THE JOURNAL
OF THE
Board of Arts and Manufactures
FOR UPPER CANADA.

APRIL, 1864.

PROVINCIAL EXHIBITION FOR 1864.

The next Annual Exhibition of the Agricultural Association for U. C., will be held in the city of Hamilton, during the week commencing on Tuesday the 26th of September next. The Prize List of the *Arts & Manufactures* Department will be found in this number of the Journal, to which we call the particular attention of all who may be in a position that will enable them to contribute of their *fine* or *industrial* art products.

It will be noticed that the prizes vary somewhat from those offered at the last Exhibition—several of the unimportant ones having been struck out, and a few new ones added, such as for resin, tar, turpentine, and a few other new natural or mechanical products, and that the prizes have been increased in amount for many of the more important items.

With a view to aiding in the development of the *flax interests* of the province, the council of the Association, in addition to the liberal prizes offered by the Association and by the Canada Company in the Agricultural Department, for raw and scutched flax, have now offered in this department two very liberal prizes of $60 and $40 respectively, for the "Best 6 varieties of *linen goods* manufac- "tured in Canada from Canadian flax; each "specimen of cloth to contain not less than 12 "yards." We look for a spirited competition for these prizes.

We would suggest to our mechanics and manufacturers that they commence early to prepare their articles for Exhibition—goods got up in a great hurry and at the latest moment, are seldom got up well, and are in almost all cases *sent in* too late to be classified and arranged, causing much dissatisfaction not only to the judges, but to the competitors themselves and to the public. Manufacturers should also be cautioned against putting a larger amount of work and finish upon their articles than is necessary or appropriate to fit them for the purposes to which it is intended they shall be adapted. The instructions given to the judges are, that their decisions shall be *based on the combination of quality, style and price, and the adaptation of the article to the purpose or purposes for which it is intended.* A strict observance to this principle in the preparation of goods, will prevent disappointment to many who would otherwise fail to obtain prizes.

At every Exhibition we notice a large amount of fine and elaborate work on articles of the coarser and more useful kinds, entirely out of place and inappropriate, except in articles of luxury and ornament, and manifesting a great want of proper taste in the producers. The very height of excellence in a manufactured article consists in the material and workmanship being good, and that both these shall be applied with such good taste and appropriateness as shall thoroughly adapt it to the use or uses for which it is intended, and so as to be afforded at such a price as shall suit the requirement of the market for which it has been prepared.

Space will not allow of our publishing the Rules and Regulations in this number, but we shall endeavour to do so in the issue for May.

FLAX AND LINEN MANUFACTURES

There is every prospect of a large increase in the growth of flax in this province during the coming season, over former years, and of the erection of several new flax scutching mills in addition to those already established, and to the six or eight machines of Rowan's, and Sandford and Mallory's, now in use in various districts. Messrs. Perine Brothers, of Doon, in the county of Waterloo, have in operation four scutching mills, besides rope, cordage and twine works, and are now erecting machinery at a cost of some ten thousand dollars, for the manufacture of linen goods. We see no reason why, with the raw material produced in the province, we should not largely manufacture linen sheetings, towellings, tickings, sail cloths, baggings, cordage, twines, and linen thread for domestic mixed cloths, for home consumption. The liberal prizes offered for linen goods at the next Provincial Exhibition will, we trust, furnish a satisfactory index of the progress which will by that time have been made in this branch of our new manufactures, although we cannot expect to attain to any great results by so early a date.

Owing to the scarcity and high prices of all kinds of cotton goods, and the certainty of their continuing so for a long time to come, a more favourable period than the present cannot arise for establishing linen manufactories in the province. The high prices of cotton goods are sure to be upheld sufficiently long to develop new enterprises of this kind that may now be commenced, and should the cotton market three or four years hence, correspond in prices with those ruling previous to the war, the incidental protection given to home manufactures by the imposition of a necessary *revenue tariff* will then be ample to enable the manufacturers to compete in their products with imported goods.

We have in our cities, towns and villages, an abundance of female and juvenile laborers, whose services could be made available in such manufactories, but which is now a burden on the communities wherein it exists.

These *industries* would also be the means of starting into existence rope and cordage works to use up the coarser portions of the flax, not adapted for the linen cloths; and in connection with other flax products we hope ere long to see oil mills established for the manufacture of linseed oil, and have no doubt but a fair return for capital thus invested would be realised, as there is a home market for a much larger quantity than we can produce for some years to come.

LINSEED OIL AND OIL CAKE.

The March number of this journal contained a very excellent article from the *Grocer*, on the manufacture of rape and linseed oils, as conducted by an extensive English firm. This subject has a peculiar interest in Canada just now, from the fact that the cultivation of flax and flax seed is becoming extensive both in the Upper and Lower sections of the Province, and will, in all probability, soon be reckoned amongst our staple products.

The manufacture of oil and oil cake has been commenced in Montreal and one or two other localities, and efforts are now being made to establish a joint stock company in this city, to be under the management of Mr. Banks, a gentleman recently from England, and who is most thoroughly acquainted with this branch of manufactures.

A meeting of a few of our merchants and business men was held at the Corn Exchange, on the 17th of February, when it was *resolved* "to form a company under the Limited Liability Act, with a capital of $10,000, to be increased afterwards if found desirable; believing that such a manufacture "would be found of great benefit to the city, the surrounding country, and the stockholders." About one half of the necessary amount of stock has been subscribed for, and with such probabilities of realising large returns on the capital proposed to be expended, as has been shown by those interesting themselves in organizing the company, there is not much doubt but the whole will soon be taken up. We have seen the names of those who have already become subscribers for stock, and are satisfied that no more reliable parties can be found in this city.

We have no very certain means of ascertaining the exact quantity of flax seed grown in Upper Canada for the past few years, but have reason to believe that in 1862 it was from 25,000 to 30,000 bushels; and that in 1863 the produce had increased to about 45,000 bushels. Reserving 5,000 bushels of this as seed for the present year, would leave about 40,000 bushels to be manufactured into oil and oil cake.

Messrs. Lyman, Clare & Co., of Montreal, have already purchased of last year's crop, about 40,000 bushels of seed, which would seem to indicate that the entire year's produce would largely exceed our estimate; but they have no doubt secured a large proportion of Lower Canada growth, as flax is extensively cultivated there.

The cost of machinery for an oil mill, with one double hydraulic press, steam engine, bedstones, tanks, weighing machine, and all other machinery and fittings necessary to complete such an establishment, is estimated to be under $5,000. Such a press and machinery would work 400 bushels of flax seed per week, which estimated at $1.50 per bushel, and with wages of the various hands necessary to work it, cost of fuel, casks, rent, freight and sundries, would amount to a total weekly outlay of about $760. The return for this expenditure is estimated at 400 gallons of boiled oil, 300 gallons of raw oil, and 168 cwt. of linseed cake, which, at present market rates, would realise the sum of $1,007; or a profit of $247 on the week's operations, towards wear and tear of machinery and dividends to stockholders.

The quantity of oil produced by this machinery could be largely increased, if necessary, by working night and day, as is usual in English oil mills; but on the lowest estimate as here given, there would be a consumption of at least 20,800 bushels of seed per annum, at a total cost of $31,200; producing 36,400 gallons of boiled and raw oils, and 8,736 cwt. of cake, representing at present prices a total value of $52,364; or a saving to the country of upwards of $21,000 per annum on the working of a single one press mill, by manufacturing the seed at home instead of sending it to a foreign country, and importing the oil therefrom for our own consumption.

This one illustration will serve to show the immense advantage of having such manufactures conducted within the Province, as can be supplied with the raw material of native production, and for which a home market is already established.

The following is the prospectus of the company referred to, which we hope soon to see in operation:

Prospectus.

The objects of this company are to erect suitable mills in Toronto, for the manufacture of linseed oil and oil cake from flax or linseed. Owing to the greatly increased breadth of land sown with flax in Upper Canada the last few years, of which the present one promises to exceed all former years, any difficulty which might previously have existed in obtaining a sufficiency of the seed, is at once obviated. The consumption of oil in *this* Province is necessarily very large, and the demand is at present supplied from England and the United States, with the exception of that manufactured at Quebec and Montreal, C.E., and Bridgeport, C. W., which forms a very insignificant portion. The manufacture has been found very remunerative. It is evident that the oil manufactured within an easy distance of where the seed is grown, can be sold to much better advantage than oil which bears the necessary expense of freight and other charges from England, and has to pay a duty of twenty per cent. before going into consumption; it is also certain that the cake will meet with ready sale at remunerative rates, on account of its well known fattening qualities, and being particularly adapted for milch cows; this fact being fully established in England, the quantity and quality of the milk and butter produced from the use of it being remarkable.

There is not a doubt of the success of this enterprize, as the want of an oil mill has long been felt in this city and its vicinity. Toronto is admirably situated for the purpose, being the chief seat of trade in Upper Canada, and being a distributing point, and in a central position commanding the trade of Upper Canada, offers superior inducements for the erection of mills at this point.

The cultivation of flax in Canada will add very materially to our resources, and the Government being alive to the importance of the subject, have done a great deal to assist private enterprize in developing this rapidly growing trade. It remains only to erect the necessary machinery to avail ourselves of the advantages of our position, to retain within ourselves the benefits of a manufacture which is protected by so large a duty, and is in such demand, besides assisting the general progress of the country. The profits to be obtained have been satisfactorily ascertained by parties of great experience in the trade, and *allowing liberally for all contingencies*, twenty-five per cent. is confidently expected.

MACHINE STRETCHED LEATHER BELTING.

Our motto is "Encourage Home Manufactures," by purchasing them in preference to imported goods, whenever they can be obtained of good quality and at fair market prices. This is a truly patriotic principle that all who desire the well-being of their country should endeavour to carry out, and will be sure to re-act to the benefit of the purchaser, as well as the manufacturer and the public generally; for by such means will capital be kept in the province — manufacturing communities created to furnish home markets for agriculturists —surplus populations of cities and towns not adapted to agricultural pursuits furnished remunerative employment—and a certain degree of independence of foreign nations for supplies of the necessaries of life established.

The machine shops and factories of the province use large quantities of *machine stretched cemented and riveted leather belting*, heretofore bought principally from our neighbours on the south side of the lakes. Mr. J. C. McLaren, of Montreal, has just forwarded to the Museum of Manufactures of the Board of Arts in Toronto, a card of several samples of this description of belting of his own manufacture, comprising widths from 3 to 12 inches, single and double; round twisted lathe belting; and rounded leather cord to be used for all purposes for which ordinary sash-cord is used.

This belting is of excellent quality, and can be seen at the Board Rooms by any person who may desire to examine it. Price lists for the various kinds of belting, and also of different sizes of fire-engine hose manufactured by him, are attached.

If the manufacturers in all new branches of industry in the province would follow the example of Mr. McLaren and a few others, in sending specimens of their productions to the Board, a very interesting museum of home manufactures would shortly be formed, which would afford to strangers visiting us a good idea of our manufacturing capabilities; and to the contributors themselves a medium for submitting their productions to the criticisms of the public. Mr. McLaren's advertisement appears on the cover of the journal.

MECHANICS' INSTITUTES RE-UNIONS.

When in the winter of 1862–3 the managers of the Toronto Mechanics' Institute first originated a series of entertainments for their members, of an amusing as well as instructive character, under the appropriate name of *Re-Unions*, they conferred a benefit on other Institutes besides their own. These gatherings have not only become very popular, but profitable, promising to be of great pecuniary benefit to the impoverished treasuries of many of these useful Institutions.

We notice that the Hamilton and Gore Mechanics' Institute held the first of a series of these Re-Unions on the evening of the 6th instant, when the Directors were gratified by having their large Hall "filled almost to overflowing," and no doubt realised a very handsome profit therefrom..

These entertainments were suggested to the Hamilton Institute by a letter from the President of the Institute in Toronto; and as the information there given may be interesting to other similar bodies, we insert the letter and comments thereon, as published in the *Hamilton Evening Times* of the 12th ultimo.

"We have great pleasure in drawing the attention of our readers to the following letter. There are two very strong reasons why the suggestions thrown out in it should meet with serious attention. It is worthy of attention and support as a scheme devised to free the Mechanics' Institute here from its financial embarrassments, and aid in freeing it from the debt which now clogs its energies and impairs its usefulness. Secondly, it is worthy of attention on account of its own intrinsic merit. In Toronto, where we believe these Re-Unions were first got up, they immediately became popular. Not merely were full houses secured, but on many occasions hundreds had to be refused admittance on account of want of room, and that in a hall quite as large if not larger than our own. We understand that the matter will be at once taken up by the Board of Directors here, and that there is every probability that the first of a series of Re-Unions will be announced for an early day. All that is needed is that those competent to render assistance should do so promptly and willingly. If they do the Re-Unions must be successful, if there is a particle of literary or musical taste in Hamilton. The following is the letter referred to:—

TORONTO, March 9, 1864.

MY DEAR SIR,—I have just received a copy of your annual report, and regret to notice that your Institute, like many others, is labouring under financial difficulties; I also notice the canvass you propose to make amongst your members and others for special subscriptions toward meeting your liabilities. Why I now address you is to suggest another mode, auxiliary to the canvass if you please, as available for raising funds; that is by holding a series of Re-Unions similar to those now being held by our Institute. You have an admirable Hall for the purpose, a Military Band is stationed in your city, which no doubt might be had occasionally if considered desirable, and you have sufficient available musical and literary talent in your community to render them successful.

When our Re-Unions were first organized, it was with a view of bringing the members of the Institute together to spend a pleasant evening in literary, musical and social intercourse; they have now become a source of profit to the Institute, and of cheap and popular entertainment for the public, of an elevating character.

Our charge for admission is ten cents each person, and we have usually from 900 to 1000 in attendance. For the first series of ten, member's season tickets were issued, admitting a gentleman and two ladies for *one dollar*; and although this charge was too low, yet, after crediting to the *rent account* the sum of $15 for each of the ten entertainments, a net profit of $170 was realised. Four special Re-Unions have since been held, no season tickets being issued, and the profits realized, after charging against the proceeds the usual amount for rent of Hall, has averaged $30 per night. We pay a moderate remuneration to a musical conductor, who attends to rehearsals and plays accompaniments when necessary. We occasionally engage some professional talent, which is also given to the Institute at a moderate remuneration. Amateur assistance is generally given gratuitous.

On four occasions the band of Her Majesty's 16th regiment has been secured, and with very satisfactory results—their performances being always popular.

I think it is now demonstrated that, by judicious management, these Re-Unions may be rendered not only subservient to the healthful and elevating recreation of the people, but to the relief of many of the Mechanic's Institutes from their financial embarrassments. Several Institutes have already made a commencement, of which I notice those of Whitby, Cobourg, Newmarket, Bradford and St. Catherines, and I believe with considerable success. I beg to direct your attention to a letter from Mr. Longman, our very efficient Secretary, to one of the Directors of the St. Catherines Institute, which you will find in the January No. of the Journal of the Board of Arts and Manufactures, for further details of management of the Re-Unions.

I am, Sir, yours very truly,
W. EDWARDS.
President Toronto Mechanics' Institute.

Alexander Rutherford, Esq., Superintendent
Hamilton and Gore Mechanics' Institute.

NOTATION.

The following letter and comment refers to an article in the January number of this Journal, originally copied from the *New York Post.* Neither the writer of the letter, or the editor of the *Reporter*, appears to be aware of the fact that by the French system of notation—now in general use in the United States and Canada—the *billion* is not equal to a *million* of millions, but to a *thousand* millions; a *trillion* to a *thousand* billions; a *quadrillion* to a *thousand* trillions, &c. With this explanation, the writers will see that the amount "eighteen septillions" is properly expressed by 24 ciphers after 18.

Sangsters's Arithmetic, the authorised text book of the Council of Public Instruction for Upper Canada, on systems of notation says: "For a certain distance, the English and French methods of division agree; the English billion is, however, a *thousand* times greater than the French, &c. &c. We shall prefer the French method."

To the Editor of the Sanitary Reporter.

SIR,—In the article on "The Wonderful Properties of Figures," which you have inserted in yesterday's paper, (No. 34) I was surprised to find that the amount "eighteen septillions," was expressed by 24 ciphers after 18.

Now, you must know that those figures express 18 *quadrillions*, not 18 *septillions;* a billion being equal to a *million* of millions, not a *thousand* millions; a *trillion* being equal to a *million* of billions, not a *thousand* billions; a *quadrillion* being equal to *million* of trillions, not a *thousand* of trillions, &c.

And, therefore, to express 18 septillions, one would require, after the 18, 42 ciphers, thus:—

septillions	sextillions	quintillions	quadrillions	trillions
18,000,000;	000,000;	000,000;	000,000;	000,000;

billions	millions.
000,000;	000,000.

I think this old way of placing a semi-colon between each 6 figures, and a comma between each intermediate 3, facilitates notation.

I noticed a few years ago a similar error in a leading journal, in its article on Japanese policy, *quintillions* being treated as only equal to *thousands* of *quadrillions*, and *quadrillions* as equal to *thousands* of *trillions*, &c.

I am, sir, yours obediently,

CYRIL A. GREAVES.

[We inserted the paper alluded to in this letter without any comment. It was a reprint from a respectable Canadian journal, and we published it (yet, at the same time, doubting the accuracy altogether of the calculation) for the purpose of exciting some correspondent to go thoroughly into the subject, and we are much obliged to Mr. Greaves for his communication. With the well-known formula, and a table of logarithms, it is no very difficult task to arrive at the truth.—ED. S. R.]

The Board of Arts and Manufactures for Upper Canada.

PROVINCIAL EXHIBITION.

PRIZE LIST—ARTS AND MANUFACTURES DEPARTMENT.

The following is the Prize List of the Arts and Manufactures Department of the Agricultural Association's Exhibition, to be held in the City of HAMILTON, on Tuesday, Wednesday, Thursday, and Friday, September 27th, 28th, 29th, and 30th, 1864. The Rules and Regulations will be published in the next issue of the Journal.

CLASSIFICATION OF PRIZE LIST.

ARTS, MANUFACTURES, LADIES' WORK, &c., &c.

Class 40—Cabinet Ware and other Wood Manufactures.
" 41—Carriages and Sleighs, and parts thereof.
" 42—Chemical Manufactures and Preparations.
" 43—Decorative and Useful Arts; Drawings and Designs.
" 44—Fine Arts.
" 45—Groceries and Provisions.
" 46—Ladies' Work.
" 47—Machinery, Castings, and Tools.
" 48—Metal Work (Miscellaneous) including Stoves.
Class 49—Miscellaneous, including Pottery, and Indian Work.
" 50—Musical Instruments.
" 51—Natural History.
" 52—Paper, Printing, and Bookbinding.
" 53—Saddle, Engine Hose, and Trunk-makers Work; and Leather.
" 54—Shoe and Bootmakers' Work, and Leather.
" 55—Woollen, Flax, and Cotton Goods, and Furs, and Wearing Apparel.
" 56—Foreign Manufactures.

Class 40—Cabinet Ware and other Wood Manufactures.

Cabinet Ware.

Sect.		1st Prize.	2nd Prize.
1	Bed Room Furniture, set of	$10 00	$6 00
2	Centre Table	8 00	4 00
3	Drawing Room Sofa	8 00	4 00
4	Drawing Room Chairs, set of	8 00	4 00
5	Dining Room Furniture, set of	10 00	6 00
6	Side Board	8 00	4 00
7	Wardrobe	6 00	3 00

Miscellaneous.

Sect.		1st Prize.	2nd Prize.
8	Coopers Work	$6 00	$3 00
9	Corn Brooms, 1 doz	2 00	1 00
10	Handles for Tools for Carpenters, Blacksmiths, Gunsmiths, Watchmakers, &c., &c., collection of	8 00	4 00
11	Joiner's Work, assortment of	8 00	4 00
12	Machine-wrought Moulding, and Flooring, 100 feet of each	6 00	3 00
13	Turning in Wood, collection of specimens	6 00	3 00
14	Turned Hollow Wooden Ware, assortment of	6 00	3 00
15	Veneers from Canadian Woods, undressed	8 00	4 00

Sect.	Class 40—*Continued.*	1st Prize.	2nd Prize.
16	Veneers from Canadian Woods, dressed and polished	8 00	4 00
17	Wash Tubs and Pails, three of each, Factory made	4 00	2 00
18	Willow Ware, six specimens	4 00	2 00
19	Extra Entries		

Class 41—Carriages and Sleighs, and Parts thereof.

Sect.		1st Prize.	2nd Prize.
1	Axle, wrought iron	$4 00	2 00
2	Bent Shafts, half a dozen	3 00	2 00
3	Bows, for Carriage Tops, two sets	3 00	2 00
4	Buggy, double seated	10 00	6 00
5	Buggy, single seated	8 00	5 00
6	Buggy, trotting	6 00	3 00
7	Carriage, two-horse, pleasure	12 00	8 00
8	Carriage, one-horse pleasure	10 00	6 00
9	Carriage Hubs, Rims or Fellows, and Machine-made Spokes, the best assortment	7 00	4 00
10	Dog Cart, single horse	7 00	4 00
11	Express Waggon	7 00	4 00
12	Sleigh, two-horse pleasure	12 00	8 00
13	Sleigh, one-horse pleasure	10 00	6 00
14	Springs, one set steel carriage	5 00	3 00
15	Sulky, trotting	5 00	3 00
16	Wheels, one pair of carriage, unpainted	4 00	2 00
17	Extra Entries		

Class 42—Chemical Manufactures and Preparations.*

Sect.		1st Prize.	2nd Prize.
1	Essential Oils, assortment of	$6 00	$4 00
2	Glue, 14 lbs	3 00	2 00
3	Isinglass, 1 lb	3 00	2 00
4	Medical Herbs, Roots and Plants, native growth	12 00	7 00
5	Oils—Linseed, Rape, and other expressed kinds	6 00	4 00
6	Oil—Coal, Shale, or Rock	6 00	4 00
7	Oil, Neat's foot, half gallon	2 00	1 00
8	Printing Inks, an assortment	3 00	2 00
9	Resin, 30 lbs	5 00	3 00
10	Tar, 1 gallon	3 00	2 00
11	Turpentine, spirits of, 1 gallon	5 00	3 00
12	Varnishes, assortment of	6 00	4 00
13	Extra Entries		

Class 43—Decorative and Useful Arts, Drawings and Designs.

Sect.		1st Prize.	2nd Prize.
1	Carving in Wood	$10 00	$6 00
2	Drawing of Machinery, in perspective	6 00	4 00
3	Decorative House Painting	6 00	4 00
4	Engraving on Wood, with proof	6 00	4 00
5	Engraving on Copper, with proof	6 00	4 00
6	Goldsmith's Work	6 00	4 00
7	Geometrical Drawing of Engine or Mill Work, coloured	6 00	4 00
8	Lithographic Drawing, plain	6 00	4 00
9	Lithographic Drawing, coloured	6 00	4 00
10	Mantlepiece in Marble	10 00	6 00
11	Mathematical, Philosophical and Surveyor's Instruments, collection of	15 00	10 00
12	Modelling in Plaster	6 00	4 00
13	Monumental Headstone	6 00	4 00
14	Picture Frame, ornamented gilt	5 00	3 00
15	Penmanship, business hand, without flourishes	4 00	2 00
16	Penmanship, ornamental	4 00	2 00
17	Seal Engraving, collection of impressions	6 00	4 00
18	Sign Writing	5 00	3 00
19	Silversmith's Work	6 00	4 00
20	Stained Glass, collection of specimens	12 00	8 00
21	Extra Entries		

Class 44—Fine Arts.

Professional List—Oil.

Sect.		1st Prize.	2nd Prize.
1	Animals, grouped or single	$12 00	$7 00
2	Historical Painting	12 00	7 00
3	Landscape, Canadian subject	12 00	7 00

* All parties exhibiting in competition for prizes in this class, must deliver their goods to the Secretary of the Board of Arts and Manufactures, Toronto, by the 1st of September, with a view to having a proper analysis made prior to the Exhibition.

Class 44—*Continued.*

Sect.		1st Prize.	2nd Prize.
4	Landscape or Marine Painting, not Canadian subject	10 00	6 00
5	Marine Painting, Canadian subject	12 00	7 00
6	Portrait, from Original Sittings	10 00	6 00
	In Water Colours.		
7	Animals, grouped or single	7 00	5 00
8	Flowers, grouped or single	7 00	5 00
9	Landscape, Canadian subject	7 00	5 00
10	Landscape or Marine Painting, not Canadian subject	7 00	5 00
11	Marine View, Canadian subject	7 00	5 00
12	Portrait, from Original Sittings	6 00	4 00
	Pencil, Crayon, &c.		
13	Crayon, coloured	6 00	4 00
14	Crayon, plain	6 00	4 00
15	Crayon Portrait, from Original Sittings	6 00	4 00
16	Pencil Portrait, from Original Sittings	6 00	4 00
17	Pencil Drawing	6 00	4 00
18	Pen and Ink Sketch	6 00	4 00
	Amateur List—Oil.		
19	Animals, grouped or single	8 00	5 00
20	Historical Painting	8 00	5 00
21	Landscape, Canadian subject	8 00	5 00
22	Landscape or Marine Painting, not Canadian subject	8 00	5 00
23	Marine Painting, Canadian subject	8 00	5 00
24	Portrait, from Original Sittings	8 00	5 00
	In Water Colours.		
25	Animals, grouped or single	7 00	5 00
26	Flowers, grouped or single	5 00	3 00
27	Landscape, Canadian subject	7 00	5 00
28	Landscape or Marine Painting, not Canadian subject	7 00	5 00
29	Marine view, Canadian subject	7 00	5 00
30	Portrait, from Original Sittings	6 00	4 00
	Pencil, Crayon, &c.		
31	Crayon, coloured	5 00	3 00
32	Crayon, plain	5 00	3 00
33	Crayon Portrait, from Original Sittings	5 00	3 00
34	Pencil Portrait, from Original Sittings	5 00	3 00
35	Pencil Drawing	5 00	3 00
36	Pen and Ink Sketch	5 00	3 00
	Photography.		
37	Ambrotypes, collection of	6 00	4 00
38	Photograph Portraits, collection of, in duplicate, one set coloured	10 00	6 00
39	Photograph Portraits, collection of, plain	8 00	5 00
40	Photograph Landscapes and Views, collection of	8 00	5 00
41	Photograph Portrait, finished in Oil	8 00	5 00
42	Extra Entries		

Class 45—Groceries and Provisions.

Sect.		1st Prize.	2nd Prize.
1	Barley, Pearl, 25 lbs	$3 00	$2 00
2	Barley, Pot, 25 lbs	3 00	2 00
3	Biscuits, an assortment of	6 00	4 00
4	Bottled Fruits, an assortment, manufactured for sale	6 00	4 00
5	Bottled Pickles, an assortment, manufactured for sale	6 00	4 00
6	Buckwheat Flour, 25 lbs	3 00	2 00
7	Chickory, 20 lbs., prepared	3 00	2 00
8	Indian Corn Meal, 25 lbs	3 00	2 00
9	Oatmeal, 25 lbs	3 00	2 00
10	Sauces for Table use, an assortment, manufactured for sale	6 00	4 00
11	Soap, one box of common	4 00	3 00
12	Soaps, collection of assorted fancy	6 00	4 00
13	Starch, 12 lbs. of Corn	2 00	1 00
14	Starch, 12 lbs. of Flour	2 00	1 00
15	Starch, 12 lbs. of Potatoe	2 00	1 00
16	Sugar, 20 lbs. of Sorghum	5 00	3 00
17	Sugar, one loaf of Refined	5 00	3 00
18	Tobacco, 14 lbs. Canadian manufactured	5 00	3 00
19	Wheat Flour	7 00	5 00
20	Extra Entries		

Class 46—Ladies' Work.

Sect.		1st Prize.	2nd Prize.	3rd Prize.
1	Bead Work	$3 00	$2 00	$1 00
2	Braiding	3 00	2 00	1 00
3	Crochet Work	3 00	2 00	1 00
4	Embroidery in Muslin	3 00	2 00	1 00
5	Embroidery in Cotton	3 00	2 00	1 00
6	Embroidery in Silk	3 00	2 00	1 00
7	Embroidery in Worsted	3 00	2 00	1 00
8	Gloves, three pairs	2 00	1 00	0 50
9	Guipure Work	3 00	2 00	1 00
10	Hair Work	3 00	2 00	1 00
11	Knitting	3 00	2 00	1 00
12	Lace Work	3 00	2 00	1 00
13	Mittens, three pairs of Woollen	2 00	1 00	0 50
14	Needle Work, ornamental	3 00	2 00	1 00
15	Netting, fancy	3 00	2 00	1 00
16	Plait for Bonnets or Hats, of Canadian Straw	3 00	2 00	1 00
17	Shirt, gentleman's	3 00	2 00	1 00
18	Socks, three pairs of Woollen	2 00	1 00	0 50
19	Stockings, three pairs of Woollen	2 00	1 00	0 50
20	Tatting	3 00	2 00	1 00
21	Wax Fruit	6 00	4 00	2 00
22	Wax Flowers	6 00	4 00	2 00
23	Wax Shells, a collection of	6 00	4 00	2 00
24	Worsted Work	3 00	2 00	1 00
25	Worsted Work (fancy) for framing	3 00	2 00	1 00
26	Worsted Work (raised)	3 00	2 00	1 00
27	Extra Entries			

Class 47—Machinery, Castings, and Tools.

Sect.		1st Prize.	2nd Prize.
1	Blacksmith's Bellows	$4 00	$3 00
2	Castings for General Machinery	10 00	6 00
3	Cast Wheel, spur or bevel, not less than 50 lbs. weight	8 00	5 00
4	Castings for Railways, Railroad Cars and Locomotives, assortment of	12 00	7 00
5	Hand Power Weaving Loom	6 00	4 00
6	Edge Tools, an assortment	15 00	10 00
7	Engine, Steam, stationary, of one to four horse power, in operation	15 00	10 00
8	Engine, Steam, stationary, five horse power and upwards, in operation	25 00	15 00
9	Engine, Hot Air, one to four horse power, in operation on the ground	15 00	10 00
10	Pump, in metal	6 00	4 00
11	Refrigerator	6 00	4 00
12	Saws, an assortment	10 00	6 00
13	Saw Mill, in Model or otherwise	6 00	4 00
14	Sewing Machine, manufacturing	8 00	5 00
15	Sewing Machine, family	8 00	5 00
16	Scales, platform	5 00	3 00
17	Scales, counter	3 00	2 00
18	Shingle Splitting Machine	6 00	4 00
19	Skates, an assortment of	6 00	4 00
20	Smoke Consuming Furnace, in operation on the ground	12 00	7 00
21	Tools for Working in Metals, assortment of	12 00	7 00
22	Turning Lathe	7 00	4 00
23	Valves and Gearing for working steam expansively, either in model or otherwise, principle of working to be the point of competition	12 00	7 00
24	Extra Entries		

Class 48—Metal Work (Miscellaneous) including Stoves.

Miscellaneous.

Sect.		1st Prize.	2nd Prize.
1	Coppersmith's Work, an assortment	8 00	5 00
2	Engineer's Brass Work, an assortment	8 00	5 00
3	Fire Arms, an assortment	8 00	5 00
4	Files, collection of cast steel	3 00	2 00
5	Fire Proof Office Safe	8 00	5 00
6	Iron Fencing and Gate, ornamental	8 00	5 00
7	Iron Work from the hammer, ornamental	7 00	4 00
8	Iron Work, ornamental cast	7 00	4 00
9	Lock—Combination Bank Lock	8 00	5 00
10	Locksmith's Work, an assortment	8 00	5 00
11	Malleable Hardware Manufactures, an assortment	8 00	5 00

Sect.	Class 48—*Continued.*	1st Prize.	2nd Prize.
12	Nails, 20 lbs. of pressed	6 00	4 00
13	Nails, 20 lbs. of cut	6 00	4 00
14	Plumber's Work, an assortment	8 00	5 00
15	Screws and bolts, an assortment	6 00	4 00
16	Sheet Brass Work, an assortment	8 00	5 00
17	Tinsmith's Work, an assortment	6 00	4 00
18	Tinsmith's Lacquered Work, an assortment of	6 00	4 00
19	Wire Work, an assortment	6 00	4 00
	Stoves.		
20	Cooking Stove, for wood	6 00	4 00
21	Cooking Stove, for coal	6 00	4 00
22	Furniture for Cooking Stove, one set	4 00	3 00
23	Hall Stove, for wood	5 00	3 00
24	Hall Stove, for coal	5 00	3 00
25	Parlour Stove, for wood	5 00	3 00
26	Parlour Stove, for coal	5 00	3 00
27	Parlour Grate	5 00	3 00
28	Parlour Fire Place complete, including setting of grate so as to economise fuel; and arrangement for ventilating room	10 00	6 00
29	Extra Entries		

Class 49—Miscellaneous, including Pottery and Indian Work.

Sect.	*Miscellaneous.*	1st Prize.	2nd Prize.
1	Artificial Leg	6 00	0 00
2	Artificial Arm	6 00	0 00
3	Brushes, an assortment	6 00	4 00
4	Model of a Steam Vessel	6 00	4 00
5	Model of a Sailing Vessel	6 00	4 00
	Pottery.		
6	Filterer for water	3 00	2 00
7	Pottery, an assortment	8 00	5 00
8	Sewerage Pipes, stoneware, assortment of sizes	10 00	6 00
9	Stoneware, an assortment	10 00	6 00
10	Slates for roofing	8 00	5 00
	Indian Work.		
11	Buckskin Mittens, one pair	2 00	1 00
12	Clothes Basket	2 00	1 00
13	Fruit Basket	2 00	1 00
14	Hand Basket	2 00	1 00
15	Moccasins, one pair of plain	2 00	1 00
16	Moccasins, worked with beads or porcupine quills, one pair	3 00	2 00
17	Extra Entries		

Class 50—Musical Instruments.

Sect.		1st Prize.	2nd Prize.
1	Harmonium	10 00	6 00
2	Melodeon	6 00	4 00
3	Organ, Church	25 00	15 00
4	Piano, Grand	20 00	12 00
5	Piano, Square	15 00	10 00
6	Piano, Cottage	10 00	6 00
7	Extra Entries		

Class 51—Natural History.

Sect.		1st Prize.	2nd Prize.
1	BIRDS—Collection of Stuffed Birds of Canada, classified, and Common and technical names attached	$8 00	$6 00
2	FISHES—Collection of Native Fishes, stuffed or preserved in spirits, and common and technical names attached	8 00	6 00
3	INSECTS—Collection of Native Insects, classified, and common and technical names attached	8 00	6 00
4	MAMMALIA AND REPTILES of Canada, stuffed or preserved in spirits, classified, and common and technical names attached	8 00	6 00
5	MINERALS—Collection of Minerals of Canada, named and classified	8 00	6 00
6	PLANTS—Collection of Native Plants, arranged in their natural families, and named	8 00	6 00
7	STUFFED BIRDS AND ANIMALS of any country, collection of	8 00	6 00
8	Extra Entries		

Class 52—Paper, Printing, Bookbinding, and Type.

Sect.		1st Prize.	2nd Prize.
1	Bookbinding (blank-book), assortment of	$5 00	$3 00
2	Bookbinding (letter-press), assortment of	5 00	3 00
3	Letter-press Printing, plain	5 00	3 00
4	Letter-press Printing, ornamental	5 00	3 00
5	Paper Hangings (Canadian paper), one dozen rolls, assorted	6 00	4 00
6	Papers—Printing, Writing, and Wrapping, one ream of each	6 00	4 00
7	Papers—Blotting and Coloured, one ream of each	6 00	4 00
8	Pocket Books, Wallets, &c., an assortment	6 00	4 00
9	Printing Type, an assortment	6 00	4 00
10	Extra Entries		

Class 53—Saddle, Engine Hose, Trunk Makers' Work, and Leather.

Saddlery, &c.

Sect.		1st Prize.	2nd Prize.
1	Engine Hose and Joints, 2½ inches diameter, 50 feet of copper rivetted	$8 00	$5 00
2	Harness, set of double carriage	8 00	5 00
3	Harness, set of single carriage	7 00	4 00
4	Harness, set of team	5 00	3 00
5	Harness, set of Express	6 00	4 00
6	Hames, carriage or gig, best assortment	5 00	3 00
7	Hames, team or cart, best assortment	5 00	3 00
8	India Rubber Belting, Engine-Hose, &c., an assortment	8 00	5 00
9	Leather Machine Belting, an assortment	8 00	5 00
10	Saddle, Ladies' full quilted	8 00	5 00
11	Saddle, Ladies' quilted safe	6 00	4 00
12	Saddle, Gentlemen's full quilted	7 00	4 00
13	Saddle, Gentlemen's plain shaftoe	6 00	3 00
14	Trunks, an assortment	8 00	5 00
15	Valises and Travelling Bags, an assortment	5 00	3 00
16	Whips and Thongs, an assortment	6 00	4 00

Leather.

17	Belt Leather, 30 lbs	4 00	3 00
18	Brown Strap and Bridle, one side of each	4 00	3 00
19	Carriage Cover, two skins (whole)	4 00	3 00
20	Deer Skins, three dressed	3 00	2 00
21	Harness Leather, two sides	4 00	3 00
22	Hog Skins for saddles, three	4 00	3 00
23	Patent Leather, for carriage or harness work, 20 feet	6 00	4 00
24	Skirting for saddles, two sides	4 00	3 00
25	Extra Entries		

Class 54—Shoe and Bootmakers' Work, Leather, &c.

Boots, &c.

Sect.		1st Prize.	2nd Prize.
1	Boots, Ladies', an assortment	$7 00	$4 00
2	Boots, Gentlemens' sewed, an assortment	7 00	4 00
3	Boots, pegged, an assortment	5 00	3 00
4	Boot and Shoemaker's Tools, an assortment	8 00	5 00
5	Boot and Shoemakers' Lasts and Trees, an assortment	8 00	5 00
6	Shoemakers' Pegs, an assortment	4 00	3 00
7	Shoes, India Rubber, an assortment	6 00	4 00

Leather.

Sect.		1st Prize.	2nd Prize
8	Calf Skins	$3 00	$2 00
9	Calf Skins, grained	3 00	2 00
10	Calf Skins, two morocco	3 00	2 00
11	Cordovan, two skins of	3 00	2 00
12	Dog Skins, two dressed	3 00	2 00
13	Kip Skins, two sides	3 00	2 00
14	Kip Skins, grained	3 00	2 00
15	Linings, six skins	3 00	2 00
16	Patent Leather for bootmakers, 20 feet	6 00	4 00
17	Sheep Skins, six coloured	3 00	2 00
18	Sole Leather, two sides	3 00	2 00
19	Upper Leather, two sides	3 00	2 00
20	Upper Leather, grained, two sides	3 00	2 00
21	Extra Entries		

Class 55—Woollen, Flax, and Cotton Goods; and Furs and Wearing Apparel.

Sect.		1st Prize.	2nd Prize.
1	Bags, from flax or hemp, the growth of Canada, one dozen	$8 00	$5 00
2	Bags, one dozen cotton	4 00	3 00
3	Blankets, woollen, one pair	6 00	4 00
4	Calico, unbleached, one piece	5 00	3 00
5	Carpet, woollen, one piece	8 00	5 00
6	Carpet, woollen stair, one piece	7 00	4 00
7	Cassimere cloth, from Merino wool, one piece	7 00	4 00
8	Cloth, fulled, one piece	7 00	4 00
9	Cloth, broad, one piece	7 00	4 00
10	Counterpanes, two	5 00	3 00
11	Cordage and Twines, from Canadian flax or hemp, assortment of	10 00	6 00
12	Check for horse collars, one piece	6 00	4 00
13	Drawers, factory made, woollen, one pair	5 00	3 00
14	Flannel, factory made, one piece	5 00	3 00
15	Flannel, not factory made, one piece	5 00	3 00
16	Flannel, scarlet, one piece	5 00	3 00
17	Fur Cap and Gloves	5 00	3 00
18	Fur Sleigh Robes, Buffalo, Wolf and Raccoon (an assortment)	10 00	6 00
19	Gloves and Mits of any leather, an assortment	5 00	3 00
20	Horse Blankets, two pairs	5 00	3 00
21	Kersey for horse clothing, one piece	5 00	3 00
22	Linen Goods, one piece	5 00	3 00
23	Oxford Grey Cloth, one piece	5 00	3 00
24	Overcoat of Canadian Cloth	5 00	3 00
25	Satinet, black, one piece	6 00	4 00
26	Satinet, mixed, one piece	5 00	3 00
27	Sheep Skin Mats, dressed and coloured, an assortment	6 00	4 00
28	Shirts, factory made, three each, woollen and Angola	5 00	3 00
29	Silk and Felt Hats	5 00	3 00
30	Stockings and Socks, factory made, woollen, three pairs of each	4 00	2 00
31	Stockings and Socks, factory made, mixed woollen and cotton, three pairs of each	4 00	2 00
32	Suit of Clothes of Canadian Cloth	8 00	5 00
33	Tweed, Winter, one piece	6 00	4 00
34	Tweed, summer, one piece	6 00	4 00
35	Twine, linen and cotton, an assortment	3 00	2 00
36	Winsey, checked, one piece	5 00	3 00
37	Woollen Cloths, Tweeds, &c., an assortment	10 00	6 00
38	Woollen Shawls, Stockings, Drawers, Shirts, and Mits, an assortment	10 00	6 00
39	Yarn, white and dyed, one pound of each	3 00	2 00
40	Yarn, fleecy woollen, for knitting, one pound	3 00	2 00
41	Yarn, cotton, two pounds	3 00	2 00
42	Yarn, linen, two pounds	3 00	2 00
43	LINEN GOODS—FOR THE BEST 6 VARIETIES OF LINEN GOODS, MANUFACTURED IN CANADA, FROM CANADIAN GROWN FLAX; EACH SPECIMEN OF CLOTH TO CONTAIN NOT LESS THAN 12 YARDS	**60 00**	**40 00**
44	Extra Entries		

Class 56—Foreign Manufactures.

Foreign Articles will be admitted for exhibition only; but Certificates will be awarded to any article of worth or peculiar merit.

ALPHABETICAL LIST OF THE PRINCIPAL ENGLISH PUBLICATIONS FOR MONTH ENDING FEBRUARY 29.

Bates (Hen. W.) Naturalist on the River Amazons, 2nd edit., 1 vol. post 8vo	0	12	0	*Murray.*
Beeton's Dictionary of Universal Information: Science, Vol. 3, 8vo, 6s. comp. 1 vol	0	15	0	*Beeton.*
Blyth (E.) Catalogue of Mammalia in Museum Asiatic Society, 8vo	0	5	0	*Williams & N.*
Browne (W. A., L.L.D.) Money, Weights & Mea. of the Chief Commer. Nations, fcp	0	1	0	*Stanford.*
Buckmaster (J. C.) Elements of Mechanical Physics, roy. 18mo	0	3	6	*Chapman. & H.*
Crocker (Jas.) Proposal for Geographical System of Measures and Weights, 8vo	0	8	6	*Macmillan.*
Evans (John) Coins of the Ancient Britons, arranged and described, roy. 8vo	1	1	0	*J. R. Smith.*
Goschen (George J.) Theory of the Foreign Exchanges, 3rd edit. revised, 8vo	0	5	0	*E. Wilson.*
Hague (John) Recreation in connection with Mechanics' Institutes, 8vo	0	0	6	*Cornish.*
Journal of Botany (The) British and Foreign, edit. by Berthold Seeman, vol 1, 8vo	1	5	0	*Hardwicke.*
Kerrison (Lady Caroline) Plans and Estimates for Labourers' Cottages, cr. 4to	0	3	6	*Hatchard.*
Kirchoff (G.) Researches on the Solar Spectrum, 2nd part, translated, 4to	0	5	0	*Macmillan.*
Lawson (Wm.) Geography of the British Empire, 2nd edit., revised, fcap. 8vo	0	3	0	*Simpkin.*
Michaelis (Gustav) New System of English Stenography, adap. from Stolze, 12mo	0	3	0	*Trübner.*
Miles (William) General Remarks on Stables, 2nd edit. imp. 8vo	0	15	0	*Longman.*
Miller (K. M.) Questions on the Marine Steam-engine given to Engineers, cr. 8vo	0	1	0	*Simpkin.*

Molesworth (G.L.) Pocket-Book of Useful Formulæ & Memoranda, 5th edit., obg., 32mo.	0	4	6	*Spon.*
Negretti and Zambra's Treatise on Meteorological Instruments, 8vo	0	5	0	*Negretti & Zam.*
Parker (Theodore) Works, Vol. 7, Discourses of Social Science, post 8vo	0	6	0	*Trübner.*
Parkinson (S.) Elementary Treatise on Mechanics, 3rd. edit., revised, cr. 8vo	0	9	0	*Macmillan.*
Progress of the Art of Building, and a Remedy for Smoky Chimneys, cr. 8vo	0	3	0	*Simpkin.*
Read (W. T.) Pop. and Math. Astronomy, cr. 8vo, reduced to	0	3	6	*Longman.*
Reed's Seamanship, and Young Mariner's Guide, 6th edit. cr. 8vo	0	1	0	*Simpkin.*
Richardson (W.) Tables for the use of Timber Merchants and Builders, fcap. 8vo	0	2	0	*Abel Heywood.*
Timbs (John) Year-book of Facts in Science and Art (for 1864), fcap. 8vo	0	5	0	*Lockwood.*

Useful Receipts.

Cement for mending Glass, Marble, China, Earthenware, &c.

White shellac, 1 oz., dissolved in 2 oz. of spirits of wine, 10 grains of borax dissolved in 2 drachms of sulphuric ether. After the ingredients are dissolved, put them together.

Put it on the edges of the broken ware with a brush or feather; then burn it off with a spirit light. Put the pieces together. hold them until they set, and they will be as firm as they were before they were broken.

Volatile Soap, for removing Paint, Grease Spots, &c.

Four table-spoonfuls of spirits of hartshorn, four table-spoonfuls of alcohol, and a table-spoonful of salt. Shake the whole well together in a bottle, and apply with a sponge or brush.

To Bronze.

1. Small figures are covered with size or varnish, and when this is *nearly dry*, any bronze powder is dusted on. When dry and hard, the superfluous powder is removed, and the figure is varnished.

2. Iron is first cleaned, and then dipped into a strong solution of sulphate of copper.

3. Paper is bronzed by mixing the bronze powder with gum-water, applying it to the surface, and when dry burnishing it.

Bronzing Liquids for Electrotype Copper Medals.

1. Crocus, or plumbago and water, made into a paste. Clean the medal, apply the paste, and expose to the heat of a clear fire for a minute. When cool, polish with a brush.

2. A solution of liver of sulphur, or sulphuret of potassium.

3. Verdigris 2 oz., sal ammoniac 1 oz., vinegar 1 pint. Boil, dip the clean medal for an instant or two in the boiling mixture, wash it with hot water and dry.

Bronzing Tin Castings.

When clean, wash them with a mixture of one part each sulphate of iron and sulphate of copper, in 20 parts water; dry, and again wash with distilled vinegar 11 parts, verdigris 4 parts. When dry, polish with colcothar.

Browning for Gun Barrels.

1. Aquafortis and nitric ether, of each 1 oz., sulphate of copper 4 oz., tincture of sesquichloride of iron 2 oz., water 3 oz.; mix. Apply once or twice to the clean barrel, and when dry, polish with a brush, or varnish.

2. Sulphate of copper, nitric ether, each 1 oz., water 1 pint. Mix, and digest for a week.

3. Nitric ether 3 oz., gum benzoin 1½ oz., tincture of sesquichloride of iron ½ oz., sulphate of copper 2 drachms, rectified spirits ½ oz. Mix and add 1 quart water.

4. Nitric ether and tincture of sesquichloride of iron of each ½ oz., sulphate of copper 2 scruples, water 10 oz.

All the above may be varnished with shellac 1 oz., dragon's blood 2 drachms, rectified spirit 1 quart. Dissolve, filter and apply.

A Water-proof Glue.

Melt common glue in the smallest possible quantity of water, and add by drops linseed oil that has been rendered drying by having a small quantity of litharge boiled in it—the glue being briskly stirred when the oil is added.

Case-hardening Iron.

1. Iron heated to redness is sprinkled with ferroprussiate of potass, and, when the salt has fused, the metal is plunged into water.

2. The iron is enclosed in a box and surrounded with animal horns, hoofs, bones, or skins, first charred and powdered. Close the box lid, heat it strongly in a furnace and let it cool. On removing the iron, it is hardened on the surface, being superficially converted into steel. When goods are wanted *hard*, but not *brittle*, they are plunged while hot in oil.

Selected Articles.

PUBLIC AND PRIVATE DIETARIES.

Below are given some extracts from a paper read before the Society of Arts, on the subject of public and private dietaries, by Edward Smith, M. D., F. R. S., &c., being a continuance of the subject of the paper published in the February No. of the Journal. The paper as a whole is not applicable to the state of Canadian society, but still it contains much valuable information of importance to private families, and especially to managers of public institutions with which dietaries are connected. The funds for the support of these institutions are either supplied by legislative and municipal grants, or by the donations of benevolent individuals, and should be managed with the utmost economy consistent with the well being of their inmates :—

The amount of nourishment which a people obtains must exert a large influence over the national character. An ill-fed nation can scarcely be a healthy one, and certainly it will be deficient in bodily strength and enterprise, whilst a sufficiently fed people, having these characteristics in a high degree, will be able to acquire wealth, which may be regarded as the material foundation for the stability of an empire and for influence among nations. Here I regard the sufficiency of food acting upon the masses of a population as the cause, not the consequence, of national greatness, but in the diffusion of the blessings which flow from wealth it may be expected that the consequence may in its turn re-act as a cause.

We have the happiness to be citizens of a country which equals, if it does not excel, any nation of ancient or modern times in the health and longevity of its people, the distribution of bodily vigour and mental energy, and the advantages of wealth with its attendant intelligence, comfort, and influence; and I have reason to believe that to this may be added the fundamental cause—the general abundance of food among the people. Yet it does not follow that these conditions have attained to their highest development, any more than that from them could be inferred the state of any section of the community or of any individual in a section. There is still doubtless need for progress in reference to the masses which constitute the nation, as there are, and always will be, multitudes who, in their individual relation, add little to the national wealth, and need the aid of others to procure the means whereby their own existence may be prolonged.

In the paper which I have now the honour to read to you, I hope to include both those who are sufficiently and those who are insufficiently fed—those who add to the wealth of, and those who are a burden to, society; and to show how the means of the one may be increased, and how the burden of the other may be lessened.

The principles which will guide me are to show in what way the largest amount of nutriment can be gained by those who have money to spend in private dietaries, and upon how little cost those may be supported who are fed by public dietaries.

The communication which I made to this Society two months ago, may be regarded as an introduction to the present one, since it gave the means of ascertaining the relation of the nutriment contained in various foods to a given cost, and it remains now to group together the cheaper foods in such a manner as will maintain health and meet the tastes of the people.

It was shown that the only practicable method of dealing with foods in relation to their nutritive value in a given dietary, is to ascertain the carbon and nitrogen contained in them, and estimate the cost of these elements at the market-price of the food. In reference to carbon, the cheapest foods were stated to be maize (or Indian corn), barley meal, rye meal, butter milk, peas, fresh vegetables (under certain conditions), oatmeal, bones, wheaten flour, and rice. As to nitrogen, the cheapest foods were butter milk, skimmed milk, peas, skimmed-milk cheese, maize, barley and rye meal, oatmeal, liver, fresh herrings, wheaten flour, fresh vegetables when cheap, dried herrings and bones. Maize, barley and rye, butter milk, peas, fresh vegetables when cheap, oatmeal, wheaten flour, and bones appear in both lists, and are therefore the cheapest foods.

On the other hand the following foods are the dearest in reference to carbon:—Tea, beef, new milk cheese, butter, dried herrings, mutton, skimmed milk (when dear), pork, fresh herrings, and new milk, and in reference to nitrogen:—Tea, dried bacon, green bacon, pork, mutton, new milk (when dear), beef, and potatoes (when dear). Tea beef, mutton, pork, and new milk (when dear) appear in both lists.

The general result is to show that farinaceous foods and bones are the cheapest, whilst meats are the dearest: that milk and cheese occupy one or other list according to the cost of the different kinds, and that sugar and fats occupy a middle place.

When the hydrogen is calculated and reckoned as carbon the relative positions of some of the foods are slightly altered but the extent of the change may be seen on reference to the column which I added to the table which was printed in my paper on December 16, 1863.*

The author stated that from actual experiments made, it is ascertained that a man in middle age and in good health, and with a fair amount of bodily exertion, requires food furnishing a daily supply of 4,300 grains of carbon and 200 grains of nitrogen; and that a reduction of about $\frac{1}{10}$th may be allowed for women. The average daily dietary of the Lancashire operatives during the existing depression varied but little from this estimate, and abundant evidence is furnished that the health of this class of persons has not only been maintained but evidently improved. A few examples are selected out of a large number, from tables prepared by a commission of which Dr. Smith is a member, and issued by the Government showing how far experience sustains this position, and furnishing also a correct insight of the modes of living adopted by our unfortunate Lancashire brethren in their distress.

No. 1. Male.—Carbon, 4,787 grains; nitrogen, 132 grains daily; cost 1s. 11½d. weekly. Bread, 10lbs.; sugar, 1lb.; butter ½lb.; and coffee, 2oz.; so that he lived on bread and butter and coffee.

No. 2. Male.—Carbon, 4,528 grains; nitrogen, 165 grains daily; cost 2s. 2d. weekly. Bread, 8 lbs.; onions, 2lbs.; treacle, 1lb.; bacon, ½lb.; cheese, ½lb.; tea, ½oz. He ate bread and treacle, bread and bacon, bread and onions, bread and cheese, and tea without milk or sugar.

No. 3. Female.—Carbon, 3,801 grains; nitrogen, 164 grains daily; cost 1s. 9d. weekly, and out of 2s. allowed for food, saved 3d. weekly to redeem her clothes. Bread, 12lbs.; treacle ½lb.; bacon ½lb.; 3 herrings, and coffee, 1oz. She obtained bacon or herring five days per week, with much bread, and coffee sweetened with treacle, and was well nourished.

No. 4. Female.—Carbon, 3,011 grains: nitro-

* See Journal for February

gen, 109 grains daily; cost 1s. 11¾d. weekly. Bread, 8lbs.; sugar ½lb.; treacle 1½lb.; bacon 2 oz. tea, 1 oz.; and coffee, 1 oz. She lived on bread and treacle, tea and coffee, and bacon only on Sunday, and was ill nourished.

Case No. 5. Female.—Carbon, 3,777 grains; nitrogen, 165 grains daily; cost, 2s. 0¼d. weekly. Bread, 8lbs.; oatmeal, 1¼lb.; treacle 1lb.; bacon, ½lb.; meat ½lb.; skimmed milk, 2 pints; and coffee 1oz. She had meat or bacon daily, oatmeal porridge and treacle, or stirabout with treacle, bread and coffee sweetened with treacle. This was the best arrangement of food which I met with, and she was abundantly nourished.

Case No. 6. Female.—Carbon, 2,832 grains; nitrogen, 117 grains daily; cost, 1s. 10d. weekly. Bread, 8lbs.; sugar, ½lb.; treacle, 1lb.; bacon ½lb.; 1 herring; and tea, 2oz. This was an ill-arranged dietary, and she was ill-nourished.

* * * * * *

In drawing up model dietaries I have endeavoured to obviate the defects now mentioned, and to meet the requirements of the system:—

1. By providing sufficient nourishment.

2. By selecting well-known foods.

3. By giving such variety as would permit the meals to be varied, and to correspond with that of the community, and particularly, whilst not permitting a deficiency of nourishment, to introduce almost daily some kind of meat for dinner.

4. By introducing fresh vegetables at a cost of 2d. per week.

The following are selected from those which cost from less than 3½d. to less than 4½d. per day, at the prices in the North of England:—

No. 1. Carbon, 4,004 grains; nitrogen, 201 grains daily; cost, 1s. 11¾d. weekly: Bread, 9lbs.; oatmeal, 1lb.; meat, ½lb.; bacon, ½lb.; skimmed milk, 3½ pints; buttermilk 3 pints; and vegetables 4lbs. This would give milk porridge twice a day, with bread and vegetables daily and meat five times a week.

No. 2. Carbon, 4,122 grains; nitrogen, 207 grains daily; cost, 2s. weekly:—Bread, 8lb.; oatmeal, 1¼lb.; treacle, ½lb.; bacon, ½lb.; 3 herrings; skimmed milk, 7 pints; and vegetables 4lbs.—This would give animal food and vegetables daily, with milk-porridge and oatmeal, pudding, and bread and treacle.

No. 7. Carbon, 4,433 grains; nitrogen, 198 grains daily; cost, 2s. 4d. weekly:—Bread, 10lbs.; oatmeal, 1lb.; treacle, ½lb.; butter, ¼lb.; meat, ½lb.; bacon ½lb.; skimmed milk, 3½ pints; and vegetables 3½lbs. This gives no coffee, much bread, with butter or treacle, oatmeal pudding with treacle, milk porridge, and meat five days weekly, with vegetables daily.

No. 8. Carbon, 4,991; nitrogen, 221 grains daily; cost, 2s. 4½d. weekly. Bread, 10 lbs.; oatmeal, 2lbs.; treacle, ½lb.; meat, ½lb.; bacon. ½lb.; skimmed milk, 3½ pints; and vegetables, 4 lbs. This is an excessive dietary, and differs from the last only in supplying meat daily, and offering more oatmeal pudding.

No. 9. Carbon, 4,434 grains; nitrogen, 210 grains daily; cost, 2s. 4½d. weekly. Bread 8lbs.; oatmeal, 2lbs.; sugar, ¼lb.; treacle, 1lb.; skimmed milk, 3½ pints; buttermilk, 3 pints; coffee, 2oz.; bacon, 1lb.; and vegetables, 4lb. This would give bacon, vegetables, and bread daily, with oatmeal pudding and treacle, milk porridge and coffee.

Such are examples of how much nutriment may be obtained from food to which the people are accustomed, and offering three meals a day with the usual variety, and usually including 2oz. of some kind of meat, at a cost up to 4½d. per day. The articles selected are the cheapest farinaceous foods, American bacon, which is the cheapest fat, and skimmed milk, whilst sparing use has been made of butchers' meat, sugars, and the dearer fats.

Let us now look at the subject in another, and to my mind more satisfactory light, and ascertain how much nutriment can be afforded at a meal for sums not exceeding 1½d. for breakfast, 2d. for dinner, and 1d for tea, or supper, or a total cost not exceeding 4½ per day. For this purpose I will again turn to the dietaries which I have prepared for the Government, and in order to apportion the daily nutriment to the wants of the system, at the period of the three meals, I will state that the amount of carbon required is 1,500 grains at breakfast, 1,800 grains at dinner, and 1,000 grains at supper, whilst that of nitrogen required at those meals is 70 grains, 90 grains, and 40 grains, respectively.

Breakfast.

No. 1.—Oatmeal brose. Carbon, 1,397 grains; nitrogen, 74 grains; cost, 1d. Oatmeal, 6oz.; treacle, 1oz.; skimmed milk, ½ pint; water, ¼ pint.

No. 2.—Milk porridge and bacon. Carbon, 1,564 grains; nitrogen, 69 grains; cost 1½d. Skimmed milk, ½ pint; oatmeal 1½ oz.; water, ½ pint; bread, 4 oz.; bacon, 2 oz.

No. 5.—Rice, milk, and bread. Carbon, 1,551 grains; nitrogen, 75 grains; cost 1½d. Rice, 2 oz.; skimmed milk, 1 pint; treacle, 1 oz.; spice; fat, ½ oz.; bread, 4 oz.

No. 6.—Coffee, bread, and butter. Carbon, 1,190 grains; nitrogen, 56 grains; cost 1½d. Coffee and chickory, ⅛ oz.; skimmed milk, ½ pint; sugar, ½ oz.; water, ½ pint; bread, 6 oz.; butter, ½ oz.

No. 8.—Oatmeal brose, bread and bacon. Carbon, 1,990 grains; nitrogen 88 grains; cost, 1½d. Oatmeal, 5 oz.; treacle, 1 oz.; skimmed milk, ½ pint; water, ¼ pint; bread, 3 oz.; bacon, 1 oz.

No. 9.—Rice milk, bread, and bacon.—Carbon, 1,889 grains; nitrogen, 76 grains; cost, 1½d. Rice, 2oz.; Skimmed milk, ¾ pint, treacle, 1 oz.; water, ⅛ pint; bread, 4 oz.; bacon, 2 oz.

No. 10.—Tea, bread, and butter. Carbon, 1,081 grains; nitrogen, 46 grains; cost, 1½d. Tea, ⅛oz.; sugar, ½ oz.; skimmed milk, ¼ pint; water, ½ pint; bread, 6 oz.; butter, ½oz.

Nos. 8 and 9 show, in a striking manner, the amount of nutriment which can be obtained from the cheaper farinaceous foods, cheap milk and cheap fat, whilst the contrast between them and Nos. 6 and 10 show how wasteful is the expenditure upon the dietary when tea and coffee are introduced. With the two last mentioned exceptions the quantity of nitrogen is universally sufficient.

Dinner.

No. I.—Bread and cheese. Carbon 1,150 grains; nitrogen, 66 grains; cost 1½d. Bread, 8oz.; cheese 1 oz.

No. 2.—Suet pudding, bread, and cheese. Carbon, 1,496 grains; nitrogen, 74 grains; cost, 1½d. Flour, 4 oz.; Suet, ½ oz.; skimmed milk, ¼ pint; bread, 4 oz.; cheese, ½ oz.

No. 3.—Rice pudding, bread, and cheese. Carbon, 1,673 grains; nitrogen, 83 grains; cost 1¾d. Rice, 3 oz.; skimmed milk, 1 pint; suet ½ oz.; sugar, ¾ oz.; spice, and salt; bread, 3 oz.; cheese, ½ oz.

No. 4.—Fish. Carbon, 1,387 grains; nitrogen, 101 grains; cost, 1¾d. Fresh herrings, 9 oz. (2); dripping, ½ oz.; potatoes, 8 oz.; bread, 3 oz.

9.—Faggots, peas pudding, bread and cheese. Carbon, 1,513 grains; nitrogen, 140 grains; cost, 2d. Liver 3 oz.; bacon, 1 oz.; herbs and peas, 3 oz.; bread 2 oz.; cheese, ½ oz.

11.—Irish-stew and bread. Carbon, 1,568 grains; nitrogen, 72 grains; cost, 2d. Meat, 3 oz.; potatoes, 12 oz.; onions, 1 oz.; bread, 4 oz.

12.—Hasty pudding, herring, and potatoes. Carbon, 2,144; nitrogen, 119 grains; cost, 2d. Flour, 6 oz.; skimmed milk, ½ pint; water; treacle, 2 oz.; 1 herring; potatoes, ½ lb.

Two of these largely exceed the standard quantity in carbon, viz., Nos. 2 and 12; whilst four, viz., Nos. 2, 4, 9 and 12, exceed it in nitrogen. No. 1 is quite insufficient for a man, whilst No. 12 is much more than enough.

Supper.

1.—Oatmeal brose, as at breakfast.

2.—Milk porridge. Carbon, 1,034 grains; nitrogen, 61 grains; cost, 1d. Skimmed milk, ¾ pint; oatmeal, 2 oz.; bread, 2 oz.; fat, ⅛ oz.

3.—Bacon and bread. Carbon, 1,250; nitrogen 43 grains; cost, 1d. Bacon, 2 oz.; bread, 5½ oz.

4.—Tea, bread, and butter. Carbon, 670 grains; nitrogen, 29 grains; cost, 1d. Tea, ⅛ oz.; sugar, ½ oz.; skimmed milk, ⅛ pint; water, ⅝ pint; bread, 4 oz.; butter, ¼ oz.

5.—Coffee, bread, and butter. Carbon, 925 grains; nitrogen, 42 grains; cost 1d. Coffee, ⅛ oz.; sugar, ½ oz.; skimmed milk, ¼ pint; water, ⅝ pint; bread, 5½ oz.; butter, ¼ oz.

In each of the first three there is an excess of the standard requirement, whilst the fourth corroborates the fact already mentioned, of the impossibility of providing an economical dietary where tea and butter are introduced.

For those who cannot afford even so cheap a diet as the foregoing, Dr. Smith recommends Indian corn, meat, pease, bread, buttermilk and skimmed milk, as affording the largest amount of nourishment at the least possible cost.

In regard to the dietaries of charitable Institutions, the author affirms some general principles which ought to be adhered to in their management:

A.—There must be a proper apportionment of the food according to sex and age. This is a subject of much difficulty, since there are no scientific data which refer to each year of life; and the relative wants of a man and woman vary with the size and activity of their bodies, rather than simply with sex, so that even a scientific man can only make a near appreciation to the truth. At present the reduction in the dietary for a woman, from the normal dietary for men, varies from half to a quarter, and it is only until a boy reaches the age of sixteen that he is considered to need the dietary of the man, and in both, I think, the dietary allowed is much under the requirement. From a consideration of the products of nutrition which pass out of the body, I do not think that the average dietary for women ought to be less than nine-tenths of that for men, neither being employed at hard labour.

The importance of the apportionment to age is exceedingly great, for it is only during the period of youth that growth progresses, and for healthy and suitable growth there must be sufficient food, and hence if the latter be withheld the former is deficient, and from the finality of the period of growth the loss can never be regained. Hence it is of far greater consequence that there should be abundant food given to a youth than to an adult, since the former can never regain his loss, whilst the latter can tolerate with comparative impunity, much variation from his proper nourishment. I have entered at length into this subject in my work on "Health and Disease, as Influenced by the Cyclical Changes in the Human System," which may be found in our library, and I shall now only state that, in my opinion, above twelve years of age the dietary allowed ought to be that of a man; from the age of ten to the age of twelve, that of a woman; and that below ten years and above one year of age, there ought to be three scales of dietary embracing the ages from two to five, from five to eight, and from eight to ten, or, as it is far more natural, the dietary under the age of ten should be unlimited in quantity.

B.—The food supplied should be, in nature and variety, similar to that which they will obtain in later life. While it is a fact of the highest interest that the body can adapt itself to a great variety of circumstances to which it had not been accustomed there can be no doubt that the changes are attended by risks, and that there are those who suffer from or sink under them, and in a wide point of view are not desireable. Hence, I would train up the body of the child as it shall be nourished when it becomes a man. I need not particularise the foods with which all are familiar, but precise information on this point will soon be supplied. As to variety of food, there can be no doubt that, within limits, it tends to improve the relish for and assimilation of food, and hence to increase nutrition, whilst beyond those limits, as we see amongst the well-fed classes, it lessens the appetite and the quantity of food that is eaten. Our ordinary habits do not seek for much variety at the first and last meals of the day, whilst one unvarying food at dinner would soon become unacceptable. Yet even in that there is less diversity than at first sight appears, since all the food may be wound up under the terms, meat, potatoes, pudding; and the only variation is the kind of meat, and the components of the puddings, and the mode of cooking them. The dinner, then, should be varied, so that the same kind of meat shall not be always supplied and that some change of food, or mode of cooking shall occur daily.

C.—The last observation may be regarded as trite and unnecessary, since it is admitted in most dietaries to a limited extent, but the next one, viz., that with variety in food there shall be uniformity in nourishment, is much disregarded. Thus, to select one from many dietaries which have been sent to me for my opinion on their fitness. On four days a week children from the age of five to the age of nine, have for dinner 3½ oz. of cooked meat and 8 oz. of potatoes, which contain between 1,200 and 1,300 grains of carbon, and nearly 70 grains of nitrogen, whilst on two days 10 oz. of suet pudding is alone allowed, containing about the same quantity of carbon, but only two-thirds of the quantity of nitrogen; but as the digestibility of the two diets must be very different, the defect of the latter is doubtless much greater than the chemical constituents indicate. On one day in the week there is rice pudding, and if we add ½ pint of milk to each 1 lb. which is no doubt beyond the mark, it will yield less than 800 grains of carbon and 27 grains of nitrogen, or a defect of more than one third of carbon and nearly two-thirds of nitrogen. I may also make use of the same dietary to show another defect in the selection of food in poor-law dietaries: 16 oz. of rice, potatoes, or other vegetables, are allowed indifferently at dinner, the amount of carbon in the rice being nearly four times as great as that in other vegetables, whilst the proportion of nitrogen in potatoes and vegetables is only one-third and one-fifth of that in rice. Thus, whilst the alteration of foods is necessary it is manifest that by the present system even good guessing at truth is not effected, and that such recondite questions as the nutritive value of foods can only be answered by scientific authority.

D. True economy consists in keeping the poor in health and strength at the least cost, and not simply in finding the cheapest dietary upon which they may live. Hence, 1st, a selection from the foods to which they are accustomed, of such as will yield the greatest nutriment at the least cost; 2nd the cooking of them so as to obtain the whole of the nutriment from them; 3rd, by supply of proper kinds of foods with sufficient variety of flavour; by well ventilated rooms and by exercise in the open air to keep up the relish for foods, for under such circumstances the food is better assimilated by the system (that is to say, less of it is wasted), and the cheaper and less savoury foods are with equal chemical value equally nutritive with others of a more costly kind.

E.—Of separate foods, I will refer to two or three. For all persons below adult age, skimmed milk or butter milk, oatmeal and bread should be given twice a day. The mid-day meal should always consist of meat and vegetables. The meat may be prepared as soup thrice a week with advantage, and to it should be added well-digested bones, pearl barley, and other vegetables, according to some of the numerous formulæ published by the Government, and of which the following three have been specially arranged by me:—

SOUPS.

OX-HEAD SOUP	PEA SOUP.	PEA SOUP.
Cost per ration ·92d.	Cost per ration 1·28d.	Cost per ration 1.16d.
Carbon ......1,117 grs.	Carbon ......1,201 grs.	Carbon...... 1,099 grs.
Nitrogen ... 49 "	Nitrogen ... 58 "	Nitrogen ... 61 "
QUANTITY PER RATION.		
Meat off ox heads 2oz.	Meat off necks of beef ....1½oz.	Meat off leg of beef .... 2 oz.
Bones do. 2⅓	" pigs' heads 1	Bones do. 4
Pearl barley...... 2	Bones of beef...1	Barley 1
Rice 1	Barley 2	Split peas 1
Oatmeal 1	Split peas 1	Onions 1
Water to make 1¼	Peameal .... ½	Carrots(crushed) 2
Pepper, salt, and herbs.	Onions 1	Oatmeal 1
	Carrots 1	Water to make 1¼pts
	Turnips 1	Pepper, salt, and various herbs.
	Water to make 1¼	
	Pepper, salt, and herbs.	

It is desirable that dried herbs be used, and these, with the other vegetables varied on each occasion. This with bread alone, or, better still, with some kind of pudding, would suffice for the dinner on the soup days.

The use of tea and coffee should be restricted to the aged and the sick, or to special occasions.

In reference to fresh vegetables, when they are bought, it should be observed that, as they are dearer than bread, their use should be limited, but when they are grown by the labour of the paupers they promote healthful exercise, and supply food at a nominal cost. It is important to bear in mind that the necessity for any given quantity of fresh vegetables is relative only, whilst they may be eaten with equal advantage in large or small quantities, provided there be a corresponding supply of other fresh food.

On dietary of prisons Dr. Smith says:—

In prison discipline there are but two circumstances affecting the dietary which render it different from that of workhouses, for in both alike it is a duty to sufficiently feed the inmates, and to do this with the greatest economy. These are simple confinement with its implied restriction of fresh air, and exertion, and mental activity, and the influence of the labour exacted under hard labour sentences; and where these two influences have been estimated in a scientific manner there can be no difficulty in establishing a system of dietary which may meet the wants of the prisoners, and be everywhere uniform or equivalent.

Now what is our knowledge upon these two subjects. As to the effect of seclusion, we know theoretically that it would lessen the activity of all the vital functions, and thereby in itself be attended by less waste of the tissues of the body, and so far less food would be needed (as each of us would find if we kept in our room for a week) but practically it has been found that the weight of the body is lessened in confinement, a fact resulting either from the deficient supply of food which was obtained, or from a diminished use made of that food, and hence, without proving either alternative, it was concluded that more food was required in a state of seclusion than would have been necessary in the ordinary circumstances of life. Upon this was based a scheme of dietary which was accepted by Government, in which the quantity of nutriment varied with the duration of imprisonment, in the following remarkable manner:

Imprisonment.	Weekly. Carbon.	Weekly. Nitrogen.
Class 1, 1 to 7 days,	19,860 grs.	889 grs.
" 2, 7 days to 21 days,	26,748 "	1,211 "
" 3, 21 days to 4 months,	29,588 "	1,323 "
" 4, 4 months and above,	33,782 "	1,566 "

As the compilers of this scheme were instructed that the dietary was not to be an instrument of punishment, it follows, that, in their opinion, mere duration of seclusion excited such an influence as to demand nearly double the amount of food at one period which was required at another, and that meat was required only in the conditions of the 3rd and 4th classes. It is usual to say that according to this scheme, the amount of food must be increased as the duration of imprisonment increased —or, in other words, that the effect of seclusion is a necessity for increased food, but in truth, if there be any logical sequence in the scheme, it is the contrary, for it begins with an amount of food which we have shown to be only about half of that which is required by the system, and it is only when the seclusion has continued 4 months that it is thought necessary to supply as much food as the system really requires. The truth is, that in ascertaining the cause of loss of weight by seclusion, there were two valid agencies, only one of which was considered, and absurd as it may seem, it was not seen that giving a man only half the food which he required would lead to loss of weight of body, apart from any other agency whatever.

But the recent experiments made by Mr. Milner and myself for the British Association, by which not only the change in weight, but the quantity of nutritive and effete matters entering and leaving the body was ascertained in a scientific manner, it was proved that seclusion with inactivity does lessen the vital activity of the body, and causes a larger portion of the food to leave the body unused than occurs under ordinary circumstances, and hence that the ordinary diet out of prison would not suffice for the same person in prison without labour. The remedy for this is simple, and I shall again refer to it.

Then as to the relation of food to prison punishments. It may be known to you that these punishments are usually oakum-picking, turning a crank, or working a hand-wheel, and to these are added in some prisons the exercise of the shot drill, or various kinds of handicraft. There is the greatest diversity in the labour exacted by these methods, as I shall subsequently prove, but in addition to this, there is the greatest diversity as to the selection of them and the rotation of their use in different prisons. Thus, as I placed upon record more than five years ago, we find that in our county prisons some find no labour at all, others only that of ordinary trades, others have crank labour alone, others treadwheel labour alone, whilst in many, one of the two, or both of the two latter forms of hard labour are conjoined with some kind of trade. In many the treadwheel and crank are unprofitably employed, whilst in many others they are used as mills or pumps. In some, women even work the crank and the treadwheel.

In some the treadwheel and crank are exceptional employments; in others they are universally used, but for a small part of the sentence; whilst in a third class they are the constant employments during the whole term of imprisonment. In most gaols they are chiefly employed for short sentences, and therefore for small crimes, and with insufficient food, whilst the light occupations are reserved for long sentences, with greater crimes, or frequent repetition, and excessive food. In some they are worked for an hour without intermission; in others thirty, twenty, fifteen, ten, and down to four minutes only. In some they are enforced for three hours daily, and simply as exercise; whilst in others the labour endures ten hours. In many, boys of fourteen years of age work the wheel and the crank; whilst in others able grown men make shoes or pick oakum only.

In some the ordinary rate of the ascent on the treadwheel is fifty-six steps per minute, whilst in others it is so low as thirty. In some the ordinary pressure on the crank is seven pounds; at others, twelve pounds; the pressure being certain, and demonstrated by weights in one, and uncertain, depending upon the turn of a screw, in another. In some the ordinary number of revolutions per day is 14,400; whilst in others, in which the crank is still the chief instrument of punishment, it varies from 13,500 to 6,000 or 7,000, at the discretion of the surgeon, the prisoner being still without disease. In some the day's work may be performed in any part of the twenty-four hours with the index in sight of the prisoner; whilst in others it must be performed before the night, and with the index outside the cell, and so that the prisoner is unable to ascertain, from time to time, how much labour he has yet to perform. In some, pumping is employed for an honr only, and even during that short period, as at Reading, there is no method of determining if any individual prisoner is labouring or not; whilst in others the labour is for the whole day pumping water into the sewers.

Oakum-picking is no labour in one prison, and hard labour in another; and in the latter it is two pounds for a day's work at Wandsworth and Westminster, and three pounds at the Coldbath Fields, whilst it is five pounds at a workhouse. In some the prisoner by good conduct obtains a lighter labour, a commendatory badge, and a pecuniary reward; in others it is treadwheel from the first to the last; whilst in many, as at Wandsworth, the change of labour is due neither to crime, sentence, nor conduct, but to the number of prisoners.

With such diversity in the conditions upon which the dietary must depend, the Government Commissioners did not attempt to determine the true influence of each agent, neither did they insist upon a uniform plan of punishment being adopted before they prepared a scheme of dietary to meet it, but simply by ascertaining the effects of given dietaries upon the weight of prisoners condemned to hard labour (no matter what and how varied that labour was) they framed a scheme which should not only meet the requirements of the labour exacted (itself unknown) but be equal to the effect of simple seclusion without labour—that also unknown. The result of such extraordinary guessing was, as might be expected, most anomalous. Thus, during an imprisonment of 7 days, no difference of food was supposed to be required, whether the prisoner performed the most severe labour with which we are acquainted—treadwheel labour— or was entirely at rest. Under 21 days, (treadwheel and other hard labour being exacted) he obtained as an equivalent for each 7 day's labour over the requirements of rest, only 1 pint of soup (containing 3 oz. of cooked meat, 3 oz. of potatoes, 1 oz, of barley-rice or oatmeal, and 1 oz. of onions, or leeks) affording about 1,100 grains of carbon, and 55 grains of nitrogen, or enough to meet the requirements of continued treadwheel labour for about 1½ hour only. For longer terms hard labour for 21 days was considered equal to no labour for 4 months, and to need the diet, class 3, which is below that of the unemployed Lancashire operatives, and for 4 months to be equal to no labour for an indefinite period, and to require the dietary of Class 4, containing enough food to supply the wants of the system on the ordinary conditions of out-of-door life. When the term of hard labour exceeded 4 months, it obtained a dietary of its own, in which 4 oz. of cooked meat was given four times, and 3 oz. thrice a week with bread, vegetables, gruel, and cocoa, containing 36,603 grains of carbon, and 1,610 grains of nitrogen; a dietary more expensive and luxurious than the others, but not greatly exceeding No. 4 in nutritive value.

The utter insufficiency of the allowance made for hard labour may be more strikingly seen when I quote the effect of these punishments as experimentally proved by myself side by side with the requirements of the system of the unemployed labourers.

Thus, the Lancashire operatives, when unemployed, required 30,100 grains of carbon weekly. Average crank labour requires 45,000 grains, and treadwheel labour requires 60,000 grains; but the amount allowed to the prisoners at hard labour is 19,860 grains, 26,748 grains, 29,581 grains, 33,782 grains, and 36,603 grains, quantities differing among themselves to the amount of nearly double of the least quantity, and below the maximum required quantity from one-third to three-fifths.

Surely no further proof can be required to show that no uniform dietary could be possible under so many varying and controlling conditions, and that in providing this scheme the information on which it was based was most defective, and that guessing, in a great degree, took the place of scientific deduction. Hence, in the absence of evident and sound guiding principles, it is not to be wondered at that the scheme was not accepted readily by the visiting justices of prisons, and even now from one-third to one-half of these prisons reject it, and adopt schemes which themselves are even less based on principle, and which exhibit the most astounding diversity.*

Considering the national importance of this subject, Dr. Smith considers that the following amongst other questions now demand solution:—

A.—shall the principle be adopted which was finally laid down by Sir James Graham, that the dietary shall meet the requirements of the prisoner under the different conditions of prison discipline, and thus maintain his health and strength, or shall it be made an instrument of punishment, and for any period be insufficient for the wants of the system? Without this, no step can be taken in the inquiry, and it must be for the legislature to decide the question. It must, however, be borne in mind, that if it be decided to give insufficient food, you take the subject out of the hands of science, and must let justice fix the amount of deficiency, for although it is evident that deficient food must lead to injury of health, as its action is slow and the different degrees of health are not marked by clear lines, it is impossible to estimate accurately the injury inflicted. It is a dangerous mode of punishment, and particularly when it is often repeated.

B.—The system to be pursued in goal discipline must be fixed so that a sentence shall always and everywhere carry with it an absence of labour or a definite kind and amount of labour. Hence it must be determined whether labour shall be a part of all goal discipline or not, and certain kinds of labour must be selected and prescribed, and thus the sentences may be without labour, with medium labour, and with hard labour. In my evidence before referred to (Question 842), I affirmed the principle that labour should be a constituent part of every sentence, on the ground which at first sight may appear paradoxical, that, within limits, it would allow the food supplied to be less costly, for without labour it has been shown that food is wasted, and either the system must be ill-nourished, or the higher kinds and more costly food, as meat, must be given so as to supply an increase of vital stimulant in the form of nitrogen. In some cases, therefore, it may be shown that the exertion supplies its own food, and as this is a most important principle, I will quote the answer which I gave to Question 827, "Would you explain to the committee a little on what principle you would act in that case?" "It would seem that the right course of proceeding would be this, to determine the amount of food which is necessary to maintain a person in fair health in the open air, and to endeavour so to arrange that it shall also maintain the prisoner in health in a state of confinement. The difference of the two conditions is mainly, or perhaps entirely, this, that in confinement you have less vital action in the body, less digestion of food, and less assimilation or conversion of food into the tissues of the body. The aim, therefore, should be so to arrange the prison discipline that there shall be such an increase of this assimilation over the present amount, with inaction, as shall enable the cheap food, which is sufficient for the support of an agricultural labourer, to keep the prisoner in health. If that be not done, it will be necessary, as we do at present, to give more nitrogen. With the deficient assimilation existing in confinement, you must increase the vital action of the body; but if you adopt the other course, that of giving exercise of fresh air, such as a labourer would have, you do not need to give a proportionate increase of nitrogen; you therefore assimilate the conditions of the prisoner much more to those of an ordinary labourer, either in quantity or in quality. I also give my assent to the proposition

* I cannot on this occasion enter further into this question, but would refer to my papers published in the *Philanthropist* for 1856, and to the evidence given before the House of Lords, in 1863.

contained in question 836, viz., "Whenever you have a deficiency of labour you might make either the labour or the open-air exercise, whichever it may be, more or less a substitute for the amount of nitrogen which otherwise would be supplied in meat."

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I have only one further remark to make, and that will have reference to the unfair position in which medical men are now placed in reference to this and other subjects. It is expected not only that medical practitioners shall be well fitted for the practice of their profession, but that they shall also be authorities upon the various recondite questions which are only accessory or incidental to their practical knowledge. Hence upon questions of lunacy, public health, poisoning, and dietary, it is expected that any medical man who may be in any way connected with the case under investigation should give opinions quite in accordance with the most advanced knowledge of the day. This is not required in other occupations in life. A graduate in arts must be acquainted with mathematics, but is it expected that every graduate should be able to fill a professorial chair, or to resolve the most abstruse problems of the science? Is a lawyer expected to be familiar with each department of the law, or an artist equally capable of excellence in every walk of art? Why, then, is it not well recognized, that the essential duty of a medical practitioner is capability for the treatment of disease, and that questions on collateral subjects should be regarded as special ones, to be solved, not by the busy practitioner, but by those specially given to such investigations. It is unreasonable to require a workhouse or goal surgeon to give a scientific opinion upon, and to frame dietaries for those under his care if the aim is to pass beyond the region of ordinary observation and to establish something recondite, as for example a dietary which shall sufficiently nourish the body at the least cost.

In the discussion which followed the reading of this paper, Dr. Smith was highly complimented on the able and scientific manner in which he had treated the subject.

Dr Lankester believed the losses arising from the improper use of diet would be more than enough to feed the whole population. He was not in favor of insufficient feeding of prisoners, but did not believe they were overfed, or that any of them would remain in durance for the sake of the food they got in prison. He did not hesitate to say that in many cases the system of diet and discipline was advantageous—men who went in as emaciated and enfeebled drunkards, often came out as strong men. He almost wished there were prisons for *respectable people* who could not restrain themselves within proper limits, both in eating and drinking. Six months in Clerkenwell or Pentonville would put them on their legs again, and enable them to go on prospering for years without incurring any doctors' bills.

THE THEORY OF THE ORIGIN OF PETROLEUM. *

It is probable that all instances of solid bitumen found on or beneath the surface of the earth have resulted from the hardening of drops or reservoirs of liquid coal oil. The lumps and crystals of graphite found in the oldest rocks, like the lumps of amber found in the newest, were doubtless oily substances involved by sand and mud. Flakes of anthracite are found in the centre of rock crystal. Gelatinous animals and mucous plants abounded in those ancient seas, and ought to have provided, by their death, plenty of animal and vegetable hydrocarbon for the mineral. The old red sandstones, like more modern formations, present us, for our cabinets, innumerable flattened fish, converted into bitumen; some in so perfect a state that every scale can be counted, and every sculptured line upon them submitted separately to the microscope; others an undistinguishable mass or daub of tar. Some rocks have been so thoroughly charged with animal dead matter that they emit a fetid odor whenever struck, and are technically known as stinkstones. The bituminous limestones and shales of many different geological ages are so many reservoirs of animal and vegetable oil, produced by the death and decomposition of successive floral and faunal creations, perhaps principally coralline. The fossiliferous black shales of the central belt of the State of New York underlie Lake Erie, cross Ohio and Kentucky into Tennessee, and return through Indiana and from the beds of Lake Michigan and Huron. In middle Kentucky, the faces of the rocks are smeared and streaked with oil, fried out of them by the sun, so that the surfaces are blackened as if with tar.

Up to the horizon of these black slates, ascending in the columns of deposits, gelatinous sea organisms, both animal and vegetable, seem to have constituted the principal, if not the sole, apparatus for generating Petroleum, But Dawson has lately discovered in the sandstones over them a true angiospermous exogenous tree, not much, if any, lower in the scale of development than those of which our forests are composed. Corniferous trees began also to abound, and coal beds to be deposited in groups. Thence the higher we ascend towards and through the second and the third or great coal measures, the more abundant became the vestiges of fresh water and land vegetation, until, in the tree stumps of the coal beds of Nova Scotia, we find small land animals. The mosses and ferns, the rushes and reeds, minute and gigantic, of which the coal beds came, suggest the vegetable origin of coal oil. For it is near or between the three systems of coal measures which succeed each other in ascending from the top of the upper Silurian to the coal measures proper that the amazing discoveries of subterranean reservoirs of oil had taken place. It is impossible to suppress the suspicion that Petroleum is a product of the slow decomposition of vegetable tissue.

But the oil wells are not sunk in coal measures, but through them at the edge of the great coal area. The oil is never found in coal beds; nor have the subterranean reservoirs of oil apparently any connection with coal beds, nor even with coal slates,

* From Report of U. S. Commissioner of Agriculture.

or bituminous shales or pyroschists, as they are called. Black slate, cannel, fat coal, like lignite, peat and living wood, will yield the oils and gases by distillation, but the geological distinction must be carefully preserved between the free Petroleum of the rocks and wells and the distilled Petroleum of the old oil works.

The connection of the oil regions with the coal basins of western Pennsylvania and Virginia, and eastern Ohio and Kentucky, is, in good measure, a geographical deception. (In the report of a geological reconnoissance of Indiana, 1859, 1860, under D. D. Owen, State geologist, and published in 1862, Profesosr Lesquereux expressed the opinion that the mineral oil of the borders of the coal field comes from the lowest great bed of the coal measures, I. B., page 285. The opinion ofsuch an authority is to be carefully considered.) The Oil creek rocks, dipping southward, pass 500 or 600 feet below the coal measures. The nearest coal bed to the more northern springs occurs on the highest hill tops, many miles away. The hills in the vicinity of some of the wells are capped by the conglomerate base of the coal measures at least a hundred feet thick. The shales and sandstones of the valley belong to formations X, IX, and VIII descending, called by the New York geologist the Catskill, Chemung, and Portage groups, extending over all the southern counties of western New York. The southern dip carries down these oil bearing rocks, and the wells must deepen in the same direction. Mr. Ridgeway reports (July 10, 1862) the lowest oil-bearing sand rock, capping the hills near Waterford, on Le Bœuff creek, and the same sandstones appear on Big French creek, tull of plant remains.

The following wells show the dip in a well-marked manner: The Phillipps well on Oil creek, is 460 feet deep; the Brawley well, at the mouth of Cherry run, 503 feet; the Cornwall well, 530 feet; the Avery well, over 700 feet; and at Titusville he estimates the proper depth at 1000 or 1,200 feet.

In the Mahoning coal oil region in western Pennsylvania and eastern Ohio, near the line, the three oil-bearing sand rock strata are beneath the lowest coal bed. The "Continental" boring at Edenburg, in Lawrence county, penetrated, in descending order, the following formations before it struck the oil: First, the superficial drift, 80 feet thick. Second, sandstones and shales, 200 feet thick, the bottom layers of which consisted of fetid black shales, from which coal gas blew off with violence. Third, the first white sandstone, 50 feet thick, arranged in three strata, a softer middle between harder upper and lower formations; the whole mass said to be thin, going east, and holding abundance of gas in its crevices. Fourth, shales and slates, 45 feet thick, charged with oil and gas. Fifth, the second white sandstone, 75 feet thick—softer, coarser, and tougher, or more difficult to bore through than the first, and full of gas; after passing through which they struck the great oil stratum, 448 feet from the surface. Crawford's boring, not far off, went down 580 feet, through another shaley formation, and struck oil, supposed to come up through a crevice from the third white sand rock.

That there is an intimate connection between the character of these sand formations and the character of the oil which issues from them is indubitable. The rule among the miners is, as stated by Mr. Clark in the "Proceedings of American Philosophical Society," (June, 1862. p. 57,) that the harder the rock may be to drill, the lighter in color, purer in quality, and smaller in quantity, will be the oil obtained therefrom; and the softer the rock, the darker and more abundant the oil.

The chemist of the Canada survey, Mr. Hunt, insists strenuously "upon the distinction between lignitic and bituminous rocks, inasmuch as some have been disposed," he says, "to regard the former as the source of the bitumen found in nature, which they conceive to have orginated from a slow distillation. The result of a careful examination of a question has, however, led us to the conclusion that the formation of the one excludes more or less completely that of the other, and that bitumen has been generated under conditions different from those which have transformed organic matters into coal and lignite; and probably, in deep water deposits, from which atmospheric oxygen was excluded."

Mr. Hunt instances in support of this view, the fact that the highly inflammable pyroschists or black slates of the Utica and Hamilton groups contain no soluble bitumen, and that the Trenton and Corniferous limestones at the base of the Silurian system are impregnated with Petroleum, and give rise to Petroleum springs, although no fossil land plant has been found in them. The fact that a considerable portion of the tissues of the lower marine animals is destitute of nitrogen, and very similar in chemical composition to the woody fibre of plants, forms another link in the chain of reasoning on this distinction between bituminous and lignitic rocks, The black slates, and even the coal beds are, in fact, layers of mud, charged slightly or to excess with lignitic matter, peat, or humus, part of which has assumed the form of glance coal and part the form of mineral charcoal, but almost none of which is soluble in benzole or sulphuret of carbon; whereas these liquids easily dissolve out the ready-formed bitumen from the rocks which may contain them. But whenever a coal bed became a repository of dead fish, like the eight-foot coal at the mouth of Yellow creek, at the bend of the Ohio, or as in the case of the two foot stratum of phosphatic iron-ore deposited between the two benches of the Deep river coal bed, at Egypt, in North Carolina—how different an aspect the mineral then wears, glossy with soluble bitumen!

Mr. Hunt argues with much force that the mere fact that intermediate strata, porous enough to absorb all the floating bitumen in their vicinity, are nevertheless destitute of any, is enough to prove that the accumulations of oil now furnishing the world with light, never came from the sub-volcanic distillations of the beds of coal in their neighborhood, but that the mineral has been generated by the transformation of organic matter in the strata where it is. Mr. Wall has shown that the asphalt of Trinidad and Venezuela (belonging, however, to a much later—upper miocene or lower pliocene—tertiary age) occurs in limestones, sandstones, and shales, associated with beds of lignite or fossil wood, and is confined to particular strata which were originally shales containg vegetable remains which have undergone "a special mineralization, producing a bituminous matter instead of coal or lignite, and not attributable to heat, nor of the nature of a distillation, but due to chemical reaction at the ordinary temperature and under the normal conditions of climate." He describes, also, wood partially converted into bitumen, when removed by solution, woody fibre remains.

The theory of the genesis of coal oil is, however, far from being cleared up by such facts. It is true that the oil is not found in immediate contact with coal beds made of land or fresh-water plants; but on the other hand, coal oil regions are geographically connected with coal bed regions, whether of devonian, carboniferous, oolitic, or tertiary age. Coal beds are said to underlie the Rangoon oil wells. Tertiary lignites abound in Trinidad, Venezuela. Lombardy, and middle Asia. The lower devonian horizon of the Canada black slate oil region yields coal beds in Pennsylvania. The structural difficulties attending the solution of the problem remain.

Fissures are filled with oil, and gas, and salt water, and different wells strike them at different depths, The oil-bearing sand rocks seem charged from top to bottom with gas and blow off from every fissure as it is passed through by the auger. Whence comes this gas, if not by subterranean distillation? It is impossible to postulate the gas first and oil afterwards; for that order would require the generation of pressure sufficient afterwards, and the oil would be in the condition of a mechanically explosive fluid. The gas must be a subsequent expansion of the oil, as it is in the case of coal-mine fire-damp. Whence, then, comes the oil, and why has it collected in reservoirs? How are such reservoirs preserved, and what is their extent? It is easy, after these questions have been answered, to describe the mechanical propulsion of the oil to the surface, partly by gravity and partly by the pressure of the gas it has itself generated, through natural fissures producing natural oil springs, or through artificial auger holes. The intermittent action of most of the flowing and spouting wells is like that of the Iceland geysers, where steam is the motive mower. The oil men of the Mahoning valley say that more gas is blown off in winter than in summer.

At the Edenburg well, above referred to, the blast of gas is sometimes violent enough to stop the pumping engine for half an hour at time. Mr. Clark reports a periodicity or daily maximum in the paroxysms. He noticed for several weeks that they recurred with singular regularity a few minutes after eight o'cluck in the evening, when the engine was forced to stop for twenty minutes or half an hour.

In the almost unchanged horizontal posture of the western coal measures no considerable fracturing or fissuring took place. Faults of all kinds are uncommon and very small when they exist at all. The rise of stratification from the Alleghany river towards Lake Erie is a fraction of one degree. The original contents of the rocks have therefore been preserved. Not so with the anthracite basins on the south-eastern side of the great coal area. Crushed and upturned and overturned, contorted and fractured in every part, this part of the earth's crust has been dried and hardened, and exposed to chemical action from the superincumbent drainage waters, until its various formations (the coal beds included in the number) have been metamorphosed and partially re-crystallized. The oils which they contained have been lost by dissolution and evaporation. The bituminous coals have become anthracites, and the last oil spring on the headwaters of the Lehigh, the Schuylkill, the Juniaia, the Potomac, or the New river ceased to flow many millions of years ago. In the West, on the contrary, in equally ancient, nay, in identically the same rocks, the Petroleum still remains, having had no outlet; always hermetically sealed and under pressure. It remains partly condensed in coal beds and black shales, partly distributed through the sand rocks and limestones, and partly filling up the joints which the shrinking of ages has produced. Possibly a small portion of it may be held in caverns through the more soluble limestone strata. Especially important are the water bearing horizons.

The vertical cleavage planes and few down-throw fissures which exist play but a subordinate role to these. Rain waters percolate from every hill surface and valley bed, sidewise and downwards, leeching every permeable stratum that will give up its salt and oily contents. Along the outcrops of every coal bed issue innumerable springs of painted water. At the base of every great sandrock, and on the top of the clayey deposits next below it, collect the mixed proceeds of the drainage in a standing sheet of oily brine. Capillary attraction and hydrostatic pressure perpetually re-enforce the reservoir. The weight of rock on top and the pressure of disengaged oil-gas sends its filaments forward and upward by every secret crack to the surface again, holding it in every part ready for an explosive rush into the air when an artificial outlet is provided. If there be no fissure in the locality, the oil wells descend to the sheet of water at about the same depth. Where fissures intercept them they are of various depths and fortune, for a well may pass a fissure where its walls are polished and tight together. A well may also pass the water sheet where some change in the porosity of the rocks above and below has taken place to oppose a like obstruction. In some parts of the western coal field, the dip is as high as five degrees, and the basins from five to ten miles wide. Sharp flexures make local dips of thirty degrees or more, and a central sub-anticlinal is sure to subdivide the basin. In the secondary basins thus formed, the wells are more perfectly artesian as to the salt water; but it is upon the subdividing anticlinals that the gas and oil collect. In such regions it is asserted that all the blowing and many of the spouting wells are ranged along the summits of such anticlinals. In the case of some of the old gas-blowing salt wells, their actions demonstrate that they have been bored past one gas-bearing stratum to another deeper salt water stratum; for when the water is allowed to rise in the auger hole, by stopping the pumps awhile, then the gas and oil no longer come up, the brine stopping their issue. In the case of neighboring wells of different depths striking a slanting fissure, the one which strikes it highest up will deliver gas; another, striking it lower down, will deliver oil; a third, striking it still lower down, will deliver nothing but salt water.

The compressibility of coal oil gas is one of its most dangerous qualities, increasing indefinitely the dangers of those explosions which annually cost so many valuable lives. Confined in the walls of the gangways and rooms, it issues from innumerable cells or pockets, the larger of which are called "blowers;" sometimes with the noise of heavy rain; sometimes with small reports. It collects among the timbers of the roof, in the upper galleries of the mine, in deserted portions of the colliery, and especially in those accumulations of refuse coal and slate, called "gob," or "goaf," with which the miners pillar up the superincumbent rocks. These acres of worked-out and filled-up galleries become vast reservoirs of fire-damp. The gas collects especially over the anticlinal rolls. From these great powder magazines, solicited by the least diminution of barometric pressure in the atmosphere, the gas rushes out to fill the working rooms. Long experience has shown that a falling barometer and explosions in coal mines always go together. But the mischief is accumulative. The vacuum produced by the first explosion is a new provocation to the world of back gas to leave its hiding places, come forward afresh, and produce another, and again another, until the proportion of air to gas becomes too small to make an explose mixture; so that, like the stroke of lightning, the coal mine explosion is not a unit, but a series, cause and effect reciprocally acting to produce the last result.

Among the most curious exhibitions of superior lightness of Petroleum to other minerals with which it is found, and of the nice train of reasoning dependent thereon, is the observation of Mr. Vanuxem that the film of black bitumen found in the cavities of the calciferous sand rock of New York, with crystals of bitter spar and quartz, occur on the upper side of the crystals, on the mother liquor of which they once floated as pellicles of oil; and, as the crystal hardened and grew, it moulded the oxydated oil to a sheet of bitumen, brittle, very pulverulent, of a shiny black, yielding little ash, and 11½ per cent. of principally water. The same mamillary surface, arguing original fluidity, characterizes the specimens obtained by the Canadian mineralogist from the Quebec group filling cavities in its limestones, sandstones, and even in the accompanying trap dykes; readily crumbling to a black powder, and, when highly heated, giving off an abundance of strong-smelling, inflammable gas, condensing to a tarry oil, and leaving 80 per cent. of a black residue, which, when heated slowly, burns away, leaving only a trace of ash. The same kind of mineral found at the Acton copper mine is harder, less friable, and more like anthracite. The Petroleum which fills cavities in the Montmorencie rocks is still unhardened. It flows in drops from a fossil coral of the Birdseye limestone there; and at Pakenham's it fills the cast moulds of large orthoceratites in the Trenton limestone to such an extent that a pint has been poured out of one. It is, perhaps, from these lower silurian fossil coralline limestones that the oil makes its way to the surface through the overlaying Loraine shales to form the Guilderland oil spring near Albany, according to Beck, through the Utica slate on the Great Mountain island, and through the red Medina shales at Albion mills, near Hamilton, according to Mr. Murray.

The next great limestone in the ascending series is the Niagara, and Eaton early made known the oozing of Petroleum from its fossil caste. Hall describes it in Monroe county as a granular crystalline dolomite, including small laminæ of bitumen, which gave it a resinous lustre. Bitumen, sometimes flow like tar from the lime kiln. The corniferous limestone, next above the Niagara, has the cells of its fossil corals filled with Petroleum, the remains of the gelatinous coral animal which inhabited them. Mr. Murray drew attention to this fact in 1844, and cited the Gravelly bay quarries in Wainfleet, Western Canada, as examples.

The oil springs of Enniskillen, as well as the lake of solid bitumen in the same township, half an acre in extent and two feet thick, no doubt have their deep-seated sources not in the black shales of the region, but in the corniferous limestone underneath. These black shales belong to the base of the Portage and Chemung group. The wells sunk in them soon strike the argillaceous shales and limestones of the Hamilton group, and go through them toward the corniferous limestone, specimens of which yielded to Hunt's analysis from 7·4 to 12·8 per cent. of bitumen, fusible and readily soluble in benzole.

In the blackish Marcellus shales, at the base of the Hamilton group, are found septaria or nodular concretions containing Petroleum. The same phenomenon recurs at the top of the Hamilton group. Still higher up, the Portage and Chemung sandstones (formation viii,) are often bituminous to the smell, and contain Petroleum in cavities, or hardened into solid seams. A calcareous sand rock in Chataqua county contains more than 2 per ct. of bituminous matter. These are the rocks around the famous oil springs of the Seneca Indians. It is only necessary to ascend the series of these devonian sandstones to their upper part among the rocks of the Catskill group, or just beneath them, to find oneself in the oil regions of northern Pennsylvania and Ohio, described by Dr. Newberry and others.

There only remains to be noticed that anomalous deposit of the Albert coal in New Brunswick, made famous by long litigation and the discussion of geologists, described by Professor Dawson in his Acadian Geology, and called, by Dr. Wetherill, of Philadelphia, Melan-asphalt.

Its position has been misinterpreted by several observers, who have reported it a volcanic injection of bitumen into a fissure of the earth many feet in width, by the force of which large pieces of the wall rock have been torn off and carried forward in the mass. It seems, however, pretty well made out, that it was originally a horizontal bed or lake of Petroleum, hardened and covered up by sand and clay deposits of carboniferous age, and afterwards upturned, bent over and fractured so as to assume its present posture. It is not properly a coal bed, therefore, but a mass of hardened coal oil, which can be, and, in fact, has been, mined like a coal bed, and the product used wholly for making gas. Dr. Wetherill's analysis gives:—Coke, 44·35; volatile matter, 55·55; ash, 0·10. Specimens of Cuban asphalt analyzed at the same time, gave: Coke, 32·00; volatile matter, 67.60; ash, 0·40; or, subtracting the ash and uniting the oxygen and nitrogen: Carbon, 86·123; hydrogen, 8·971; oxygen and hydrogen, 4.906 = $C_{63}H_{42}ON$. Like Cuban and Egyptian asphalt, this Albertine (as it is commonly called) is highly electrified by friction, which coal is not.

From the New York Tribune Almanac.

THE PRINCIPAL STATES OF EUROPE: THEIR GOVERNMENTS, AREA, POPULATION, ARMY AND NAVY.

Great Britain.

AREA AND POPULATION.

	Area in Eng. sq. ms.	Population in 1861.
England and Wales	58,153	20,061,725
Scotland	31,324	3,061,251
Ireland	32,612	5,764,543
Total	121,989	28,887,519

BRITISH DEPENDENCIES.

In Europe: Gibraltar, Heligoland, Malta and Java*	121	168,130
In Asia: East India Company's Possessions, Ceylon, Hong Kong, Labuan	875,797	187,745,750
In Africa: Gambia, Sierra Leone, Gold Coast, Cape Colony, Natal, St. Helena, Mauritius, Seychelles	149,985	953,045
In America: Labrador, Canada, New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland, British Columbia, Vancouver's Island, West Indies, Hondurus, Guiana, Falkland Islands	847,506	4,400,913
In Australia: New South Wales, Queensland, Victoria, South Australia, West Australia, Tasmania, New Zealand	1,570,433	1,211,089
Total	3,443,902	194,478,927

Parliament.—House of Lords has 465 peers: namely, 30 spiritual lords (26 English and 4 Irish bishops and archbishops) and 434 secular lords, viz., 3 princes of the royal house, 20 dukes, 21 marquises, 112 earls, 22 viscounts, 213 barons, 16 Scottish peers, 28 Irish peers (for life).

House of Commons has 654 members, namely, 496 English and Welsh, 53 Scottish, and 105 Irish.

Army and Navy.—According to the army estimates in the budget of 1862–3, the English army consisted of 14,066 cavalry, 129,562 infantry; total, 143,628. The British Army in India consisted of 7,062 cavalry, 14,000 artillery, 54,837 infantry; total, 75,899.

According to the navy list, April, 1862, the English fleet consisted of 372 steamers afloat, with 117,465 horse-power, 40 steamers building, with 21,360 horse-power, 144 sailing vessels afloat; total 566, with 14,748 guns. There were also 170 steam gunboats and 147 coasting vessels, so as to make the complete number of vessels enumerated in the navy list 885.

* The Ionian Islands, which were since 1815 under British protectorate, were, in 1863, with the consent of the British government, annexed to the kingdom of Greece.

France.

AREA AND POPULATION.

	Area in geo. sq. ms.*	Pop. Jan. 1, 1862.
France	10,034	37,472,732
Algeria	7,017	1,999,125
Total	17,051	39,471,857

FRENCH DEPENDENCIES.

In Asia: Pondichery, Karikal, Yanaon, Mahe, Chandernagor, 6 provinces in L. Cochin China†	510	2,219,878
In Africa, exclusive of Algiers: Senegal, Reunion, Ste. Marie, Mayotte	4,622	447,328
In America: Martinique, Guadelupe, Guyana, St. Pierre, and Miquelon	3,322	301,323
In Oceania: Marquesas Isles, Pomotou, Wallis, Gambier, Toubouai, Society Islands, New Caledonia	452	99,460
Total	8,906	3,067,989

The Chambers.—The Senate consists of not over 150 members, appointed for life by the Emperor, and of the archbishops, marshals of the empire, and admirals, who are *de facto* entitled to seats.

The Corps Legislatif consists of 267 members. At the election which took place on June 7 and 8, the different opposition parties elected together about 30 members against 5 in 1857. The total number of votes cast for the opposition candidates were estimated at about 1,900,000 against 571,859 in 1857.

Army and Navy.—The French army was composed, in 1862, as follows: Gendarmerie—1 regiment, 28 legions, 4 battalions, 5 squadrons, 129 companies, 24,535 men. Infantry—115 regiments, 376 battalions, 2,953 companies, 252,652 men. Cavalry—64 regiments, 385 squadrons, 9 companies, 62,799 men. Artillery—22 regiments, 227 battalions, 7 squadrons, 63 companies; 16,646 horses, 1,362 cannon, 39,882 men. Engineers—3 regiments, 1 division, 6 battalions, 73 companies, 7,486 men. The total strength of the army on the peace footing was 404,192, and on the war footing 757,725.

The fleet, in the same year, consisted of 94 iron-clad screw steamers, with 1,142 guns and 21,136 horse-power, 187 other screw steamers, with 5,662 guns and 61,760 horse-power, 86 wheel steamers, with 534 guns and 19,540 horse-power, 111 sailing vessels, with 2,380 guns—total 478 vessels, with 9,718 guns, and 102,436 horse-power.

Russia.

AREA AND POPULATION.

	Area in geo. sq. ms.	Population.
Russia in Europe	90,134.53	59,330,752
Caucasia	8,073.78	4,257,704
Russia in Asia	262,745.97	4,070,938
Russia in America	24,298.00	54,000
Kingdom of Poland	2,257.81	4,800,000
Grandduchy of Finland	6,870.00	1,680,000
	394,340.09	74,193,394

Army and Navy.—The Russian Army is composed—1, of active troops; 2, of reserve troops; 3, of irregular troops. According to the reports of

* 1 geographical square mile about equal to 21 English square miles.

† According to a letter in the *Moniteur de l' Armee*, dated Saigoon, Cochin China, Sept. 6, 1863, a treaty has been concluded between France and the king of Cambodia (in Farther India), by virtue of which this whole kingdom is placed under the protectorate of France. France also receives the right to establish a settlement on the banks of the river Cambodia or Mei Kong, at Nam Van.

the Ministry of War, the effective of the land forces was, in 1859, as follows:

	Gens.	Officers.	Soldiers.
Active Army	334	26,997	783,352
Reserve Troops	23	3,054	66,873
Irregular Troops	30	4,665	92,000
Total	387	34,716	942,225

The navy, on June 1, 1862, consisted of 248 steamers, with 2,387 guns and 37,007 horse-power, 62 sailing vessels, with 304 guns—total, 310 vessels, with 3,691 guns.

Austria.

Area and Population.—Austria comprises the following crown lands, each one of which has a provincial diet:

Austria below the Ens	360.08	1,681,697
Austria above the Ens	217.90	707,450
Salzburg	130.15	146,769
Styria	407.84	1,056,773
Carinthia	188.42	332,456
Carniola	181.42	451,941
Goerts, Gradisca, Istria and Trieste	145.10	520,978
Tyrol and Vorarlberg	532.04	851,016
Bohemia	943,70	4,705,525
Moravia	403.77	1,867,094
Silesia	93.50	443,912
Gallicia	1,425.78	4,597,470
Bukovina	189,92	456,920
Dalmatia	232.36	404,499
Venetia	456.99	2,446,056
Hungaria	3,896.33	6,900,785
Croatia and Slavonia	350.16	876,009
Transylvania	997.51	1,926,727
Military Frontier	609.38	1,064,922
Active Army		579,989
		35,019,058

Nationalities.—As to nationality the Austrian empire contains 7,889,925 Germans, 11,044,882 northern Slavi, 3,982,774 southern Slavi, 2,989,136 western Roumanians, 2,642,953 eastern Roumanians, 4,947,134 Magyars, and 1,217,532 other races.

Among the northern Slavi there are 6,132,742 Czechi, Moravians and Slovackians, 2,159,648 Poles and 2,762,482 Ruthenians; among the southern Slavi, 1,183,533 Slovenians, 1,337,010 Croats, 1,438,201 Serbins, & 24,030 Bulgarians; among the western Roumanians, 2,557,913 Italians, 416,725 Friulians, 14,498 Ladinians; among the other races, 3,175 Albians, 2,255 Greeks and Bohemians, 16,131 Armenians, 146,100 Gipsies, and 1,049,871 Jews.

Parliament.—The Austrian *Reichsrath* (Council of the Empire) consists of the House of Nobles and of the House of Deputies.

The House of Nobles consists of the princes of the imperial house who are of age, of heads of noble landed families, appointed as hereditary members, of the archbishops and bishops of princely ranks, and finally of life members.

The House of Deputies consists of 343 members, delegated by direct election, by the diets of several crown lands. The following crown lands have as yet sent no delegates: Hungary (85), Croatia and Slavonia (9), Venetia (20). The Diet of Transylvania elected deputies (26) for the first time, in September, 1863.

Army and Navy.—The Austrian army, in 1863, was composed as follows:

	Active.	Non-active.
Infantry	162,318	442,000
Cavalry	40,344	52,760
Other Troops	46,018	92,935
Total	248,680	587,695

The navy consisted of 64 steamers with 647 guns, and 51 sailing vessels, with 340 guns; total, 115 vessels, with 987 guns.

Prussia.

Area and Population.—Area, 5,103 geographical square miles; population (3rd December, 1861) 18,500,446. The number of the non-German population amounts to 2,480,609, and consists of 1,950,199 Poles, 233,379 Mazures, 7,652 Rassubes, 82,232 Wends, 10,324 Bohemians, 48,544 Moravians, 136,990 Lets, 414 Courlanders, 10,502 Walloons, and 363 Hollanders.

Representative Chambers.—The House of Lords consists of all princes of the royal blood, all princes formerly sovereign but now subject to the King of Prussia, hereditary peers, peers for life, 90 members elected by the wealthiest classes, and 30 members elected by the municipal corporations of as many principal cities,

The Chamber of Representatives consists of 352 members, who are elected by indirect universal suffrage for three years. The last election took place October 28, 1863. In the new Chamber the "Party of Progress" counts about 140 members; the "Left Center" which differs but little from the former, 82; the "Parliamentary Union" (Right Center), 4; the Moderate Liberals, 7; Catholics, 25; Poles, 27; Conservatives, about 40. The members not classified will mostly vote with the majority.

Army and Navy.—The Prussian army, in 1863, was composed as follows:

	Peace footing.	War footing.
Regular Troops	191,033	356,532
First levy of the Landwehr	....	123,923
Troops in garrison	8,265	153,966
	199,298	634,421
To these must be added:		
Officers	8,000	10,000
Gendarmes	2,250	2,250
Two divisions of the School of Under Officers	980	980
Company of Under Officers of the Guard ...	70	70
Feldjager	77	77
Invalids	2,102	......
Total	211,778	647,798
If a second levy of the Landwehr is raised, there must be added		95,496
Total		743,294

INTERESTING PHOTO-CHEMICAL DISCOVERIES.

At a recent meeting of the Manchester Literary and Philosophical Society, Professor Roscoe exhibited the light emitted by burning a portion of a fine specimen of pure magnesium wire 1 mm. in diameter and 10 ft. long, which had been manufactured by Mr. Sonstadt. Professor Bunsen and the speaker had examined the photo-chemical action of the sun compared with that of a terrestrial source of light, and for the purpose of this comparison they chose the light evolved by the combustion of magnesium wire. They showed that a burning surface of magnesium wire which, seen from a point

* The Russian possessions in America were formerly the property of a company, but at the end of the year 1863 they were formally incorporated with the Russian empire.

at the sea's level, has an apparent magnitude equal to that of the sun, effects on that point the same chemical action as the sun would do when shining from a cloudless sky at a height of 9 deg. 53 min. above the horizon. On comparing the chemical with the visible brightness of these two sources of light, it was found that the brightness of the sun's disc, as measured by the eye when the sun's zenith-distance was 67 deg. 22 min. is 524·7 times as great as that of the burning magnesium wire, whilst at the same zenith-distance the chemical brightness of the sun is only 36.6 times as great. Hence the value of this light as a source of the chemically active rays for photographic purposes becomes at once apparent. The extract from the memoir referred to is as follows :—" The steady and equable light evolved by magnesium wire burning in the air, and the immense chemical action thus produced, render this source of light valuable as a simple means of obtaining a given amount of illumination expressed in terms of our measurement of light. * * The combustion of magnesium constitutes so definite and simple a source of light for the purpose of photo-chemical measurement, that the wide distribution of this metal as a source of light may even become of technical importance. A burning magnesium wire of the thickness of 0·297 millimetre evolves, according to a measurement we have made, as much light as 74 stearine candles, of which five go to the pound. If this light lasted one minute, 0·987 metre of wire, weighing 0·1204 grm. would be burnt. In order to produce a light equal to 74 candles burning for ten hours, whereby about 20 lbs. of stearine is consumed, 72·2 grms. of magnesium would be required. The magnesium wire can be easily prepared by forcing out the metal from a heated steel press having a fine opening at the bottom; this wire might be rolled up in coils on a spindle, which could be made to revolve by clockwork, and thus the end of the wire guided by passing through a groove or between rollers, could be continually pushed forward into a gas or spirit-lamp flame, in which it would burn." Professor Roscoe stated that great credit was due to Mr. Sonstadt for the able manner in which he had brought the difficult subject of the metallurgy of magnesium into the present satisfactory position, and expressed his opinion that, even for photographic purposes, the application of the metal will prove most important.—Mr. Brothers, Mr. Parry, and other photographers present, corroborated Dr. Roscoe's opinion respecting the value of such a source of light for photograpy. Since the meeting Mr. Brothers made an experiment upon the magnesium light, which he reports as follows—" The result of an experiment I have just tried is that in 50 seconds with the magnesium light I have obtained a good negative copy of an engraving, the copy being made in a darkened room. Another copy was made in the usual way in daylight, and in 50 seconds the result was about equal to the negative taken by the artificial light. The sun was shining, but there was a good deal of fog in the atmosphere."

SUBSTITUTES FOR GUTTA PERCHA.

Sir W. Holmes has forwarded to the Council of the Society of Arts, from Demarara, some specimens of a gum termed "Balata," the produce of the Bullet tree (*Sapota Mulleri*), which grows in that colony, and which, he states, possesses the properties of gutta-percha' and may be used as a substitute for it. The specimens include not only the inspissated juice, but also a bottle of the juice itself. Mr. Ondaatjie, colonial surgeon, has forwarded to the Council, from Ceylon, a specimen of the *Alstonia Scholaris*, which he states may be used as a substitute for gutta-percha. It is stated to possess the same properties and is as workable as the latter. It readily softens when plunged in boiling water, is soluble in turpentine and chloroform, receives and retains impressions permanently, and is adapted for seals to documents. The tree abounds with milky juice, like the gutta-percha, has a fleshy bark and porous wood, and belongs to the natural order Apocynea. The natives believe that the tree is very poisonous, and class it among their most virulent poisons, but Mr. Ondaatjie states that his experiments with the juice, &c., have proved the contrary. These specimens are sent in response to premiums offered by the Society for the discovery of a substitute for gutta-percha.

The following letter accompanied the specimen of *Balata*, sent by Sir W. Holmes :—

By the last mail I received your "Subjects for Premiums" for the session of 1863-64.

My object in addressing you is to advise, that by this packet I forward a box containing samples of *Balata* in its milky state. and also dried or coagulated. I entertain the hope that these samples fully meet the requirements of the 77th Section of your list of premiums, in reference to a substitute for india-rubber or gutta-percha, but I also trust it will be found more valuable than india-rubber or gutta-percha by themselves, possessing much of the elasticity of the one and the ductility of the other, whilst it requires a much higher temperature to melt or soften it.

After these preliminary observations I must go somewhat into detail. I was Commissioner, representing the colony of British Guiana, at the International Exhibition of 1862. Amongst the varied contributions from the colony was a morsel of the dried milk of the bullet tree (*Sapota Mulleri-Miq?*); it weighed perhaps half a pound. Amongst the numerous individuals who visited the Guiana department was Mr. Charles Hancock, who is well known in the gutta-percha trade. This gentleman was struck with the appearance of the specimen, and obtained a portion for experiment; he reported favourably as to its utility and value, a result most gratifying to me, as I had received adverse opinions from less experienced persons. This happened, I think, in July, 1862. From that time to the present I have been engaged in investigations how to produce the material cheaply, and how to dry or coagulate it rapidly. In both particulars I believe I have succeeded so far as to warrant the introduction of steam machinery to be applied to its extraction, and by a fortunate accident I have discovered how to dry or coagulate it, preserving the characteristic of elasticity at a single operation, by the addition of a simple ingredient not very costly.

The samples forwarded consist of—1stly, a bottle of milk, as extracted from the tree by tapping;

2ndly, of lumps or cakes, weighing together five lbs., of this milk prepared for the market; and, 3rdly, some balls to shew, by the result of the process discovered by me, that this material is nearly as elastic as india-rubber; indeed, as far as I can judge, *Balata* cannot be rivalled by either that material or gutta-percha, possessing, as I before stated, much of the elasticity of the one and the ductility of the other, without the intractability of india-rubber or the brittleness and friability of gutta-percha. Amongst the useful properties possessed by *Balata*, I believe the fresh-milk of the bullet tree to be the best waterproofing material yet discovered, and further, that *Balata*, as prepared by me, will supply the great want of the day, as a good insulating medium for telegraphic purposes.

The bullet tree is a magnificent timber tree, often squaring 30 to 40 inches and is much used, especially in Berbice, for building purposes. The milk, when quite fresh, is so bland that it is sometimes used as a substitute for cow's milk, and the fruit is delicious.

The bullet tree abounds in many districts of the colony; indeed, I may say, throughout this part of South America, and I trust that *Balata* may ere long be added as an important item to the exports of the colony, and tend to prove that the International Exhibition of 1862 has in this instance also been productive of practically useful results, not only to this community, but to the interests of science and art generally.

I annex a letter from the Honourable William Walker, Government Secretary of the colony, and Chairman of the Correspondence Committee of the Royal Agricultural and Commercial Society of British Guiana, which is affiliated to the Society of Arts, in order to fulfil the conditions specified in the prospectus.

THE INFLUENCE OF ENGINEERING SCIENCE ON NATIONAL PROSPERITY.

(From the Address of J. R. McLean, Esq., F.R.A.S., President of the Institution of Civil Engineers, on taking the chair for the first time after his election, January 12, 1864.)

* * * * *

"I will now attempt to point out the causes of the enormous increase of the income of Great Britain, representing the profits of many hundreds of millions sterling invested in railways, canals, mines, ships, and other works in this country, in India, and in our colonies.

Fortunately the railway system, since the introduction of the locomotive engine, improved by Stephenson, gave it vitality, has been a complete success in the reproduction of capital, in the enormous saving in the cost of transport, and in the facilities it affords for the development of mines, and of nearly all branches of national industry.

After the opening of the Manchester and Liverpool Railway, the accumulated wealth of Great Britain, which, previous to that time had been but sparingly invested in public undertakings, and was for the most part hoarded, or placed on doubtful securities, was thrown lavishly into the railway system; and, although for a time this led to the belief, that the supply of capital for the construction of such undertakings was inexhaustible, and induced excess of speculation, temporary distress, and subsequent distrust in the system; yet the progress of railways ever since that period has been steady, and a reproductive profit has been assured on a capital of nearly £400,000,000. This vast capital has been created because railway securities, on the principle of limited liability, occupy the highest place in public estimation, for investing the realised profits of the country, in consequence of the facility with which they can be purchased, and transferred in amounts suited to the requirements of every class of society; and this leads to a constant accumulation of capital by inducing people to save a portion of their income—not merely for their own support in an after period of life, but for the benefit of their descendants. Thus railway securities afford the means of transmitting wealth, as printing does knowledge, from one generation to another.

The beneficial effects of the railway system have not been confined to Great Britain. Before the introduction of railways the land was nearly the only safe means in Europe for the investment of capital; and, in consequence of the competition for this security, the interest was reduced to a minimum rate, and was barely sufficient to induce people to save a portion of their income. The construction of railways, by inducing saving, has established a wealthy and educated middle class in most countries in Europe, who have not only developed the industrial resources and increased the capital of the country to which they belong, but have also, as in this country, promoted education, and humanized the conduct of all classes of the people.

I have only one more remark to make on railways as a cause of the increase of wealth. The land occupied by railways in Great Britain is under two hundred thousand acres, including stations and and other conveniences, and to obtain possession of this land it has been necessary, during every session of Parliament, for the last thirty years, to engage the services of the ablest counsel, and the most eminent engineers, in the committee rooms of both Houses, at an incalculable expense. The land used for agricultural purposes is about forty million acres. Yet the railway system, occupying only about one half per cent. of the total area of the land, now pays nearly as great an amount of income and property tax as is paid by the whole of the farmers of Great Britain.

Another source of wealth is the great deposit of coal, and iron, stone, and other minerals—in nearly every part of the kingdom.

The most important of these is coal. The quantity of coal raised in Great Britain is now about one hundred millions of tons yearly, produced by the labour of about three hundred thousand men.

We are indebted to Professor Liebig, the celebrated German chemist, for data by which we can estimate the value of this enormous quantity of fuel, by comparing it with wood or any other produce of the soil.

Liebig informs us, that every acre of fertile land will produce yearly about two tons and a half of wood, or other crop, which contains about the same quantity of carbon (80 per cent.) as one ton of coal. The one hundred million tons of coal now raised annually from our mines contain about eighty million tons of carbon; and to produce the equivalent of this in wood would require one year's growth of, in round numbers, one hundred millions of acres of land—an area about four times larger than the arable and pasture land of England, (which does not exceed twenty-five million acres) and as nearly as possible equal in extent to the area of the kingdom of France. Yet this supply of fuel, even if it existed in the form of wood, would be practically useless as a substitute for coal; the labouring population of the kingdom would be unable to cut and convert it, the whole of our railways and canals would not suffice to transport it, while the cost of these operations, if no other obstacle intervened, would prevent them from being carried on beneficially. The development of coal then, is mainly the cause of the increase of wealth, but if railways had not proved reproductive investments, this mineral would have added little more to the wealth of Great Britain than it did in 1815.

The serious question as to the permanence of this fuel, on which the wealth of the nation so much depends, has been prominently raised.

Since the great discovery of Murchison, that coal underlies, and may be found with reasonable certainty under the lower new red sandstone and permian formations, which extend over millions of acres of Great Britain; and if beneath them at greater depths, under all the measures which overlie the permian, and which, together, comprise upwards of one half the area of Great Britain, we may consider our coal-mines to be practically inexhaustible, and that we have not to fear any deficiency in quantity, arising from the exhaustion of the mineral, but rather the practical difficulty of obtaining it from a great depth below the surface, in consequence of the central heat of our globe, which, it is alleged, will ultimately and within a defined and not distant period, reduce the production to a limited supply.

Much may be said in support of the theory of central heat, but I think undue importance has been given to it, as a difficulty in mining operations. A comparatively thin coating of clay, or fire-bricks, surrounding a blast furnace filled with molten iron, affords such protection that the hand may be placed without inconvenience on the outer surface of the brick-work, and it is difficult to understand how any internal heat can penetrate through the crust of the earth—estimated to be thirty-four miles in thickness—so as to interfere with the temperature at the comparatively small depth from the surface at which mining operations are carried on. I am of opinion that the heat, which undoubtedly exists in some mines, arises, not from central heat, but from superincumbent pressure, and defective ventilation. The gases in the coal are highly compressed, and, when liberated by mining operations, are at a high temperature; but we know that with large shafts, air may be conveyed to any depth that has yet been reached in mining operations, without in the slightest degree altering its temperature; and that by a proper enlargement of the air passages, air descending the shaft may be distributed through the workings, so as to lessen the liability of accident from explosion, or serious inconvenience from heat, at any depth to which shafts can be sunk. The system of sending compressed air down the shaft by means of water is found to abate inconvenience in deep mines owing to an excess of temperature.

I therefore think that the time when we shall experience a want of coal, arising from exhaustion, or from difficulties occasioned by the depth of the mines, or an excess of temperature, need not at present in any way influence our conduct in the development and use of that important mineral; especially as the power (which is the substitute for labour) derived from coal is so cheap, that we are enabled to consume daily for our domestic comforts, for machinery in the conversion of minerals, and for other manufacturing processes, and for export, a power equal to twelve millions of horses, at a cost, at the mine, of not more than one penny per horse-power, working ten hours a day, and no saving in consumption of this enormous quantity of coal can be made, except by employing more expensive labour as a substitute.

With this power at our command the cost of sinking to and of raising minerals from the greatest depths, is inappreciable; while the intrinsic value of coal, when compared with any other fuel, is so great that it may be drawn profitably from almost any depth—the only limit being the strength of the machinery and materials required to raise it.

The next mineral in importance is ironstone.

In the year 1862 the production of ironstone and iron ore in the United Kingdom, amounted to 7,586,956 tons, which, by the operation of five hundred and sixty-two blast furnaces, was converted into 3,943,469 tons of pig iron.

The importance of the iron and coal trade as a source of wealth is proved by the fact, that the declared value of the iron and coal exported from this country during 1862, either in a raw, or a manufactured, or a partially manufactured state, was nearly £25,000,000, due altogether to the development of our natural resources; and this sum represents the cost price only, and is exclusive of carriage, or freight and profits of trade, which may fairly be taken to represent one half more.

In 1862 our other mines produced the following quantities of minerals, viz.:—

Tin ore	14,127	tons
Copper ore	224,171	"
Lead ore	95,311	"
Zinc (blende)	7,497	"
Pyrites (sulphur)	98,433	"
Salt	981,598	"
Fire-clay, china-clay, and porcelain stone	853,803	"

These minerals, and the metals produced from them by means of coal, have enabled us, with the assistance of the shipping interest, to obviate to a great extent, the effects of the failure in the supply of cotton; for, notwithstanding the great decrease of the export of cotton goods (to the extent of £10,000,000 in the year 1862), the total amount of exports during the financial year just ended (1863) has been £124,137,812, exclusive of carriage and freight, and we have thus been enabled to pay for all imports, and partially to alleviate the distress among the cotton operatives in Lancashire.

I will not occupy your time in detailing all the various profitable employments which result from mining and manufacturing operations, but will only refer to, perhaps, the most remarkable of them—ship-building.

The Government returns for 1861 show, that in that year 975 ships, representing 200,839 tons, were built and registered in the United Kingdom; —of these 91,095 tons were constructed of iron, the average of the iron vessels being a burthen of 430 tons each.

And this, it should be remembered, is exclusive of iron ships built in private yards for the Royal Navy, and of the ships constructed for foreignersl The iron screw steam-ships, in consequence of their great and regular speed, due to engineering skill, have practically become an extension of the railway system over all parts of the world, and have enabled us more freely to exchange the products of our industry for those of other nations, thereby conducing to the employment, the intellectual and social enjoyment, and the convenience of the people, and providing for the further increase of population and universal wealth.

On these considerations I am justified in stating, that the increase of the income of England since the year 1815, has not arisen from the land; but that it is mainly due to the discoveries of our great engineers. There remains still to be considered the question of the distribution of this wealth, which has been the means of providing profitable employment for millions of a rapidly increasing population, who, but for such industrial undertakings, must have remained a burthen on the land, and a cause of poverty and discontent; unless reduced in number by famine, or by extensive emigration.

We may also congratulate ourselves that this wealth has not been employed in reproductive undertakings alone, but that the great cause of education has felt the stimulus of it, and that every year the importance of developing and directing the intelligence of the people is more distinctly recognized."

THE INVENTION OF THE CARD-MAKING MACHINE.

Whittemore—1797.

We do not rank the card-setting machine among "the most important American discoveries and inventions," and yet we cannot omit it from our account, for it is generally regarded as coming nearest in its movements to the acts of intelligence of any piece of mechanism that has ever been devised. Two delicate needles dart forward and punch the leather; the wire is drawn in from the reel and cut off at the proper length; a fork sweeps forward and bends the wire into the form of the letter U; a pair of pincers seize the bent wire and thrust it deftly into the holes prepared for it; and finally a press rises on the opposite side of the leather and bends the wire at the proper angle to make a perfect card. All of these varied movements go on automatically and continuously, and if a crooked or imperfect tooth is made, the machine instantly stops of its own accord. This last, the stop-motion, is the only material improvement made in the machine from the form in which it was originally devised by its first inventor.

A few years since a manufacturer of these machines, a Mr. Earle, of Leicester, Mass., had a very fine machine on exhibition at the Mechanics' Fair in Boston, when the Rev. Mr. Pierpont came along with a friend and stopped to look at it.

"Here," Mr. Pierpont remarked, "is the machine that more than any other impresses me with the feeling that it must be endowed with thought."

At that time the stop-motion had not been invented, and great efforts were being made to devise it. With this in his mind, Mr. Earle replied:—

"Yes, all it needs to be a perfect sentient being is a conscience."

In the course of that season the stop-motion was perfected, and when Mr. Pierpont passed through the next Fair, he reminded Mr. Earle of the previous conversation. Mr. Earle replied:—

"The defect is now remedied. The machine has got a conscience, and it does just what a conscience ought to do—it stops at the first wrong step."

We have heard a gentleman speak repeatedly of visiting a large card manufactory in New Jersey. While he was talking with the proprietor a man came out of the mill and went off to his house. Some 15 minutes afterward our friend went into the factory, and found a very large room full of machines in active operation, with not a single person in the building to attend to them!

The card-setting machine was invented by Amos Whittemore, who was born at Cambridge, Mass., April 19th, 1759. His father was a farmer, but Amos early showed a fondness for mechanical pursuits, and, on arriving at the proper age, he became an apprentice to a gunsmith. Long before the expiration of his apprenticeship his master confessed that he could teach him no more, and advised him to set up business for himself. Some years later he became interested, with his brother William and five others, in the manufacture of cotton and wool cards, conducting their business in Boston, under the firm of Giles, Richards & Co., and supplying nearly all the cards then used in the country. Amos attended to the mechanical department.

It soon occurred to him that if a machine could be devised to perform the operations, it would supersede a vast amount of hand-labor, and would be of great value. After long and patient meditation the plan had so far taken shape in his own mind that he was ready to communicate his idea to his brother William. This brother encouraged and assisted him to the utmost, and a chamber was set apart for the construction of a model. Here the enthusiastic inventor devoted himself to the perfecting and embodying of his plans with such zeal as frequently to neglect his food and sleep. In the course of three months the machine was so far advanced as to punch the leather, and to cut, bend, and insert the wire; but the bending of the teeth at the proper angle completely baffled his genius, and he began to despair of success. While his mind was on the stretch to overcome the obstacle, one night during his sleep the idea was presented to him in a dream. Rising early in the morning he hastened to his workshop, and, before he broke his fast, he was able to announce to his brother that the machine was perfected.

Steps were immediately taken to secure a patent, and this was obtained on the 2d of June, 1797. The brothers determined also that a patent should be taken out in England, and that the inventor should visit that country for the purpose. At that time but two vessels traded between Boston and

London, and in one these, the *Minerva*, Mr. Whittemore sailed in the spring of 1799. He was absent a year, his return voyage occupying 59 days.

On the 3d of March, 1809, the patent was extended by a unanimous vote of Congress, for 14 years from the expiration of the first term. In 1812, the Legislature of New York passed an act incorporating the "New York Manufacturing Company," with a capital of $800,000, of which $300,000 was directed to be employed in the manufacture of cotton and wool cards. On the 20th of July, 1812, this company bought of the Messrs. Whittemore their patent right and entire machinery for $150,000. In 1818, the company sold all of its manufacturing property to Samual Whittemore, a brother of the inventor, who is reputed to have made a very large fortune in the manufacture of cotton and wool cards.

After the sale of his interest in his patent, Amos Whittemore purchased a pleasant estate in West Cambridge, and retired from active business. Here, after a pure and blameless life, he died in 1828, at the age of 69 years.—*Scientific American.*

Miscellaneous.

Purification of Coal Gas.

It has already been observed that dry hydrate of lime ceases to absorb sulphuretted hydrogen gas, in the purifiers, before being saturated with that gas. By observations upon the absorption of the pure sulphuretted hydrogen by hydrate of lime, I find that the latter ceases to absorb the gas, even in the most favourable circumstances, when a quantity which varies from one-fourth to one-half of an equivalent of gas is absorbed, instead of a whole equivalent, as might be expected; and that, of the small quantity absorbed, a portion is taken up by the hydrate of lime, slowly and with difficulty. I am convinced from these experiments that the quantity of sulphuretted hydrogen which hydrate of lime can take up in the dry purifiers is not under estimated at one-fourth of an equivalent. It is also to be observed that, unless attention be paid to have the hydrate of lime in a certain state of dampness, the absorption may be considerably less. Now, the hydrate of lime may be made to occasion the absorption of two whole equivalents of sulphuretted hydrogen, or eight times the above quantity, and this large absorption to take place with increased force, and with certainty at all times, by preparing it in a particular manner. Three and a half parts of quicklime are slaked with a solution of nine parts of anhydrous sulphate of soda, in 14 or 15 parts of tepid water. This gives a mixture of 4⅝ parts of hydrate of lime with about 20 parts of crystallized sulphate of soda, which is dry, or only slightly damp. It is the matter to which the coal gas is to be exposed in the dry purifiers. To prepare this mixture, instead of dissolving the anhydrous sulphate of soda, it may be ground, and be mixed with the quicklime, previously slaked in the usual way. An addition of 11 parts of water is then made to the mixed powders—[3½ parts of quicklime, slaked, 9 parts of ground sulphate of soda, and 11 parts of water]—which water combines with the sulphate of soda, and gives a dry powder, consisting of hydrate of lime, with crystallized or hydrated sulphate of soda. This mixture (however prepared) absorbs sulphuretted hydrogen with unabated vigour, till completely saturated, and then has an olive-green colour, and consists of sulphate of lime or gypsum, and the bi-hydrosulphuret of sodium. This residuary product would, I believe, bring a price equal to that of the sulphate of soda consumed, or perhaps considerably greater. The soda-makers could economize it in different ways. If water be poured over the mass, the bi-hydrosulphuret of sodium is, I find, dissolved out with much ease, and a pure pulverulent gypsum remains, which might be available as manure. The solution of bi-hydrosulphuret of sodium evaporated to dryness may be readily reconverted into sulphate of soda, by a slight roasting, with access of air, one proportion of the sulphur escaping in the form of sulphurous acid. It could be managed, in favourable circumstances, to throw the latter into a sulphuric acid chamber. Otherwise, carbonic acid gas (as by Gossage's patent) might be passed over the residuary matter in question, without dissolving it, and the sodium converted into carbonate of soda, with the escape of two proportions of sulphuretted hydrogen gas, which last would be burned in the sulphuric acid chamber; or the solution of the bi-hydrosulphuret of sodium, separated from the sulphate of lime, might be treated by itself with the carbonic acid, and the soda converted into carbonate of soda, with the recovery and useful application, as before, of the sulphur; or carbonate of soda may be used instead of sulphate of soda, but is not so cheap.

Sulphate of soda may be added to the liquid lime-purifiers with the same advantages. T. G.

We have used this mode of purification (which we have taken the liberty to insert) with great success both in this country and abroad. It was pointed out some years ago to the Editor by Professor Graham, the present Master of the Royal Mint. It may be observed that the above process also removes the ammonia from the gas, the sulphate of lime which is formed being the active agent. Care must be taken not to use the sulphate of soda as obtained in making nitric acid from nitrate of soda. The dry method of purification by the above system is to be preferred to the wet method.—*Sanitary Reporter.*

Preservation of Meat.

The importance of preserving meat, whether for our sailors or for other purposes, cannot be overrated, and various ways of effecting this object have been, from time to time, devised. The methods hitherto adopted, on a large scale, have been the packing of cooked meat in air-tight cases, or impregnating it with salt, and keeping it in barrels immersed in brine. The first, though effectual for preserving the meat for almost any length of time, leaves the flesh, even when the utmost care is taken in the process, more or less insipid and tasteless; the second though also preservative for a considerable time, renders the meat not only flavourless, but absolutely extracts from it, as Liebig tells us, nearly all its nutritive properties, as well as those peculiar properties which are necessary for keeping the human body in health. It is well known that a long continuance of such food, thus prepared, engenders scurvy. The Admiralty are now making experiments with a process devised by Dr. Morgan, an Irish gentleman; and a few days since some animals were slaughtered, and their carcases subjected to this process in the presence of the officers of her Majesty's Victualling Department at Deptford. A bullock having been killed in the usual way, the chest was immediately opened, and a metal pipe with a stop-cock inserted in connection with the arterial system. This pipe was connected by means of elastic tubing, with a tub filled with brine, placed at an elevation of about twenty feet above the floor. The stop-cock being turned, the brine was forced through the arteries of the animal, and, passing through the capillaries, flowed back through the veins, carrying with it all the blood, making its exit by means of an incision provided for that purpose. About six gallons of brine passed thus through the body, washing out all the blood from the vessels. Having thus cleared the vessels, the metal pipe was connected with another tub, similarly placed, containing the preservative materials to be injected, and, at the same time, their exit, after traversing the body, was prevented. On communication being made, the liquid was forced into the vessels, and, by means of the pressure, it penetrated into every part of the animal, and might be seen exuding from any point where an incision was made. The liquid used on the occasion of the late experiments consisted of six gallons and a-half of brine, ten pounds of sugar, three-quarters of a pound of saltpetre, with half a bottle of catchup and an infusion of cloves and pepper. The whole process is very rapid, and is extremely simple, requiring nothing that can be called machinery. It took no longer than three minutes to send the first six gallons of liquid through the animal to wash out the vessels, and about three minutes more to inject the animal with the preservative liquid. Indeed, so rapid is whole proceeding, that, even on the occasion above referred to, where the men were unaccustomed to the work, and the arrangements were necessarily imperfect, the time occupied was only twenty minutes from the killing the animal to the complete infiltration being made. The beast is then skinned, cut up into pieces, large or small, as may be required, and taken to a drying-room, where it is hung until thoroughly dried, after which it is packed in boxes with sawdust and charcoal. It is confidently believed that the meat treated in this manner will stand any climate. So far as its preservative powers have been tested in this country, the process is stated to answer the purpose. A purveyor at Portsmouth has for some time past treated meat in this way with success, and sells it in the regular course of trade. It is obvious that any variety of liquids, chemicals, or condiments may be thus injected into the animal and the meat flavoured in any way that may be thought desirable; the meat may also be dried like hams or bacon, if so wished. Indeed, it would seem that the method is peculiarly fitted for this purpose. In hot countries, and in countries where animals are abundant, and where now they are bred almost entirely for their wool, fat, or hides, the process seems especially valuable, as by it the meat, instead of being thrown away, might be rendered available for export for food to other countries. The Victualling Department have had a few animals thus prepared for experiment, and it is intended to send the meat out on voyages to various parts of the world to test its keeping qualities. So little machinery is required, that a ship's crew could readily carry out the process at any place where they could land and animals were abundant, and thus lay in a store of meat which, although, no doubt, salted to a certain extent, would not have the same disadvantages in a sanitary point of view, as meat preserved in brine-pickle.—*Grocer*.

Coal—A Geological Question.

The various kinds of coal with which we are acquainted are believed to be of vegetable origin, the remains of forests of a former epoch, and the theories as to their formation are well known; but there appears to be one fact connected with the subject which, as far as we can learn, has been entirely overlooked, and which will go to prove that the trees and plants which are now furnished in all parts of the world differ from those of the epoch to which we allude. When wood and land plants of any description are burnt, we always find that the ashes which remain contain carbonate of potash, from which source that salt is commercially supplied. On the other hand, when sea plants are burnt their ashes abound in carbonate of soda, and until of late years this salt was entirely derived from that source; it is now, however, also obtained from common salt. We have, therefore, a supply of these two alkaline salts, the one from the ashes of land plants and the other from the ashes of sea plants. But as we find neither the one salt nor the other in the ashes of any coal that we have examined, and as we do not find any account of these alkaline bodies being found by any other analyst in any variety of coal, we have reason to infer that coal is not derived from a vegetable kingdom similar to that with which the earth now abounds.

Now, neither wood nor coal contain the substances which they respectively afford by destructive distillation; but the elements of each being liberated by heat reunite and form certain well-known compounds, those produced by wood essentially differing from those produced by coal under the same circumstances, and whilst the ashes of the wood charcoal afford carbonate of potash, the charcoal or coke of coal does not, as we have before said, yield that substance.

We readily admit that the elements constituting wood might undergo certain changes in the earth during its transformation into coal, so that the destructive distillation of coal in the present day may give rise to products differing from those of wood similarly treated; but we would ask, What has become of so imperishable a compound as the carbonate of potash, which, if coal be derived from forests similar to those of our own time, it ought to contain? We might also ask a similar question as regards carbonate of soda, supposing it be contended that the origin of coal has been from sea plants.—*Sanitary Reporter*.

The Wrongs of the Stomach.

In most of the early literature is to be found a dialogue between Body and Soul, in which each accuses the other of their mutual perdition, recapitulating the offences which have produced it. Something similar might be written, with good effect, dividing the imaginary conversation between, let us say, the Stomach and the Man, and making an attack of gout the subject of their recriminations. The man might accuse the stomach of having done its duty so badly that he is tormented with a burning fire in his extremities, which will neither let him eat, drink, walk, nor rest. The stomach might plead justification, and say that she had lighted the said fire as the only means of getting a moment's rest from an intolerable task-master. Again the man might complain that he had lost all enjoyment of life, that his spirits were depressed, his mind gloomy, his appetite gone, his once fine muscular system reduced to flabby indolence; that his food did him more harm than good, so that it had become a misery to eat, and that every meal was followed by a leaden oppression which rendered life an insupportable burden. The stomach, having listened to all this, delivered in a tone of angry accusation, would reply: "My case is just as bad as your own. Once upon a time, before you took to evil courses, I was as healthy a stomach as you could meet in a day's march; I went through my work regularly, and did it so cheerfully and so well that, like some unreasonable masters when they get hold of a willing servant, you seemed to think I could do without rest and didn't care even for an occasional holiday. Then you heaped burden after burden upon me. Before I had well digested your breakfast for you, you thrust a dinner upon me large enough for three stomachs. Not satisfied with that, you wound up the day with a supper, drenching me all the time with ale, wine, spirits, tea, coffee, rum, more wine, and more spirits, till I thought you had taken leave of your senses; and when I heard you groaning in your sleep, starting up every now and then as if apoplexy had broken into the house, and was going to carry you off, I said to myself: 'Serve him right if it did.' And in this way you went on year after year, treating all my remonstrances with contempt. I gave you headache after headache; I tried to call you to reason with half a dozen attacks of influenza; gave you a billious fever; made you smart with rheumatism; twinged you with gout till you roared. But all to no purpose. You went on making me digest till the work broke my back, and now I can digest no longer." This reproach might be made even pathetic, by a description of the stomach watching its hard tasks come down to it from the regions above between dinner and bed-time. First comes a plate of soup and bread, and a glass of sherry; "I can manage that," says the stomach. Then a plate of fish, with more bread and more sherry; "and that," adds the stomach, "though these sauces don't quite agree with me." Then comes beef, or mutton, or both, and stout,; then a dish of tart. "Confound this pastry," says the stomach, "it gives me more trouble than any thing else; but if the master will only stop here, I think, if I put out all my powers, I can get even this rubbish out of the way." But she has hardly taken this hopeful view of the case, when down come cheese, celery, apples, oranges, nuts, figs, almonds, and raisins, port, sherry, claret, and a tumbler of hot Hollands and water. "Good gracious, was there ever such a mess?" exclaims the stomach; "what can the man nean? Does he think one pair of hands can manage all this?" Still the willing slave goes to work, when presently there is a rush of tea from above, with a thin slice of bread and butter. And when the stomach, with infinite labor, has got the Hodge-podge into some sort of homogeneous shape, and is preparing to take a nap after her exhaustion, lo! a devilled drumstick rushes into its laboratory, two devilled kidneys, a bottle of stout, and three tumblers of hot brandy and water.—*London Review.*

Brainwork and Longevity.

The philosophers ought to have length of days for their portion, seeing how their pursuits ought to elevate them above the disturbances of life. And such is in fact, the operation of their mode of life, by which their faculties are furnished with constant entertainment on subjects which would seem to lie out-side the range of uneasy passions, while creating or exciting the noblest moral emotion. And an unusual amount of healthy longevity is, in fact, found among philosophers—whether mathematicians, naturalists, or speculative students. Such things have been heard of as strifes in those serene fields of thought: such sights have been seen as faces furrowed with fretfulness, or working with passion; but the old age of many philosophers is, at this moment, an honour to their vocation. Peter Barlow was, when he lately died at 82, the same Peter Barlow that he had been to two generations of friends and disciples. Sir David Brewster is still active and occupied at the same age. The late Mr. Tooke did not puzzle his brains about the currency too much to be still up to the subject at 86. Sir Roderick Murchison is past 70, and so is Sir J. Herschel. Literature ought to have the same operation as science; but it seems to have more room for agitations and anxieties except in the case of authors who live in and with their work, exempt from self-regard. Jacob Grimm was a very perfect example in the philosophic serenity which a literary career can yield; and he lived to 78. There is something remarkable in the longevity of literary women in modern times, even if we look not beyond our own country. Mrs. Piozzi and Mrs. Delaney perhaps scarcely enter within the conditions; and the still lamented Jane Austen was under an early doom from consumption; but Miss Edgeworth was above 80 when she died; Joanna and Agnes Baillie were older still; and Mrs. Trollope died the other day at 84. The artists who have departed lately have been old. Biot was 87, and Vernet 74. Our Mulready was 77, and Cockerell, the architect, was 73.—*Once a Week.*

Oxygen Gas.

At a lecture delivered to the shampooers and attendants at the Hammam, Jermyn-Street, on Monday night, by Dr. Leared, Physician to the Hospital for Consumption, a novel mode of producing oxygen gas in a perfectly safe, cheap, and simple manner, was introduced for the first time in public by Mr.

Robins, the analytical chemist. The method consists in treating chromate of potash and peroxide of barium with diluted sulphuric acid. The operation is performed in a common glass jar or retort, and at the ordinary temperature. To those who are accquainted with the plan hitherto adopted of heating manganese in iron bottles this discovery will need little recommendation, and it is difficult to predict to what discoveries and improvements in the economy of life and light it may lead. Meantime it is interesting that this discovery should have been first introduced to the public within the walls of an institution where the body is so largely benefited by natural processes of oxygenation.

A New Pigment.

A new pigment, says the *Mining Journal*, calculated at the same time to increase the resources of the decorative painter, and to afford a ready means of preserving iron and other metals, has recently been introduced at Paris by Mr. L. Oudry of the Auteuil Electro-Metallurgic Works. He first obtains an absolutely pure copper by throwing down the metal by the galvanic process; he then reduces the precipitate to an impalpable powder by stamping. This powder is then combined with a particular preparation of benzine, and used in the same way as ordinary paint; beautiful bronzed effects are produced upon it by means of dressing with acidified solutions and pure copper powder. The articles painted with the new material have all the appearance of electro-bronze, whilst its cost is less than one-sixth; it will last from eight to ten years. Mr. Oudry also proposes to substitute benzine oil for linseed and other oils, over which it possesses great advantages.

Our Machinery.

What a contrast does the work of the machinists of the present day present to those of a hundred years ago! At one time, as Mr. Smiles observes, an engine of any size, when once erected required the constant attention of the engineer, who almost lived beside it in order to keep it in working order, such was the friction of its parts and the clumsiness of its construction. At the present time, however, almost absolute perfection of working is obtained. When the 5,000 different pieces of the marine engines designed for the *Warrior* were brought together from the different shops of Messrs. Penn, although the workmen who built them up had never seen them before, yet such was the mathematical accuracy of their fit that, immediately steam was got up, they began working with the utmost smoothness. As a new-born child, as soon as it enters the world and expands its lungs, begins to stretch its limbs, so this gigantic engine, immediately steam began to expand in its cylinder, at once exerted its huge members with the smoothness and ease of life.—*Once a Week.*

The Metal Vanadium.

The metal called Vanadium, discovered in English pig iron, is used in the preparation of writing ink. To a solution of nutgalls is added a minute portion of vanadic acid, and the ink thus obtained is intensely black and indelible by the ordinary agents which destroy the color of the ink in common use.

Rat-skin Gloves.

An exchange says:—"It is rumored that a company of Frenchmen has been formed in Chicago, for the purpose of catching all the rats possible, curing their skins and exporting them to Paris, to be used in the manufacture of gloves. For years what is called 'French kid' gloves have been made from the skins of these animals, caught in Paris and other parts of Europe; but the demand being greater than the supply it has become necessary to extend the rat catching arrangements to America, and no finer field than Chicago for such operations can possibly present itself."

How Glass Chimneys were Invented.

Argand, the inventor of the famous lamp which bears his name, had been experimenting for some time trying to increase the light, but to no purpose. On a table before him lay the broken neck of an oil flask. This he took up carelessly, and placed it, almost without thought, over the wick. A brilliant flame rewarded this act, and the hint was not lost on the experimentalist, who proceeded to put his discovery into practical operation at once.

Is Flax Exhaustive?

It is believed by many that flax is an exhaustive crop, but it is to be doubted if it is more so than most of the small grains. All of them are so if the land is continually cropped and nothing returned to the soil. Experiments of Professor Johnson showed that flax is less exhausting than either wheat or oats, judging from the amount of phosphoric acid given by its ash. Dr. Hodges, of Belfast, Ireland, recommends the application of 48 lbs. muriate of potash, 16 lbs. soda ash, 54 lbs. bone dust, 56 lbs. sulphate magnesia, 34 lbs. gypsum, per acre, as a manure for flax land.

Death in the Sweet-meat Jars.

A child was recently poisoned in Pennsylvania, so that death ensued, from eating apple-butter which had been kept in a glazed jar. This glazing contains an active poison—the oxide of lead—which is dissolved by fruit acids, and is extremely dangerous to life. All such substance as apple-butter and the like should be kept in wood or glass vessels, so as to avoid the possibility of mischief. The above is not a solitary instance, as many similar have occurred.

Lighthouse Illumination.

Lighthouse illumination produced by a magneto-electric apparatus has been in successful operation at the South Foreland and Dungeness beacon for two years. Currents of air produced by the rotation of masses of iron in the neighborhood of powerful permanent magnets generate the current of electricity, which ignites pieces of carbon intensely, thus producing the light.

Preventing Incrustation of Steam Boilers.

Mr. John Travis, of Royston, Lancashire, proposes the use of Irish moss, or silicate, arseniate, or phosphate of soda, to prevent incrustation of steam-boilers. From 6 lbs. to 8 lbs. per week, usually suffices for 40 or 50 horse-power boiler.