rich, certainly not of certain products. But here, again, Mr. Gunton asks, "Why?" The obvious answer is, "Because they have not the means." But will any one claim that the working-classes consume all they would if they had the means? Surely not. There may be some so low that they could make no use of any thing more than they have, but this is hardly conceivable. With scarcely an exception, they want much which they cannot have because they have not the means to purchase it. But their means consist wholly in their wages. To increase their wages is to supply their wants. This is all they think of. But the employer is apt to look at the question as though all money paid for labor beyond the minimum possible would be hoarded in the cellar and lost to industry. This view, tacitly shared by the economists, is obviously false. What is supplying wants to the laborer is furnishing a market to the manufacturer or the farmer. The vast number of laborers, and the certainty that all increase of wages will be expended and not hoarded, make even the smallest general rise in wages an important stimulus to production. It expands the market for all classes of products. Statistics show that periods of high wages have uniformly been periods of increased production, and increased production means prosperity to the manufacturer; i.e., profits rise as wages rise.

Time fails me to elaborate this important principle as it has been done in Mr. Gunton's book, and I can only recommend those interested to read his argument for themselves. From this, however, as the fundamental theorem, a large number of new and striking truths, most of them in the nature of paradoxes, arise. Only a few of them can be considered here. One of them is that *prices fall as wages rise.* This is maintained by Mr. Gunton, in face of his general law that the price is determined by the cost of production. Surely one would suppose that the cost of production would be greater if the cost of labor were increased. Just here lies the paradox. Doubtless this would be true for an isolated case, but it would not where the rise of wages was on a large scale. The reason is, that, with the increase of wages, the market is increased and production is increased. As the production was at the minimum for existing methods before, the increased production must now be brought about by an improvement in the methods; i.e., by introduction of improved machinery. This always lessens the cost of production; and this, according to the law above stated, will sooner or later compel a reduction in the prices of commodities thus more cheaply produced.

Another of these statements which Mr. Gunton claims to establish by statistics is, that *rents rise with wages.*

One would naturally suppose that rent, as the price paid for lodgings or business-offices, or space to build or work upon, or for agricultural purposes, would follow the law of prices, and fall as wages rose. Mr. George virtually asserted this in maintaining that the rent was taken out of wages, so that the higher the rent the lower the wages. But Mr. Gunton shows, that, as rents have risen, wages have risen; that the highest wages are paid where the highest rents are charged, i.e., in cities; and that the lowest of all wages are received by those who pay no rent, but occupy the soil without let or hindrance. The argument is scarcely fair, and the truth seems to be, that, as wages rise higher, rents will be paid, but better tenements will be occupied; so that the case is on a par with the last, that increase of wages increases consumption, which is seen in better habitations, the same as in better clothes and furniture.

But perhaps the most important of Mr. Gunton's conclusions are those relating to the hours of labor. Two of these may be briefly considered. One of these is that *a reduction of hours tends to increase production.*

This, perhaps, sounds more paradoxical than any of the preceding propositions. Surely one would naturally suppose that there would be more produced in ten hours than in eight. Not so. The laborer remains a consumer the same after as before the reduction. Unless new machinery is introduced, the same amount of labor will be required after the reduction as before: hence a larger number of laborers must be employed. These, in the present condition of society, are always to be had. The number of able-bodied persons constantly seeking or out of employment is equal to one-fifth of the whole. These unemployed persons would at once find employment. While unemployed, the amount consumed by them is at an absolute minimum. As soon as they begin to receive wages, they begin to consume more, and thus the demand for various kinds of commodities is increased. This demand is sure to be supplied by increased production, which will be secured by the introduction of improved machinery if it cannot be done otherwise.

But this is not the only way in which a reduction of the hours of labor works the increase of production. By affording a little leisure to the workingman, it gives him a taste, or rather an opportunity to indulge taste already possessed, for certain elements of culture and social refinements, which he will then begin to demand, and which will be accordingly supplied by the general law of demand and supply, which supply consists in increased production. But, assuming that all his earnings were previously expended on necessities, this would be impossible, and hence arises a final paradox that *the reduction of hours tends to increase wages.*

But for the foregoing explanations this would be strange enough. Whenever there is a demand for a reduction of hours, it is always met by the reply, that, in the state of business, it can only be granted on condition that wages be correspondingly reduced. And this would doubtless be necessary with many isolated industries, at least at the outset. A reduction of hours is considered equivalent to an increase of wages. But a general reduction of hours, continued long enough to have its natural and final effect upon society and upon industry, will create an increased demand for all classes of commodities requiring the introduction of improved machinery for their production, thus cheapening the cost of production, increasing the profits of the manufacturer, and enabling him to pay higher wages and still enjoy greater profits. This, under free competition, he will be compelled to do, and will do in harmony with the economic laws of society.

Without further argument of these several propositions, I will close this paper with a single comment. If any considerable part of what is claimed is true, it proves in a most conclusive manner what I have so often insisted upon, — that to the power of production there is practically no limit, and that all that is needed to place in the possession of every member of society every object of his most cherished desire is the power to purchase it. Very few indeed are there who possess, or can possess, every purchasable object of desire. The present production of industrial society would not be equal to a tenth, probably not a hundredth, of what would be consumed if every one could supply at will every proper and legitimate want of his nature. It is therefore useless to talk of increasing production except by the increase of the power to consume. This is demand in its true economic sense, — the demand which will be supplied by the natural operation of industrial laws. We have therefore narrowed down the great economic problem to the one single point of how to enable the members of society to secure for an equivalent the objects which they desire to consume. Mr. Gunton has sounded the keynote of the solution of this problem in demanding increased wages and reduced hours of labor for the great consuming class of workingmen, — in popular phrase, the 'toiling millions.' It remains for other economic philosophers to show how this principle can be extended to include all mankind.

ELECTRICAL SCIENCE.

Electric Tramways in Great Britain.

THE paper on the Bessbrook and Newry tramway, read by Dr. Hopkinson before the Institute of Civil Engineers, has brought forward some valuable information as to the status of electric tramways in Great Britain. Last year there were eight tramways operated by electricity in Great Britain. The longest is 6 miles; the shortest, $\frac{3}{4}$ of a mile; the average being $2\frac{3}{4}$ miles. The power for the two shortest of these is from gas; for two of the longest, from water; for the rest, from steam. The electricity is transmitted by rails, — in some cases specially insulated central or side rails, — or accumulators are carried on the cars; the overhead system so generally adopted in this country and in Germany being in no case used.

The Bessbrook and Newry line is $3\frac{1}{4}$ miles long, with an average gradient of 1 in 86, a maximum gradient of 1 in 50. The conditions are, that ten trains run in each direction per day for a daily traffic of 100 tons each way, and a maximum capacity of 200 tons per day, in addition to the passenger traffic. The electrical locomotive draws a gross load of 18 tons, in addition to passengers and its own weight, at an average speed of 6 miles per hour: with 12 tons load, its speed is 9 miles per hour.

The generating dynamos are driven from a turbine at about one-third the distance from the Bessbrook end of the line. The weight of the motor-cars is distributed as follows: —

	Tons.	Cwt.	Qrs.
Car body	3	6	1
Leading truck	1	17	2
Rear "	1	0	0
Motor and accessories	2	1	1
	8	5	0

The current is conveyed to the car through a central rail insulated on blocks of paraffined wood, returning through the earth and track. The gearing is first from the motor-axle through a spur-gear to a countershaft, then from the countershaft to the car-axle by a chain gearing. The total cost of the line and equipment, including two locomotive cars, was £2,500. The cost of running per train mile has been 4.2 d.

During the discussion, Mr. Lineff brought forward a comparison between the cost of conductors and accumulators for electric traction. He assumes the interest and depreciation of conductors at ten per cent; of accumulators, at thirty per cent; representing overhead conductors by A; underground by B, and batteries by C.

Length of Line.	Two Cars.			Four Cars.			Six Cars.			Eight Cars.			Ten Cars.		
	A.	B.	C.	A.	B.	C.	A.	B.	C.	A.	B.	C.	A.	B.	C.
1 mile	200	1,500	2,400	225	1,525	4,800	250	1,550	7,200	275	1,575	9,600	300	1,600	12,000
2 miles	400	3,000	2,400	450	3,050	4,800	500	3,100	7,200	550	3,150	9,600	600	3,200	12,000
3 "	600	4,500	2,400	675	4,575	4,800	750	4,650	7,200	825	4,725	9,600	900	4,800	12,000
4 "	800	6,000	2,400	900	6,100	4,800	1,000	6,200	7,200	1,100	6,300	9,600	1,200	6,400	12,000

Mr. Lineff assumes that each car needs three sets of storage-cells, $1\frac{1}{2}$ tons in each set, at £60 per ton; and the cost is increased three times in the table to allow for three times the depreciation as compared with conductors. The increased cost of cars and motors for the accumulators is taken at fifty per cent of their value. In reality there would be required but two sets of cells per car, while the increased cost of each car could hardly be the £135 assumed. The comparison, then, is hardly fair to the accumulators. Instead of the £400 per car assumed, £250 would be a fairer price, the cost of the cells being taken at £60 per ton. As it stands, in a line four miles long the accumulators would be cheaper for five cars or less, as compared with underground conductors, while the overhead wire would cost less than either for any number of cars. If the lower estimate given be assumed, then the cost of underground conductors and accumulators will be the same on a four-mile line when about nine cars are run. Any increase in the length of the line favors the storage-battery: an increase in the number of cars favors the underground conductor. Still in this estimate there is not included any consideration of reliability and flexibility, and in these the storage has many advantages over any other system. It will be seen, however, that the overhead conductor is cheaper than either of the other plans, and in the smaller towns and the suburbs of cities it will probably be generally adopted.

HIGH CANDLE-POWER INCANDESCENT LAMPS. — An English firm, Clark, Chapman, Parsons, & Co., are manufacturing incandescent lamps of candle-powers up to 1,000 candles. They consume about 2 watts per candle, and have a life of 800 hours. It is very possible that the life and efficiency of these lamps will be improved, in which case they will be active competitors with arc-lamps for street-lighting. If the intensity of 1,000 candles is honestly measured, and gives the average of the light in all directions, then the efficiency is about half that of the ordinary arc-lamp. The price of the incandescent lamps is not given; but we may suppose that the cost of renewal will not be much in excess of that of the carbons used in the arc-lamps, while the attendance will cost little or nothing. The lamps would seem to have a wide field for application in buildings where a high candle-power is desired, and where the irregularities of arc-lamps are objectionable. The voltage used is 100; the ampères, 20.

THE GIBSON STORAGE-BATTERY. — In this cell the plates are made by fixing peroxide of lead in perforations in a lead plate. In the ordinary 'grid' form of storage-battery plate the holes are of an hour-glass form, — smallest in the middle, — the contraction preventing the plug of active material from falling out. This has the disadvantage that the pressure caused by the gradual corrosion of the grid has a tendency to break the plug in the middle and force it out. To remedy this, M. Godot invented a plate in which the hole was largest in the middle, and smallest at the surface. The objection to M. Godot's plate is in difficulty and cost of manufacture. In the Gibson form the holes go square through the plate: in them are put capsules of peroxide of lead in the form of a paste. The capsules only fit loosely in the holes, and extend beyond the surface. Plates thus prepared are passed between rollers set at such a distance apart that they press the capsules to the level of the surface of the plate, at the same time flattening the lead slightly, and causing the edges to overlap the holes, thus keeping the active material in. The method seems a decided improvement over that of M. Godot to accomplish the same purpose: very possibly, if tried with the best possible form of plate, it will be an improvement on the ordinary 'grid' type. It hardly seems probable, however, that it will improve either the efficiency of the battery or storage capacity, although it might increase the rate of discharge and the life of the plate.

MAGNESIUM IN PRIMARY BATTERIES. — M. Hein has been investigating the value of magnesium as a positive element in primary batteries. The electro-motive forces are high as compared with results ordinarily obtained; but there are the objections that magnesium is expensive (it is worth from a dollar and a half to two dollars a pound), and the resistance of the solutions of magnesium salts is greater than that of the ordinary solutions used.

Positive Element.	*Solution.*	*Negative Element.*	*Solution.*	*Electro-motive Force.*
Magnesium	Dilute sulphuric acid	Zinc	Dilute sulphuric acid	.876
"	" " "	Copper	Sulphate of copper	2.03
"	Sulphate of magnesium	"	" " "	1.93
Magnesium	Dilute sulphuric acid	Carbon	Dilute nitric acid	2.888
"	Sulphate of magnesium	"	" " "	2.863
"	Chloride of magnesium	"	" " "	2.910
Magnesium	Bichromate solution	Carbon	Bichromate solution.	2.952
"	Dilute sulphuric acid	"	" "	2.980
"	Sulphate of magnesium	"	" "	2.901
"	Chloride of magnesium	"	" "	2.970
Magnesium	Chloride of ammonia	Carbon and manganese dioxide.		2.219
"	Chloride of magnesium	"		2.334