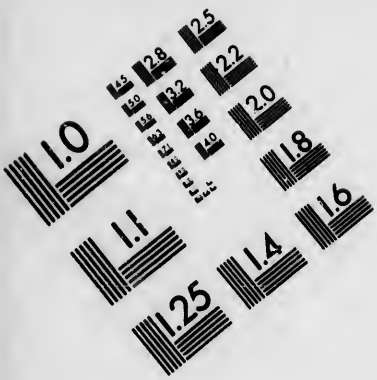

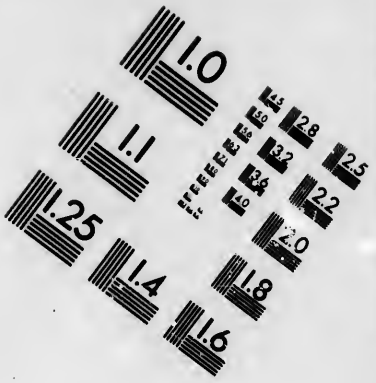

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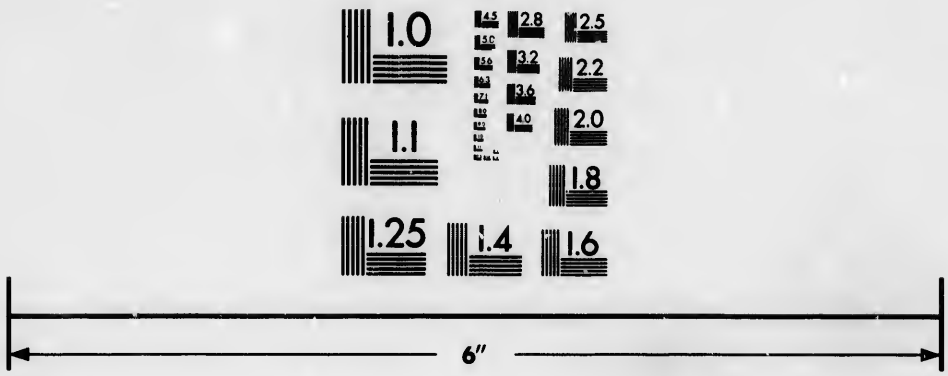

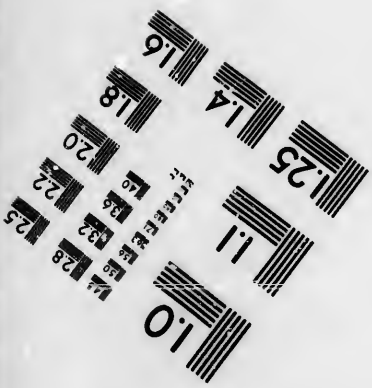

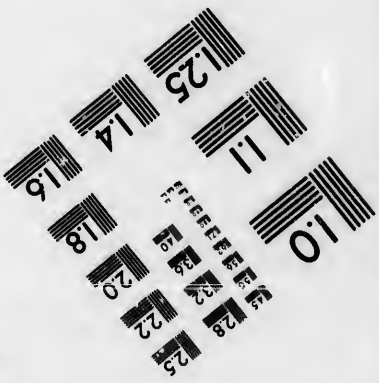

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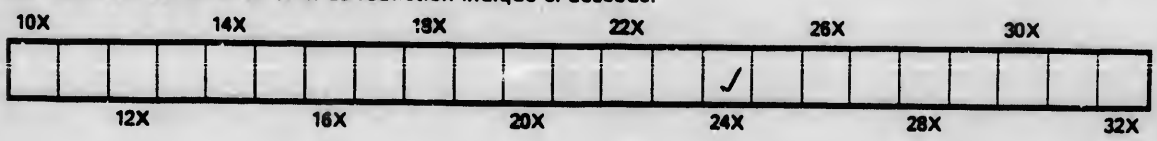

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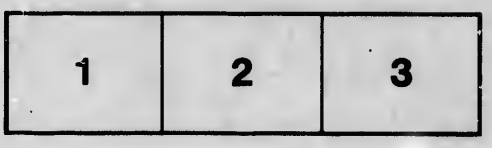

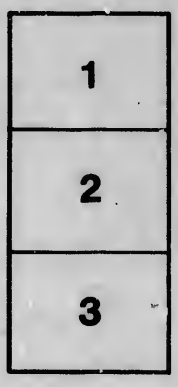

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Notes on the Manufacture of Compressed Peat Fuel

UNDER THE DICKSON PATENTS

Feb. 1/99

These notes, of the character of suggestions, were originally compiled for the private use of the undersigned, but have been printed by request, to serve, at least, as a form or basis for computation. The present issue is a revision, with the addition of further data.

CERTAIN WORKS ON PEAT

"Metallurgy," by John Percy, M.D., F.R.S., F.G.S. Vol. on Fuel, etc., London, 1875.

"Utilization of Peat and Peat Lands," by ——— Paget, C.E., contained in Part 2 of the "Reports on the Vienna Universal Exhibition of 1873."

"On Torbite and Its Uses," by D. K. Clark, Civil Engineer. Paper read before the British Association for the Advancement of Science in 1865.

"Peat and Its Uses as a Fertilizer and Fuel," by Samuel W. Johnson, New York, 1866.

"The Industrial Resources of Ireland," by Sir Robert Kane, Dublin, 1845.

"Report of Commission for Investigation of Improved Peat Fuel Manufacture," Dublin, 1873.

"Facts About Peat" (as an article of fuel), by T. H. Leavitt, Boston, 1867.

"The Utilization of Peat," by B. H. Paul. Paper published in the journal of the Society of Arts, 1862.

EXTRACTS FROM T. H. LEAVITT'S "FACTS ABOUT PEAT."

(1). "Freshly cut, it is found to be saturated with water to the extent of from thirty to ninety per cent., according to locality and density; and even when subjected to the ordinary process of air-drying, it will be found to have retained a considerable percentage of moisture for a long time, even after it has the appearance of being perfectly dry."

(2). "An acre of peat of fair quality, *well-drained*, if one foot in depth, will generally contain 1,000 to 1,200 tons, yielding 250 to 350 tons of dry fuel."

(3). "Few peats, however *well-drained*, contain less than 50 per cent of water, and most contain from 65 to 85 per cent. Our own estimates have always been made on 75 per cent of moisture, which is safe, but it is quite probable that 70 per cent. would be fair in the majority of *well-drained* meadows."

(4). "A cubic foot of crude peat taken from a *well-drained* bog weigh from 50 to 55 pounds."

(5). "A ton of wet peat, as cut, will measure about 40 cubic feet, and about 160 cubic feet of crude material are required to produce one ton of dry fuel. Some very compact peats, however, require not more than 140 or even 120 cubic feet for a ton of dry fuel." (Italics not the author's.)

NOTES ON THE ABOVE EXTRACTS.

The ton is presumably 2000 lbs. here, and all calculations are made on the basis of 2000 lbs. to the ton.

SHRINKAGE:—The average percentage of shrinkage in bulk is not given.

A. M. Panton, of Stratford, places the shrinkage in bulk of Welland peat at 50 per cent. The product of different bogs varies widely. The important figures to obtain are however, the number of tons of dry fuel an acre will yield, and the weight of a dry yard.

From above extracts we have one cu. ft. of wet peat equals 50 lbs., yielding 12½ lbs. of dry peat, or one cu. yd. yields 337 lbs. of dry fuel, and one acre 272 tons, taken one foot deep, or 1,089 tons per 4 ft. in depth. If 120 cu. ft. yield a ton of dry fuel then we have 362 tons per acre taken one foot deep or 1,442 per 4 feet. The shrinkage in weight according to these figures is from 66⅔ to 75 per cent., and the yield 33⅓ and 25 per cent.

By reference to the article, "Cutting Peat by Hand in Hanover," we find Schroeder's experience shewed a yield of but 10 per cent.

Mr. Panton says that a cu. yd. of wet peat from the Welland bog would give 250 lbs. which at 55 lbs. (supposed) to the wet cu. ft. indicates 17 per cent.

WEIGHT OF DRY PEAT:—By measurement on dry crude slaned peat from the Welland bog, the bulk of one ton of dry fuel was found to be, when packed closely in a box, 90 cubic feet (600 lbs. to the cu. yd). By another measurement, on puddled peat loosely thrown in a box, the same figure was obtained. Another set of measurements shewed: 1 cubic foot dry crude puddled peat to equal 22 lbs.; 1 cubic foot dry powdered peat, 24 lbs., or 594 and 648 lbs. to the cu. yd. respectively.

A dry yard of peat from the Ellice bog, north of Stratford, weighed 660 lbs.

"The weight of a cubic yard of various kinds of air-dried peat is, according to Sir Robert Kane, as follows: light peat, so much used for domestic fuel, about 500 lbs.; good peat, packed close in the form of sods, about 900 lbs.; and the densest peat, well packed, as much as 1,100 lbs.

"Other statements concerning the weight of air-dried peat are as follows: the weight of a cubic metre of air-dried peat varies from 250 kilograms (423 lbs. to the cubic yard) for mossy peat to 450 (763 lbs. to the cubic yard) for the blackest kind."—*Percy's Metallurgy.*

CALCULATIONS on the size of cut required to yield one month's supply (1,250 tons). One acre yields 250 tons taken one foot deep.

Let the cut be 12 feet wide and 3 feet deep. Then the length to yield 1,250 tons would be 6,050 feet, and for spreading ground we require a strip on each side, 33 feet in width (total 66), if peats are 8 in. thick and if 3 ft. berme and 10 per cent. for interstices is allowed.

CUTTING AND SPREADING:—Leavitt in "Facts about Peat," page 33, states that a man *can* cut 25 or more blocks of peat weighing 15 pounds each, in a minute when working "by the job" he *will* cut 20-22; and when working "by the day" he *does* cut 15 or more.

The latter figures give 67½ tons per day; Leavitt offers 50 as a conservative estimate. If it takes two men to spread what one man cuts, (considering that the peats have to be wheeled a certain distance when large quantities are required) then we have at least 16 tons of wet peat (making at least 4 tons of dry peat) per man per day.

A. M. P., experimenting in the Welland bog, allows 2¼ dry tons per man when two men work together, one cutting and one spreading; but in this bog there are roots to be contended with, from which many bogs are free. If we allow another man spreading, this must be reduced to 1½ tons per man per day.

Leavitt, page 40, quotes B. H. Paul as follows: "Two men working together, one cutting and one casting, will in good weather get through what is the equivalent to ten tons of dry peat." If we say three men, on account of the distance to spread, we have 3⅓ tons per man. The same author, page 36, quotes Prof. Johnson with reference to Brosowsky's peat cutting machine, as follows:

"Four hands will cut and lay out to dry 12,000 to 14,000 peats daily or 3,100 cu. ft."

Which means 77½ tons, estimating 50 lbs. to the cu. ft., or 19½ tons of wet or nearly 5 tons of dry peat per day per man, or adding 2 helpers, 3⅓ tons. If the number of tons that a man can take out and spread when 3 work together may be estimated at from 1½

to 4, the cost per ton with the labor at one dollar per day will be from 25 cts. to 66 cts per ton, even when the peat has to be wheeled some distance (say an average of 22 feet, that is from 4 to 40.) There is a great discrepancy here, but very probably in a good bog the taking out and spreading may not exceed 35 cts. per ton.

In the estimated "cost of production" the amount set opposite "cutting and spreading" is partly based upon the percentage of yield of dry fuel from wet peat, from a well-drained bog, according to Leavitt. This yield, as will be remarked, is much higher than in the figures that Percy gives as Schroeder's experience in Hanover, and consequently the cost of excavating per ton of dry fuel might be greater. However a great deal depends on the state of drainage of the bog, and the character of the peat. It would appear from the extract that the peat from Schroeder's turbary was of good quality, and in all probability, as well or better drained than the majority of the bogs in this country. The weight of the air-dried peat at the figure given in the extract from Percy's Metallurgy, as below, (viz.:— 1-16 cubic foot weighs 1¼ lbs. (Hanoverian ?) is 648 lbs. to the cubic yard (English).

DRYING:—A. M. P., in his report on the manufacture of peat from the Welland bog, says that the cost of turning and stacking should not add over 30 cents. per ton (though varying with different circumstances.) This means 24 cents with labor at 10 cents per hour. The marking and cutting of puddled peat (necessary where a dredge is used) would add something, but how much is doubtful.

TRAMMING:—He gives the cost of loading, tramming and unloading at 12½ cts. with labor at $1.25 per day; but the distance, though not given, may be presumed short, from the circumstances of his experiment.

If a man can load one ton on a car in half an hour, which I calculate as safe from a small experiment, and if it will take a man, going and returning, 45 minutes, averaging the distance at ¾ of a mile (that is from 100 yds. to 1½ miles), the cost will be for loading 5 and tramming 7½ cts. per ton with labor at $1.00 per day.

Now suppose a carrier or elevator 18 in. wide with a load averaging 6 in. deep per foot of carrier, we have ¾ cu. ft. or 17 lbs. per foot. If the carrier is travelling 30 ft. per minute, it will take away over a ¼ ton per minute, or a ton in 4 minutes, therefore it will not take the man more than 5 minutes to dump his load by portions on the carrier, the cost of this therefore, is not more than 1 ct. per ton. The cost of the tramming may be reduced by bringing in the cars in a train by means of a small locomotive.

STEAM EXCAVATOR:—The crew would consist of, say, one runner at $60 per mo. (12 hour day), one assistant at $40, one fireman and one extra man at $30 each, and allow three men at $30 on the field to clear the ground, distribute the puddled peat, collect fuel, etc.; total, $250, but including board, $325. Product estimated at 1,200 cubic yards per 12 hours, yielding from 100 to 250—say 150—dry tons, or 3,750 tons per month of 25 days. The cost per dry ton would be thus under 10 cents; repairs, oil, etc., extra. This estimate is considered fair.

TRACKS:—In order to have two sets of tracks one on each side of the cut which is gradually being widened, we shall require 2½ miles of track.

FOREMAN:—A foreman over the field work at $2.00 per day would add 2c. per ton (calculating that 6 months' outside work is done per annum and 15,000 tons of dry peat excavated.) Allow two foremen when dredge is not used. For 15,000 tons the gang of men excavating might number 60, and drying and tramming the same.

The over-feeding of the breakers may be prevented by the installation of a chain-raker over the breakers.

The excavation and tramming would probably be done by contract.

Re Weight of Manufactured Fuel.—This has been found to vary in density from say 65 to 85 lbs. per cubic foot, and when measured as stored from 40 to 55 lbs.

CUTTING PEAT BY HAND IN HANOVER.

PERCY'S METALLURGY (Vol. on "Fuel, Etc.") page 220.

It has been asserted that nowhere has the extraction of peat been more skilfully and more economically conducted than in East Friesland, in Hanover; and as the detailed account of the process, published several years ago by Schroeder, has been widely circulated in various languages, and generally accepted as important in a practical point of view, it is inserted in this place; and, further, the author has met with nothing better of its kind. It is stated that the price of peat is not so high in this locality as in many other countries where wages are considerably lower, a fact which is ascribed to more skilful organization of labor in getting the peat and preparing it for the market.

The bog, it is assumed, will admit of being drained by simple trenching. The peat is gotten in lengths, 10 feet wide and from 100 to 1,000 paces long, excavated crosswise, *i.e.*, in the direction of the width, so that the working face is 10 feet broad. It is wholly extracted either in one working or, if the bed be too thick for that method, in one or more successive courses. Usually only one length of the dimensions above given is cut in a year from the same bog. In the following year another similar length by the side of the former is excavated, the trench, made by the removal of the peat, thus yearly increasing 10 feet in width and the useless stuff, pared off the surface to the depth of 1 or 1½ foot, is thrown into the worked-out space, with a view to its future cultivation, and in order that the walls of the trench may receive some degree of support, and their tendency to break off and fall down be diminished, an evil which adds much to the difficulty of getting the peat. Five workmen are employed, whose labor is distributed as follows. One man, the *clearer*, removes with a spade, from the surface of a length pared the year before, a layer about 2 inches thick, which has been weathered by atmospheric action, especially by frost. Two men, the *cutters*, are engaged in cutting the peat, of whom one stands on the top and thrusts straight down a long-nandled, heavy iron tool, which cuts sods 17 inches long and 5 wide, whilst the other, standing underneath, using a light wooden spade, pointed with iron, cuts the peat horizontally of the thickness of 5½ inches and conveys it on a board to the margin of the trench; and from time to time these men change places with each other. Each peat so obtained measures ¼ cubic foot, and, when fresh, weighs from 12½ to 13 lbs. (The Hanoverian foot is divided into 12 inches, and is equal to 11½ English inches; and the Hanoverian pound is equal to 1.0731 lb. avoirdupois.) Expert workmen will cut about 25 of such peats or 6½ cubic feet in a minute. (See Note A.) A fourth man, the *barrow-loader*, takes the peats where they are left by the cutters, and with the assistance of the first man piles them in wheelbarrows, one upon another, in two rows of six each to a load, which therefore weighs about 150 lbs. The fifth man, the *barrow-wheeler*, with the help of the first, wheels away the peats, and, by simply upsetting the barrow, arranges them, for draining and drying, over the surface of the bog, on one side of the trench, previously cleared and prepared for that purpose, in rows of sixteen each, and at right angles to the direction of the trench, each row beginning at the distance of 10 feet and extending to the distance of 50 feet from the trench. The fifth man may also be set to work at clearing off the useless stuff from the surface of the bog, along the same side of the trench, to the extent of 10 feet from it, that is, up to the commencement of the rows of peats placed for drying, so that this length of bog may be made ready for cutting during the following year. By moderate labor 3,000 cubic feet or 12,000 peats may be cut daily; and this quantity is said to be a day's work for five men, and is taken as *the day's work* in contracts with the workmen. Skilful workmen, by extra labor, will per-

form the day's work in from 8 to 10 hours; when the extraction cannot be carried on during the whole day, as often happens, such workmen will by laboring 15 hours daily *(? on some days)* get 7 days' work in 5, that is 4,200 cubic feet, or 16,800 peats a day, somewhat more than 210,000 lbs. or 90 tons, which divided amongst the five men is at the rate of about 18 tons per man. (See Note B.) When the peat to be cut is not more than 4 or 5 feet thick, five workmen suffice, but, in extracting double that thickness of peat at the same time an additional workman is required, and the extraction is effected in two courses. Peat to the depth of 4 feet is first extracted, and as provision must be made for drying this as well as that to be afterwards cut out in the second and lower course, the peats gotten in the first course must be carried far enough away from the trench to leave an intermediate space for those of the second course, a space of 10 feet from the edge of the trench being always kept free with a view to next year's working. After taking out the peat along a short portion of a length to the depth of 4 feet from the surface laid bare by the removal of the overlying useless stuff forming a layer about 1½ foot thick, the extraction of the second layer of that portion is proceeded with. The organization of labor is the same as in cutting a single course of peat, with the exception of that relating to the sixth man. In getting the second and lower course of peat, 4 feet thick, the cutters would not be able to throw up the peats fast enough for the wheeler without the aid of the sixth man, the *helper*, who now stands on the top of the second course, where the first course has last been taken off, and catches on a broad wooden shovel the peats thrown up to him by the cutters below, and tosses them to the loader above. This man also acts as a second wheeler in conveying the peats to the drying-ground. The peats, after having been left for a certain time on the drying-ground, are carried away by women and gradually built up by them in high wall-like rows; a peat and a half thick, care being taken to let one row become somewhat dry before another is piled upon it. In ordinary weather the peats so arranged are left to dry further for about a month; and when they appear to be dry, but when in reality they are only half dry, they are either carted from the bog to be stored up in magazines, or, as is usual in East Friesland, piled up in large stacks in the bog itself, and there left to be further air-dried. A good workwoman can deal with 12,000 peats daily, that is, the number gotten by a gang of five men. When the weather is very favorable, the peats may be taken immediately from the wall-like rows and piled up carefully in cylindrical stacks of from 200 to 500 cubic feet in volume, that is, from ¼ to ½ a day's work.

The day's work, of 3,000 cubic feet of freshly-gotten, very good black peat, hardly yields 800 cubic feet of dry peat, while the same volume of light grey peat will yield 2,000 cubic feet, and occasionally even more, of dry peat. (See Note C.) The volume of a good black peat after drying is at the most 1/16 of a cubic foot, and the dimensions are 12 inches long, 3 wide and 3 thick. The weight of an air-dried black peat of average quality, with the usual proportion of from 18 to 20 per cent. of hygroscopic water, and when freshly cut of the dimensions previously stated, is 1¼ lb., which indicates a yield of 10 per cent. of air dried peat from the bog (see Note D); but in the half-dried condition in which the peat often comes into the market, the weight is often 50 per cent. greater. A peat from the lower part of the bog is, as a rule, heavier than 1¼ lb.; and after good drainage, the result of working, when a bed from 8 to 10 feet thick, previously drained superficially, is often reduced 2 feet and more in thickness, the density of the peat is increased so considerably that a dry black peat weighs 1½ lb. and one of the best quality 2 lbs. (See Note E.) On an average, in the case of ordinary black peat, the day's work may at the least be taken as 150 Centner, but it may amount to 180 or even 240 Centner (1 Centner=113.426 lbs. av.). (See Note F.)

The cost of cutting, etc., for the day's work (=3,000 cubic feet), exclusive of rent and wear of tools, was, in 1860, as follows (1 Rthlr. or Thaler = 2*s.* 10¾*d.*, and 1 Sgr. or Silbergroschen=1⅙*d.*):—

	Sgr.	Rthlr.	Sgr.		Rthlr.	Sgr.
Two cutters	at 15 to 20	1	0	to	1	10
One clearer	" 14 " 19	0	14	"	0	19
One helper, One barrow-loader, One barrow-wheeler	" 13½ " 18½	1	10½	"	1	25½
Customary payments, including allowance for drink		0	10½	"	0	10½
Cost of drying		0	20	"	0	20
Cost of stacking in circular heaps		0	10	"	0	10
		4	5	to	5	5
English money		12s.	$0\frac{5}{6}$d.	to	14s.	$11\frac{7}{12}$d.

(See Note G.)

The cost of getting in the first year of opening the bog is higher by about 13½ to 18½ Sgr. than in succeeding years, so that, without reckoning rent and cost of tools, the cost of the day's work may descend to 3 Rthlr. 15 Sgr., or 10*s.* 1¾*d.*

Taking the cost of the usual day's work (150 Centner) at the highest figures, 5 Rthlr. 5 Sgr., exclusive of rent, the cost per Centner is about 3½ Kreuzer (=1.05*d.*); and taking the day's work at 180 Centner, and the cost at 3 Rthlr. 15 Sgr., the cost per Centner amounts only to about 2 Kreuzer (=0.6*d.*). (See Note H.)

Now the cost in Bavaria, where the wages were actually lower, amounted in 1860, to 11½ Kreuzer (=3.45*d.*) per Centner; and as 1,000 of the Bavarian peats weigh 438 lbs., the price per peat is ½ Pfg. (=0.048*d.*).

As a guarantee for the accuracy of the foregoing figures, it should be stated that they were the result of Schroeder's personal experience in managing the working of a bog in East Friesland during two years.

NOTE A.—By this one Hanoverian cubic foot of wet peat from this bog weighs from 50 to 52 Hanoverian pounds or one English cubic foot weighs 47 to 49 English pounds, and an excavation of 6¼ cubic feet (Hanoverian) per minute indicates 79 tons of 2,000 English pounds per day of 10 hours.

NOTE B.—This 210,000 lbs.=225,350 English pounds or 112½ tons of 2,000 English pounds, *i.e.* 22½ tons per man (16 tons, "by moderate labour," as previously referred to.)

NOTE C.—The shrinkage in bulk here is from 33⅓ to 73⅓%, the least in those peats which yield the smallest percentage of dry fuel from a given quantity of wet.

NOTE D.—This is a much lower per cent. than that given by Leavitt—viz. 25%.

NOTE E.—Indicating a yield of 16 per cent. of dry peat.

NOTE F.—That is from 8½ to 13.6 tons of 2,000 lbs., or 1.7 to 2.7 tons per man (gang of 5).

NOTE G.—The cost of drying and stacking is here put at 30 Sgr., or 71 cents for 8½ tons (the lowest estimate) equaling 8.3 cents per ton, but labour was from 36 to 51 cents including customary extra payments. Taking the average at 43 cents, and the wages in Canada at 233 per cent. greater (namely, $1.00 per day) the cost here would be 19¼ cents, or 24 cents with wages at $1.25 per day.

NOTE H.—The cost per ton of 2,000 lbs. at 2 Kreuzer per Centner for cutting, drying and stacking equals about 22 cents, equivalent to 51 cents, with labour at $1.00 per day, but at 3½ Kreuzer equivalent to 87 cents.

MANUFACTURE.

In winter, say eight months, a man will be required to feed carriers in the store shed, cost $400, for two shifts, but he would serve two machines.

Distributed over 15,000 tons (the product of one machine running 20 hours per day) this would add 3c. per ton, but with two machines running, only 1½c.

In the machinery department—provide for one engineer at $700, one at $500, and two helpers at $375 each per annum (two men for day and two for night.)

Distributed over 15,000 tons, this comes to 13c. per ton. As the year is reckoned at 250 days, there is ample here for waste time, repairing, etc. The fuel will consist of roots, pieces of stumps, crude peat, etc. Call the cost of collecting 90c. for a quantity equivalent to a ton of a fuel which would furnish one H.P. per hour per 4 lbs.—and say two such tons would be used per 30 tons of product, and the cost will be 6c. per ton of product. (See the cost of the manufactured fuel.)

In the case of a two-machine plant (steam type) the cost of manufacture is placed at 21 cents.

Repairs would cost for material, say not over $225, or 1½c. per ton.

In some cases the railway companies will build sidings, at their own cost; in others, they will furnish rails, charging interest on same at about ————, while the ballasting and ties have to be paid for by the Contractor.

EXPENSES OF DISTRIBUTION.

LOADING INTO CARS.—If a carrier travels 50 ft. per minute and carries _ lbs. per ft., it will take 8 minutes to load one ton and cost say 1½c. per ton or $150, for loading 10,000 tons, passing through the fuel storehouse, or if distributed over 15,000 tons (the annual production) 1c. per ton. The balance of the 15,000 tons is supposed to be loaded directly into the cars.

DELIVERY.—The cost of this per ton can be covered by 25c.

OFFICE EXPENSES.—The office expenses for disposal of 30,000 tons—the product of a two-machine plant—are placed at 20 cents per ton, which would give $6,000, for this.

Office expenses for the sale (in one town) of 8,000 tons, and including periodical inspection at the factory.

Office rent, fuel and light	$200 00
Manager, book-keeping and collection of accounts, etc.	1,300 00
Stationery, postage, travelling, insurance and incidentals	500 00
Total	$2,000 00
	or 25c. per ton

NOTE.—The balance of the annual product of 15,000 [illegible] supposed to be sold in other districts; and at the same rate of 25c. per [illegible]ll be $1,750 to cover office expenses and selling the same.

MEMORANDUM RE FREIGHT AND DELIVERY.—If the [illegible] 7½ miles from the point of consumption and the average load be 2½ ton. [illegible]an be hired at $2.50 per day, when fairly regular work is assured; then [illegible] delivery can be estimated somewhat as follows:—

Loading and unloading	1 hour
Going at 3 miles per hour	2½ hours
Return at 5 miles per hour	1½ "
Total	5 hours

Cost per ton, 50c.; or 6⅔c. per ton mile.

If a team cost $3.00 per day, then the cost per ton will be 60c. or 8c. per ton mile.

NOTE.—It is assumed that the road be fairly level and that the loading be done by gravity at the factory. The distance is perhaps extreme, but the load will often be increased.

Among the advantages of freighting by rail instead of by teams, we may suggest the following: that the state of the road bed varies with the weather; that if the distance be just a little too great to deliver one load in half a day, certain complications may ensue which render the delivery more expensive. Moreover, it will be necessary to have the railway to depend upon in case we wish to dispose of surplus fuel outside the district.

The density of the peat fuel varying, the number of tons that *could* be stored in a box car 7½ x 7½ x 35 would run from 40 to 55 tons. Railways will build special cars for the traffic, if sufficient were obtained.

ESTIMATED COST OF PLANT.

Comprising one machine carrying its own steam cylinders, two breakers, boiler, etc., etc. Product, 3 tons per hour or 7,500 tons per year of 250 working days of ten hours each. Double this product for a 20-hour day.

NOTE:—The preliminary outlay for machinery, building and contents may be placed at $5,500: for storage for 1,000 tons of fuel, $350.; for trams and track $650.; total $6,500, and the outlay for labor till revenue commences may be estimated on credit obtainable, if any, and on the amount of fuel that the manufacturers feel inclined to make before they test the market, at the same time fulfilling the conditions imposed by the CANADIAN PEAT FUEL CO. It will thus be seen that a comparatively small amount of capital need be sunk in the preliminaries.

MACHINERY SHED AND CONTENTS.

Building—30 x 40 ft.—and boiler room with foundations for machines	$ 350 00
Steam compressor—capacity 3 tons per hour (weight 14 tons)	2500 00
Breakers,—2 @ $200	400 00
Boilers (2)—50 H. P. each, (locomotive type); feed pump, inspirator, steam pipes, smoke stack, etc	1500 00
Auxiliary engine,—20 H.P., (second hand) and foundation	275 00
5 H.P. Dynamo (for furnishing 2 H.P. for 20 lights and 2 H.P. for motors), wiring, belting and lamps	125 00
Pump for fire protection (second hand) and 300 feet of hose	300 00
Carriers, elevators, hoppers, feed box, chute and tank	150 00
Belting, shafting, pulleys, etc	200 00
Tools for engine house and machine shop	100 00
Freight (100 miles) and cartage	100 00
Installation of all machinery above mentioned	400 00
Inspection, travelling and incidentals	300 00
	$6700 00

NOTES:—All machinery quoted f.o.b. cars at Engine Works where made. Belting, etc., figures at close wholesale prices. The foundation for compressor (which is self-contained) and boilers need not be concrete or masonry, but heavy timbers on ballast. Roughly estimated, total weight of machinery under 40 tons.

STORAGE FOR CRUDE DRY PEAT.

Two sheds, 40 x 225 ft. each, capacity 10-11 tons per foot according to density. Take as a conservative estimate that it would be necessary to provide for 8 months' supply—5,000 tons. To store after breaking would cost less, but the wisdom of doing so is open to question.

450 running feet of shed at $8	$3600 00
950 " " carrier at 95c	902 50
40 " " elevator, etc	65 00
1 2 H.P. motor, wiring, belting, pulleys, etc	82 50
	$4650 00

Add $4,500 to provide for storage of another 5,000 tons.

STORE FOR MANUFACTURED FUEL.

One shed, 40 x 70 ft. Estimated required storage—50 per cent. of the output of the 6

months in which the least fuel is burned—1,900 tons. Capacity 20-28 tons per foot, according to density; the storage is here calculated on the density of the Ellice peat (would run 28 tons to the foot in these sheds.)

70 running feet of shed at $8			$560 00
140 " "	carrier at 95 cts		133 00
15 " "	elevator to cars, etc		32 00
			$725 00

Add $675 to provide for storage of another 1,900 tons.

NOTE:—The cost of the buildings was figured by a contractor on a design furnished him—3 ply tar paper on roof—hipped roof for carriers above—hoppered floor and channel under floor for carriers—all well built and designed to save manual labor in handling either the crude or manufactured article. When the trams arrive at the machinery shed they may either be dumped or unloaded gradually to suit the carrier and elevator which takes the peat to the breakers above the machine. Chain-rakers or or other device may be installed to regulate the feeding of carriers or breakers. The powdered peat will descend into a feed box and thence to the machine. The manufactured article will drop onto an elevator which will transfer its load to a carrier running under the roof of the store-house. A switch can be placed where required to unload the carrier.

The store-house for the crude article for winter use can be filled in the same way; and both store-houses can be emptied by having a carrier run under the central portion of the floor, which portion will consist of a hatchway in sections, which can be removed successively at will, to allow the peat to fall upon the carrier.

If it is desirable or cheaper, in the case of the manufactured article, to load by gravity into the cars on the switch, the lower carrier can be dispensed with. A considerable saving in carriers may be effected by widening the shed and the cost of handling the peat not increased, because the feeder has time on his hands. The carriers here figured on are constructed on the principal of clay carriers, stout canvas being used, supported every 18 inches by slats of wood fastened by means of attachment links to two strands of link belting, one on either side of the canvas; the whole being supported every 10 ft. by idlers with the necessary sprockets, take-ups, etc., at either end. (Wooden slats may be substituted for canvas at an increase of cost.) This style of carrier is suggested on account of the lessened friction which would be considerable in any form of carrier which transported its load with scrapers.

TRAM TRACKS.

Steel Angles—1⅜ x 2 x 5/16 in.—2.7 lbs. per foot.
Spikes—2½ x 5/16 in.—20 to the lb., spaced 30 in.
Stringers and Ties—2 x 4 in., hemlock.
Ties—5 ft. long, spaced 33 in.

A T rail, say 4 lbs. per ft., would be preferable, and the extra cost would be say $300 per mile.

	COST PER MILE.	
14.25 tons angles at $40	$570 00	
2 kegs spikes for angles at $7.50	15 00	
3 kegs spikes for timber at $2	6 00	
6½ M for ties at $10, delivered	65 00	
7 M for stringers at $10	70 00	
Punching angles, labor in field, etc	100 00	
1 mile track (switches, etc., extra)		$826 00
4 trams (for more expensive trams say $200)		100 00
		$926 00

SUMMARY.

	10 HRS. PER DAY.		20 HRS. PER DAY.	
Machinery shed and contents	$6,700		$6,700	
Storage for crude peat	4,650		9,150	
Storage for product	725		1,400	
Tracks, including switches, etc., and trams	950		1,850	
Ballasting of railway switch and ties (nominal distance) say	250		250	
		$13,275		$19,350
EXPENDITURE FOR LABOR WITHOUT REVENUE.				
Excavating, drying, and tramming from May 1st to Sept. 30, 7,500 tons at 80 cts	$6,000			
Manufacturing from June 1 to Sept. 30; 2,500 tons at 30c.	750			
		6,750		
Double this amount for 20 hrs. per day				13,500
REQUIRED CAPITAL (annual product 7,500 tons)		$20,025		
REQUIRED CAPITAL (annual product 15,000 tons)				$32,850
Add for dredge and distributor, set down in swamp(?)	$4,000			
Deduct in this case from labor account for 7,500 tons	1,500			
For 15,000 tons	3,000			
Balance required to add respectively		2,500		1,000
		$22,525		$33,850
N.B.—Add for premiums to CANADIAN PEAT FUEL COMPANY and organization expenses		.....		.....
Add for price of peat lands		.....		.....
Add for drainage and cleaning land, if necessary		.....		.....
Add for boarding house, if necessary		.....		.....

NOTE.—The cost of the dredge to excavate the peat at 10c. per dry ton is only suggested here. A further margin allowed it will be noticed. A 3 or 4 H.P. locomotive ought also to be figured on, for large works, which could probably be procured for about $750 where a number were turned out from same design.

It is obvious that the amounts of required capital as given above may be reduced (even if no credit were obtainable on warehouse receipts, etc.) considering that the first year's output is not likely to be, and in any case need not be, the full capacity of the plant. Subsequently a certain amount of credit will be obtainable and the machines may be run to their full capacity, and the remaining required storage constructed without further calls on subscriptions or without issuing new stock, if otherwise desired.

ESTIMATED COST OF PRODUCTION

PER TON

NOTE ESPECIALLY that ordinary labor is placed at $1.00 per day of 10 hours. For each additional 25c. per day, there will be required to add to the cutting, spreading, turning, stacking, tramming and cost of collection of fuel about 20 cents, when the cutting and spreading is done by hand, and about 10 cents, when dredge is used to the "cutting and spreading." Allow further increases or deductions when salaries paid to engineers, etc., are not the local rates. The tramming is supposed to be done by locomotive when placed at 8 and 9 cents.

COMPRESSOR OF STEAM TYPE	ONE MACHINE PLANT.	TWO MACHINE PLANT USING STEAM EXCAVATOR.	
Cutting and spreading, under favorable conditions	$0 35	$0 10	$0 10
Turning and stacking	0 24	0 32	0 32

Tramming, 12½c.; storing, 1c	0 13½	0 09	0 08
Foreman over above	0 04	0 02	0 02
Incidentals (specially re "cutting and spreading")	0 06½	0 07	0 06
Total cost of dry crude peat at sheds	$0 83	$0 60	$0 58
Unstoring crude peat (by carrier)	0 03	0 03	0 02
Manufacture and repairing, labor	0 13	0 13	0 09
Fuel (cost of collection)	0 06	0 05	0 05
Repair material (including excavator)	0 01½	0 02½	0 02½
Oil, waste, etc. " "	0 01	0 01½	0 01½
Incidentals	0 03½	0 03	0 03
	0 28	0 28	0 24
Total cost of fuel in store house	$1 11	$0 88	$0 82
Loading into cars by elevator	0 01	0 01	0 01
Freight—10 miles	0 35	0 35	0 35
Delivery in town	0 25	0 25	0 25
Manager, office expenses, insurance and incidentals	0 25	0 25	0 20
	0 86	0 86	0 81
Total cost of manufacture and delivery	$1 97	$1 74	$1 63
Royalty to Canadian Peat Fuel Co	0 25	0 25	0 25
	$2 22	$1 99	$1 88
Deductions, if fuel sold to factories on switch:			
For "delivery in town"	25		
Say ½ office expenses	0 12		
	0 37	0 37	0 37
	$1 85	$1 62	$1 51

Bad Debts.—Nothing is allowed in the cost per ton.

Advertising.—Nothing is allowed for this unless the office expenses cover it. The allowance of 20 cents per ton on 3,000 tons, the product of a two-machine plant, will give a total of $6,000 for office expenses.

Depreciation.—Deduct from profits 10 per cent. on cost of machinery and buildings.

Interest on Rails on Switch.—Deduct ... per cent. on $..... per mile of siding.

ESTIMATED COST OF A ONE MACHINE PLANT.

Comprising one compressor of the GEAR type, one breaker, etc. Product 1½ tons per hour or 3,750 tons per year of 250 working days at 10 hours each.

MACHINERY SHED AND CONTENTS.

Building, (30 x 40)—with foundations for machines	$ 300 00
Compressor (capacity 1½ tons per hour), weight 7 tons	1,500 00
Breaker	200 00
Engine, 30 H.P., and 40 H.P. boiler (locomotive type), injector, fittings and foundations	1,300 00
Pump for fire protection (second hand) and 200 ft. of hose	250 00
Carriers, elevator, hoppers, feed box, chute and tank	125 00
Belting, shafting, pulleys, etc	150 00
Tools, $50, freight and cartage, $75	125 00

Installation of all machinery above mentioned	250 00	
Inspection, travelling and incidentals	250 00	
		$4,450 00
STORE FOR CRUDE PEAT—8 mos., supply, 2,500 tons	$2,300 00	
STORE FOR PRODUCT—500 tons	200 00	
Tracks and trams—½ mile and 2 trams	450 00	
		$2,950 00
EXPENDITURE FOR LABOR—without revenue. Excavating, drying and tramming from May 1st to Sept. 30, 3,750 tons @ 80 cts.	3,000 00	
Manufacturing 900 tons @ 30 cts	270 00	
		$3,270 00
		$10,670 00

NOTE:—A second hand engine and boiler may be procured for about $500.
Preliminary expenses for plant and the manufacture of 1,000 tons may be placed at about $5,000.
Add in capital the price of the peat lands, cost of drainage and clearing if necessary.

ESTIMATED COST OF PRODUCTION.

One Machine Plant, Gear Type.

	PER TON	
Cutting and spreading (under favorable conditions)	$0.30	
Turning and stacking	.24	
Tramming, 08; storing, 01	.09	
Foreman over above	.05	
Incidentals (specially re cutting and spreading)	.06	
		74
Unstoring crude peat by carrier	.03	
Manufacture and repairing labor	.20	
Fuel (cost of collection)	.06	
Repair material	.03	
Oil, waste, etc	.01	
Incidentals	.03	
		36
		$1.10
Delivery by wagon within three miles	.25	
Management, insurance, etc	.25	
		50
		$1.60
Royalty to C. P. F. Co.		25
		$1.85

Add for railway freight if necessary.

NOTE previous remarks on cost of ordinary labor, depreciation, etc. The total $1.85 compares favorably with the cost of production on larger works, because the spreading would cost less than on large works; the distance to tram would not be so great; for unstoring, a boy @ 75 cts. per day would do; the delivery could be done more cheaply from a small plant because the demand for labor would not be so great as to cause a rise in prices, the managing etc. would not demand a special office, and no calculation for freight by railway is considered as required.

ARTHUR G. ARDAGH,
TORONTO, ONT.

January, 1899.

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179. *Howe* (*Hon. Joseph*). A Letter to the Right Hon. C. B. Adderley on the Relations of England with her Colonies. Lond. 1863

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182. ——— Confederation considered in Relation to the Interests of the Empire. Lond. 1866

183. *Hamilton* (*P. S.*). A Review of the Hon. Joseph Howe's Essay entitled "Confederation considered in Relation to the Interests of the Empire." Halifax (N.S.) 1866

184. *Clinton* (*Colonel Henry*). A Reform Bill—A fair and full Representation in the Parliament of England for the whole English Empire. Lond. 1866

185. *Hursthouse* (*Charles*). Letter to the Earl of Carnarvon, Secretary of State for the Colonies. Subjects—(1) British Regiments in New Zealand. (2) New Zealand as a permanent Military Station of the Empire. (3) Britain's Colonial Empire—whether to keep it? (4) How Great Britain might become "Greater." Lond. 1866

186. ——— Australasian Federation, with the further Question of seeking Separation from the Mother Country. Lond. 1866

187. *Carnarvon* (*Earl of*). The Confederation of the British North American Provinces. Speech in the House of Lords, February 19. Lond. 1867

188. *Eddy* (*C. W.*). Trade Follows the Flag. Lond. 1867

189. *Hursthouse* (*C. Flinders*). The Incorporation of Britain's Colonial into her Home Empire. The political fusion and amalgamation of the two—their consolidation into one. Lond. 1867

190. *Haliburton* (*R. G.*). Intercolonial Trade our only Safeguard against Disunion. Ottawa. 1868

191. Federal Union. Despatches of Sir George Grey. Lond. 1868

192. *Macfie* (*R. A.*). The Relations of the United Kingdom with the Colonies. Leith. 1869

193. *Wolff* (*Sir Henry Drummond*). The Mother Country and the Colonies. Lond. 1869

194. *Kilgour* (*Henry*). The British Empire. Proposed institution of a Joint Committee of the Legislatures and Governments of the Empire, having periodical meetings in Great Britain. Lond. 1869

195. *Weld* (*Sir Frederick A.*). Notes on New Zealand Affairs. Comprising a sketch of its Political History in reference especially to the Native Question; its present position; the policy for the future, and a few general remarks upon the Relation of England to her Colonies. Lond. 1866

196. *Pote* (*Charles*). Letter to the Right Hon. W. E. Gladstone on the Withdrawal of the Troops from the Cape of Good Hope. Grahamstown (C.C.) 1869

1869 222. *Weld* (*Sir Frederick A.*). Speech on the Relation between England and her Colonies, and their Duties in reference to Defence. Launceston, Tas. 1879

1870 223. *Little* (*J. Stanley*). A World Empire: being an Essay upon Imperial Federation. Lond. 1879

1870 224. *Colomb* (*Capt.* [*Sir*] *J. C. R.*). The Naval and Military

1871 Resources of the Colonies. Lond. 1879

225. An Organised Empire. Lond. 1879

1871 226. *Hearn* (*Hon. W. E.*). National Loyalty; or, the Colonies and the Mother Country. Melbourne. 1879

227. *Sprigg* (*Sir J. Gordon*). Speech on Resolutions proposing a Conference to consider the practicability of a Union of the South African Colonies. Cape Town. 1880

1872 228. *Robertson* (*Alexander*). Two Speeches on our Home

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1872 229. A Federal British Empire the Best Defence. 1880

230. Constitutional Union of the United Kingdom and the

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231. A Practical Method for the Constitutional Union of the

1872 United Kingdom and the Nine Parliamentary Colonies. Lond. 1880

232. England's Future. By *R. R. S.* Lond. 1880

1872 233. *Robertson* (*Alexander*). The British Colonies: their Present Condition and Future Prospects. 1880

1873 234. The British and Colonial Union, Established for the Con-

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236. Imperial Federation. Petition of the London Chamber of Commerce to the Right Hon. the Earl of Derby,

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237. *Galt* (*Sir Alexander T.*). The Relations of the Colonies to the Empire: Present and Future. Lond. 1883

1877 238. *Eckroyd* (*W. Farrer*). Speech on Customs and Inland

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1877 239. *Young* ([*Sir*] *Frederick*). On the Political Relations of Mother Countries and Colonies. Lond. 1883

240. *Macrae* (*Rev. David*). Britain not England. Edin. 1884

1877 241. Imperial Federation and Parliamentary Reform. Lond. 1884

1877 242. *Service* (*James*). Federation of Australasia. Speech in Moving the Adoption by the Legislative Assembly of Resolutions endorsing the proceedings of the Sydney

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248. *Wise* (*B.*). An Australian Appeal to the English Democracy. [Private circulation.] Sydney. 1885

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250. *Russell* (*W. J.*). Are we to keep or lose our Colonies? Southampton. 1885

251. *Davin* (*N. F.*). Ireland and the Empire. Ottawa. 1885

252. *Palliser* (*Capt. E.*). The Military Aspect of Imperial Federation. Ottawa. 1885

253. *Merriman* (*Hon. J. X.*). The Formation of a Nation. Lond. 1885

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256. *Page* (*Major S. Flood*). Home Rule and Imperial Parliament. Lond. 1886

257. *Bourinot* (*J. G.*). The Fishery Question: its Imperial Importance. Ottawa. 1886

258. *Heaton* (*J. Henniker*). Recent History of the Imperial Penny Postage Movement. (*Imperial Federation.*) 1886

259. *Taylor* (*H. D'Esterre*). Disruption of the Empire. Melb. 1886

260. *Wood* (*J. Dennistoun*). Irish Home Rule from a Colonial Point of View. Lond. 1886

261. *Wood* (*J. D.*). A Letter on the Election of Lord Rosebery as Chairman of the Imperial Federation League, addressed to the Executive Committee of the League. Lond. 1886

262. Fifty Years' Progress. Special Number of *Imperial Federation*. Contents:— Lond. 1886

263. The Area of the Empire. By *C. E. Howard Vincent, C.B., M.P.*

264. The Population of the United Kingdom and the Self-Governing Colonies in 1837 and 1885. By *J. Dennistoun Wood*, late Attorney-General of Victoria.

265. The Laws of the Empire. By *Sir John Gorst, Q.C., M.P.*, late Solicitor-General of England.

266. Growth of Constitutional Self-Government in the Empire. By *F. P. Labilliere*, Barrister-at-Law.

267. Administrative Unity. By *Sir Henry Barkly, G.C.M.G., K.C.B.*, late Governor of Cape Colony.

268. Religious Development. By *Canon Dalton, M.A., C.M.G.*

269. The Progress of Popular Education. By *Stephen A. Swaine, F.R.Hist.Soc., F.R.Col.Inst.*

1884 270. The Trade of the British Empire, Now and Fifty Years Ago. By *Stephen Bourne, F.S.S., F.R.Col.Inst.*

1884 271. Naval and Military Progress. By *Col. Sir C. H. Nugent, K.C.B.*

1884 272. The Growth of Responsibility. By *Capt. (Sir) J. C. R. Colomb, late R.M.A.*
Diagrams and Map.

1885 273. *Young (James)*. Our National Future : Being Four Letters by James Young in Opposition to Commercial Union (as proposed) and Imperial Federation ; and pointing
1885 out what the writer believes to be the true future of Canada as a part of North America. Galt. 1887

1885 274. *Ross (P. H. W.)*. Federation of the British Colonies : A Paper of Suggestions. Lond. 1887

275. *Gisborne (William)*. Imperial Federation. Lond. 1887

1885 276. Imperial Federation on a Commercial Basis : Free Trade *versus* Fair Trade. By *J. E. D.* Hobart. 1887

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1885 278. *Rawson (Sir Rawson W.)*. British and Foreign Colonies. Lond. 1887

1885 279. *Hersey (Maurice)*. Genesis of Imperial Federation. Sydney. 1887

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1885 281. *Fenton (Ferrar)*. Union of the British Race. Lond. 1887

1885 282. *Legge (C. H. G.)*. Imperial Federation : Practical Suggestions with Reference thereto. G'town. 1887

1886 283. *Seeley (J. R.)*. Our Colonial Expansion. Lond. 1887

1886 284. *Morton (James)*. Gladstone Answered, and the Irish Question Solved by Means of a British Federation Union. Lond. 1887

1886 285. *Little (J. Stanley)*. The United States of Britain : An Address on England and her Colonies. Guildford. 1887

1886 286. *Waterhouse (Herbert)*. Imperial Federation. Bradford. 1887

1886 287. *Heyes (J. F.)*. Aspects of Imperial Federation. Lond. 1888

288. *Gregory (Morgan)*. A Few Suggestions on Imperial Federation and Land Law Reform. Sheffield. 1888

289. *Rosebery (Right Hon. the Earl of)*. Speeches at Leeds
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290. *Morgan (O. V., M.P.)*. Speech on the Federation of
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291. *McNeill (Alexander)*. Speech on the Federation of the Empire. Montreal. 1888

292. *Mercier (Hon. Honoré)*, Premier of Quebec. Speech at the Annual Banquet of the Club National, Montreal, 10th April. 1888

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