hours, and to reduce the whole quantity, or only part of it, to the necessary size for making first-class coke. The above-mentioned quantity of coal consists of the screenings from ordinary bar screens with 1½ inch spaces, on which the pit coal is screened, in previously erected screening plant as found in most collieries. In reference to screening and sizing plant a machine, patented by the Humboldt Company, which is used either for breaking anthracite or other coal into nuts of any required size, or for breaking lumps of coal from the picking table, mixed with dirt or shale, to a suitable size for subsequent treatment in the washers, is also illustrated and described. (6 Figs.)

Steel Castings—At a recent meeting of the Manchester Association of Engineers the question of steel castings was introduced by Alfred Saxon, who, after enumerating the infinite variety of purposes for which steel castings were now used, said that for repetition work they would, speaking generally, be better than cast iron or steel forgings. There were certainly difficulties in the machining of steel castings, and in connection with many of them special designing was no doubt necessary. A source of trouble not infrequently was their liability to burst during contraction in cooling, when they were being shrunk on to parts of engines; in these cases he thought, however, the engineer had not carefully studied the nature of the material he had to deal with, and had simply allowed the same amount for shrinkage as he would in a forged iron or steel shaft. In some quarters it was stated that failures and disappointments in steel castings were vastly in excess of those in cast iron. He urged that engineers should insist upon their castings being sent in unpainted. In the use of cast iron they had failures and bad castings, but yet they would never think of discontinuing them; in steel they had a stronger metal, from which almost any form of casting could be produced, and it was their duty to see how they could economically use it in the way of lightening their structures, or where strength was needed without increase of bulk.

Quebec Mining Association Excursions.—A notable feature of the proceedings of the summer meeting of this association at Quebec on 27th and 28th June, was the delightful series of excursions thoughtfully arranged for the entertainment of the members and their friends by the local committee. These included a thoroughly enjoyable calèche drive to the historic sites of the ancient city on the morning of Friday, 28th, at the conclusion of which cake and wine were served in the Union Club. In the afternoon the members and a number of prominent citizens of Quebec were the guests of Messrs. Carrière, Lainé & Company, in the steam yacht "Vega" visiting the Chaudiere Falls, Montmorenci Falls, and the large engineering works of the firm at Levis. Before returning to Quebec, the Hon. E. J. Flynn and his Worship Mayor Villeneuve gracefully acknowledged the courtesy of Messrs. Carrière, Lainé & Co., and congratulated them on the success of their engineering enterprise. Mr. C. H. Carrière, Mr. James King, M.L.A., and Mr. Lawrence Lynch, members of the local committee, were then duly "bounced" to the strains of "They are jolly good fellows." On Saturday many of the members took advantage of the special rates given to the association and visited the Saguenay *via* Lake St. John, while others who could not afford time for so long a journey ran out to Ste. Anne de Beaupré.