land is a skilled seamstress, a successful authoress, an artist of ability, and a mistress of the spinning wheel and loom. These are but well known instances, out of the scores of examples, of the highest of dignitaries protecting themselves against reverses of fortune by acquiring trades.

THE PROFITABLENESS OF IRRIGATION.

During recent years the British Government has invested something like seventy millions of dollars in irrigation works in India, and it is proposed to spend thirty millions more for such purposes during the next five years. In almost every instance, the works have proved immediately remunerative, while in some cases the profit has been enormous.

On a few of the larger complete works, the expenditure has been as follows:

Ganges Canal	$13,223,225
Eastern Jumna Canal	1,038,615
Western Jumna Canal	1,671,085
Godavery Delta Works	3,221,405
Kistnah Delta Works	2,164,470
Cauvery Delta Works	211,020
Sind Inundation Canals	2,980,000

For all India the net annual revenue from irrigation works now amounts to upwards of five million dollars, or 7·7 per cent of the capital invested. From Oude and the Central Provinces, the returns have been *nil*. In Rajapootana there has been an annual loss of 19 per cent of the capital. Elsewhere the profits were very encouraging. In the Northwestern Provinces, the revenue shows a profit on the outlay of 4·6 per cent, in the Punjaub 5·6 per cent; in Madras 27·6, in Bombay, including Sind, 16·9, in British Burmah 3·27 per cent. The Ganges canal yields 4·88 per cent, the Eastern Jumna 25 2, the Western Jumna 30, the Godavery delta works 42·16, the Kistnah works, 19·73, the Cauvery works 273·31, the Sind canals 33·3 per cent annually.

Charging against the capital outlay of these works the interest lost on the money invested before the works became productive, compensation paid to landowners, money spent on unfinished and impractical schemes, etc., in addition to the direct outlay, the revenue still shows a considerable balance of profit. The corrected capital, and the percentage of annual revenue thereon, appear in the following table:

	Capital invested.	Percentage of revenue on capital.
Northwestern Provinces	$17,827,225	5·2
Punjaub	15,671,010	4·8
Madras	9,467,200	22·72
Bombay (with Sind)	11,113,940	11·9
Gauges Canal	14,400,890	4·5
Eastern Jumna Canal	2,349,890	11·2
Western " "	6,531,965	7·6
Godavery Delta Works	3,418,525	39·7
Kistnah " "	2,337,135	13·2
Cauvery " "	1,467,890	36·6
Sind Inundation Canal	5,930,000	18·6

But the revenue returns from these great undertakings are not the only source of profit. In a country like India, where rains are irregular and transportation difficult—and often in the wet season impossible—a failure of seasonable rain is apt to be followed by loss of harvests and consequent famine, entailing great loss of life, loss of revenue to the government, and sometimes the abandonment of thousands of square miles of fertile soil to the jungle, for lack of cultivators. All this is prevented by irrigation.

In 1860, when a large part of the Northwest Provinces was baked as in an oven, the Ganges canal preserved grain crops enough to feed a million of people who must otherwise have perished unless kept alive at the cost of the Government. And again in 1874 a great multitude were saved from the horrors of starvation; and the enormous outlay consequent upon the famine in the low provinces was kept from being still more enormous by the Soave canal, which even in its unfinished condition enabled luxuriant harvests to come to maturity when otherwise every green thing would have been destroyed by the drouth. In other parts, the seats of some of the worst famines of history have been thoroughly watered and placed beyond the reach of such disasters.

COMPARATIVE COST OF ILLUMINATION.

A number of experiments have been made lately in London to test the comparative cost of illumination with the various materials used for that purpose. Below is the result, the first column containing a description of the materials tested; the second, the price of the material in London, reckoning twenty-four cents to the shilling; the third column shows the duration of the light furnished for one cent, the light being reduced to equal one sperm candle. With the exception of the last named material, common gas, the prices do not vary sufficiently from those which prevail here to effect the value of the comparison. London gas is reputedly of inferior illuminating power, so that the economy of its use can scarcely be so much greater than ours as its cheapness would seem to indicate.

Standard sperm candles, per lb.	$ 48	1h. 7m.
Best wax candle per lb.	48	1:6
Sperm oil in moderator, per gallon	2.28	1:12
Belmont sperm candle, per lb.	30	1:27
Stella, or Burmese wax, per lb.	30	1:37
Petroline candle, per lb.	36	2:15
Composite candle, No. 1, per lb.	22	2:5
" " " 3 "	16	2:45
Common dip candles, per lb.	12	2:52
Almond oil, in moderator, per gallon	2.22	3
Colza, per gallon	1.20	4:37
Paraffin oil, in lamp, per gallon	72	9:35
Common gas, per 1,000 feet	90	26

The price of gas being about three times as great here as in London, no such marked advantage as appears in the table can accrue from its use on the score of cost. Still it must rank among the most economical of artificial illuminations, at least three or four times as economical as common candles, for a given amount of light.

A British Steam Tramway.

The Wantage line was only opened for public traffic in October last, and lies in a somewhat remote district. Perhaps it may be well to state, for the information of those who are unacquainted with its formation, that it is about 2¼ miles in length, laid down along the side of the turnpike road leading from the town to the station of the Great Western Railway at Wantage Road. It consists of a single line of 4 feet 8½ inches gage, with four turnouts or passing places, with movable facing points at intermediate distances. The rails are of the ordinary bridge section, 40 lbs. per yard, bolted to longitudinal timbers of the dimensions 10 inches by 6 inches, with transoms 5 inches by 4 inches, 10 feet apart. The line crosses the turnpike road once only in the distance, and passes over the Wilts and Berks canal by an iron bridge of 38 feet span; its sharpest curves are of 70 feet radius, and its steepest gradient is 1 in 47, the length of the longest being 330 yards. The machine in use on the line is Mr. Grantham's patent combined steam car. The car has from the commencement continued to run daily with satisfaction, and without in any way obstructing the traffic on the road; and from its freedom from noise, steam, and smoke—the two latter being scarcely observable—horses traveling on the road appear to take no more notice of it than of an ordinary horse car. It may be stated also that on the occasion of the Berks volunteer review, which was held on August 7 last, on ground adjoining the Great Western Railway station, when it was computed that not less than 5,000 persons traveled on the road in vehicles of all descriptions during the day, and the car was running backwards and forwards the whole time, no inconvenience or difficulty with the horses was experienced. The car, which is 27 feet 3 inches in length, 11 feet 1 inch high, and 6 feet 6 inches wide, is divided into first and second passenger compartments, with the boiler and machinery fixed in the center, and runs on four wheels, one pair for driving, the other pair fixed to a radial axle for easing the curves; it is propelled backwards and forwards without turning at either end of the line, and only requires to be replenished with water after a double journey; it is driven from either end by removable levers, the driver having complete control of the machine as regards turning on, shutting off, or reversing steam, as well as applying the brake power, which is so perfect that the car can be brought to an almost immediate standstill. It is constructed to carry, both inside and outside, 60 passengers, and the full complement has often been conveyed by it; it appears highly popular with the public, and the traveling is much prefered to that of the horse cars; and judging from the silence with which it glides along on the rails, the absence of clatter and noise, as well as the ease with which the machine can be worked, it is considered, by those competent to form an opinion of its action, that the time is not far distant when the expensive system of working our street traffic on tramways by means of horse power will be succeeded by the use of steam under proper restrictions, especially as it must be apparent to all acquainted with the subject that the cost of working must be greatly in favor of steam. For the information of those interested, the cost of working the Wantage line, per day of twelve hours, as nearly as can be ascertained, is submitted:

DISTANCE TRAVELED PER DAY, 40 MILES.

Weight of gas coke, 240 lbs.
Weight of steam coal, 56 lbs.
—296 lbs. cost

	67	cents.
Fuel for lighting	3	"
Oil and light for car	6	"
Driver's wages	$1.20	"
Stoker's wages	72	"
Conductor's wages	56	"
Estimated wear and tear	96	"
COST OF WORKING PER MILE, 11 CENTS FOR STEAM CAR.	$4.20	
Cost of horse cars—Four horses, at 72 cents	$2.88	cents.
Two drivers.	1.44	"
Conductor.	56	"
Oil and light	4	"
Estimated wear and tear	1.44	"
Rent of stables, etc	24	"
COST OF WORKING PER MILE, 16·5 CENTS FOR HORSE CAR.	$6.60	

It will be seen by the above table that the cost of working the Wantage line by horse power is greatly in excess of the cost of working it by steam power; but the time occupied, owing to the restrictions laid down by the Board of Trade, confining the speed to eight miles per hour, is the same.

The Lowe Gas Process.

The long effort to obtain the gases of water upon a practical scale, that is, in unlimited quantity and at an economical cost, is too old and familiar a story to need repetition here. It has covered so many unsuccessful attempts and so many misrepresentations that the very name has been a synonym for failure and fraud. Nevertheless it is to-day an accomplished fact, as real as the systems of steam power and telegraphy; and it is peculiarly gratifying that, after sixty-five years of unsuccessful experiments, in which the most enlightened nations have participated, our Centennial year should witness the complete demonstration by our own countrymen, of a method, the value and influence of which, on the industries of this industrious age, can hardly be estimated. This journal has heretofore directed attention to the earliest performances of the new method, which has now accepted and accomplished a test upon so large a working scale as to entitle it to a marked recognition. It has recently gone into operation at the Manayunk Station of the Philadelphia Gas Trust, with such excellent results as would seem to justify all that has been claimed for it.

Indeed, each successive trial appears to develop stronger points in the system. For example, in the able report of Professor Henry Wurtz upon its workings in Utica, where it distributed satisfactorily some 24,000,000 cubic feet, its facility was deemed remarkable at a yield of 3,000 cubic feet per single generator for a run of forty minutes. At Philadelphia, however, it has, in the first days of its operation, produced as high as 10,000 feet for thirty minutes, and it is believed that increasing familiarity with the apparatus will show a gain even on this. This advance is, in part, attributable to the delivery of steam at a temperature never before attained, and by a plan at once economical and efficient, the heat being derived from the products of combustion previously burned in a stack of refractory material, through which, when at a white heat, the steam is conducted. This ingenious method also avoids the oxidation so troublesome in all other superheaters.

The high heats evolved by this simple apparatus are likely to reduce to a minimum the carbonic acid gas, already at a low proportion in this process. It would really seem that the question which has been so prominently before the public of late, as to the possibility of obtaining better and more economical methods of lighting, has been fully met and answered by this system.

It certainly furnishes a very brilliant illuminant at what is claimed to be an important reduction in cost, and it is to be hoped that those who control the gas-making interest will give prompt attention to the matter. Their business has grown to be one of the great industries of the period, and it should be conducted upon progressive principles.

But valuable as this process may be for illuminating purposes, it must be manifest that a demonstrated success in this department carries with it some great possibilities in the direction of fuel. There is scarcely a question of greater practical interest than that relating to improved methods of heating, as it affects so wide a range of manufactures in metallurgy, mechanics, and chemistry, to say nothing of the still wider realm of domestic uses. Our present systems are still grossly defective and wasteful, utilizing not more than one eighth of the heating power of coal, without reckoning the inconvenience and cost of handling so heavy a material.

It is hardly unsafe to predict that the coming fuel, for the next stage of swiftly developing civilization, will be in a gaseous form, the advantages of which are too apparent to need enumeration.

When this time comes, and we hope to see it, it is our belief that the gases employed will be the product of water by some such process as the one whereof we write. Air, which is similarly decomposed into gas, is employed to some extent now, principally in the case of the Siemens furnace for steel manufacture, but the excess of nitrogen and carbonic acid render it a very questionable economy. Certainly an element that would furnish hydrogen, in lieu of these two non-combustible gases, would possess great advantages.

The field of investigation presented by the Lowe process at Philadelphia is one of great interest, and should be improved. We shall watch its development and report upon it from time to time.

NEW BOOKS AND PUBLICATIONS.

NOTES ON BUILDING CONSTRUCTION. Part II. (Advanced Course). London, England: Rivingtons, Waterloo Place. For sale by J. B. Lippincott & Co., Philadelphia, Pa.

This is a continuation of a very admirable text book prepared for the use of students in the Government Science and Art Schools, South Kensington, London, and especially directed to the requirements of the examiners of that celebrated institution. If the architects and builders of the coming generation are educated up to the standard contemplated in this work, and are imbued with the thoroughly practical spirit it inculcates, an important improvement in our homes and public buildings, in regard to both the art and the science of architecture, may be looked for. Technical explanations are seldom given with such clearness as in this work; and it is a pity that the author's name is not given, as he has written a standard manual of the very highest excellence. Part I. of the book was published some time since, and reviewed by us at the time. Part III. is now in the press.

THE ELEMENTS OF GRAPHICAL STATICS. By Karl Von Ott, Professor of the Imperial and Royal German High School of Practical Science, etc. Translated by George Sydenham Clarke, Lieutenant Royal Engineers, etc. Price $2.00. New York city: E. & F. N. Spon, 446 Broome street.

The literature of the graphical method is rapidly extending, and its study now forms a large and important part of the education of properly trained engineers; but although Professor Clerk-Maxwell, and more notably the late Professor Rankine, have used this method in their many well known works, it has scarcely received the attention which it merits. Lieutenant Clarke has faithfully performed the translator's task, and has added some valuable notes to Professor Ott's book, which is an excellent introductory treatise on the whole subject.

ALGEBRA SELF-TAUGHT. By W. P. Higgs, M. A., etc., Author of "Scientific Notes for Unscientific People." Price $1.00. New York city: E. and F. N. Spon, 446 Broome street.

This is the book that we have been looking for for some time past, namely, a clear and practical introduction to the science of algebra, written in a way to interest the young and uneducated. The many correspondents who modestly inform us that they are "unacquainted with algebra and formulas" should read this little book carefully; and it will open before them a large field of knowledge of the highest practical value in all the mechanical arts.

ELECTRO-TELEGRAPHY. By Frederick S. Beechey, Telegraph Engineer. Price 60 cents. New York city: E. & F. N. Spon, 446 Broome street.

A very readable little text book, containing much information.

TABLES FOR SYSTEMATIC QUALITATIVE CHEMICAL ANALYSIS. By John H. Snively, Ph. Dr., Professor of Analytical Chemistry in the Tennessee College of Pharmacy, etc. Price $1.00, post paid. Nashville, Tenn.: C. W. Smith, 158 Church street.

This handy volume contains practical directions for the analytical processes used in the investigation of all common substances, which are ar