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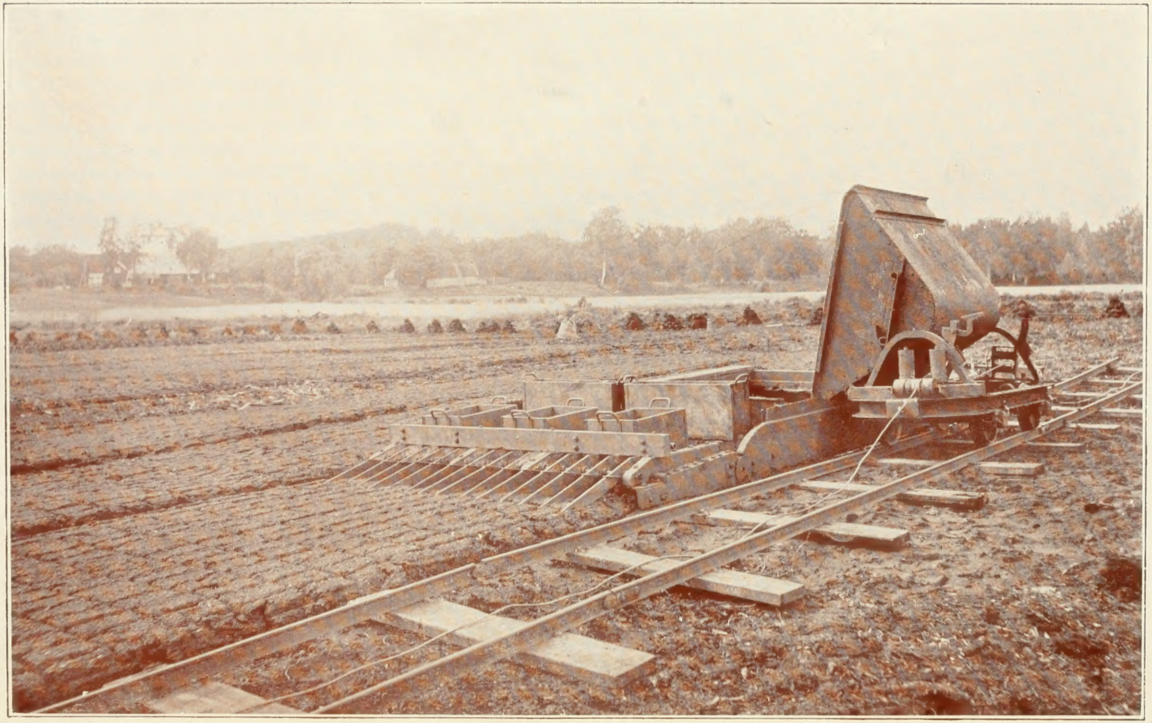
PEAT:

ITS USE AND MANUFACTURE.



Jacobsson's Field Peat Press at work at St Olof's Peat Bog, Sweden. (For description see p. 39.)

PEAT:

ITS USE AND MANUFACTURE.

BY

PHILIP R. BJÖRLING

AND

FREDERICK T. GISSING.

With Sixty Illustrations.

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PREFACE.

Whilst peat may be used for a great variety of purposes, all of which find place in this volume, its chief importance at the present time is as a source of fuel. Its great bulk as compared with coal and its high percentage of water have, however, hitherto proved obstacles to its extended use. For many years past endeavours have been made to find a practical means of overcoming these obstacles, and it is probable that some, at least, of the investigators who have been working at the problem will eventually prove successful in pointing out the way to utilise the immense quantities of energy now lying dormant in the form of peat.

In the preparation of this volume, which is the outcome of a suggestion made by the late Sir Clement Le Neve Foster, who placed valuable notes at our disposal, it has been the author's aim to describe the principal methods and classes of machinery that have from time to time been adopted for utilising peat, reference being made not only to the successful, or at least partially successful, methods, but also to several failures, with a view to prevent future investigators from working on similar lines.

It will be noticed that almost every method described is based upon the principles of drying the peat by air, by artificial heat, or by pressure. Both in theory and in practice the application of these principles is open to the objections that the peat has to be handled too many times, which greatly increases the cost of treatment, and that the state of the weather at the time has considerable influence. If the peat is compressed after drying, the cost of production is further increased. The only satisfactory method for the economical conversion of peat into a fuel for domestic and manufacturing purposes appears to be to take it direct from the peat bog and on no account to handle it before it is ready for transport, burning, or charring, except by machinery of some description. In no case must artificial heat be employed in the drying. This operation has always proved the chief difficulty. On account of the evaporation of the volatile gases and of the bituminous matter contained in the peat, heat detrimentally affects its calorific value. Pressure has been tried, but without success, because it hardens the outside crust so that the centre of the block contains water that cannot be removed before the fuel is burned. It is perfectly easy to reduce the proportion of water to 20 per cent., but in order to produce a satisfactory fuel, it must be reduced to not more than 7 per cent.

A bibliography has been appended, giving a list of the various original sources of information consulted, and also a list of patents relating to peat since the year 1899.

The manuscript was nearly completed when Mr Björling died, and thanks are due to the publishers for their valuable help in carefully editing the uncompleted manuscript, to Mr E. H. Beckett, A.M.I.C.E., for examining the proofs of the

engineering portion of the work, to Mr William Dixon, and to the following firms, who have kindly supplied information and lent photographs or electros:—A. B. Lennox, C.E., the Åbjörn Anderssons Mekaniska Verkstads Aktiebolag, and the No. 1 Peat-Coal Syndicate, Ltd.

FREDERICK T. GISSING.

March 1907.

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PEAT.

CHAPTER I.

FORMATION, GROWTH, AND DISTRIBUTION.

As to the antiquity of the use of peat, or turf, as fuel there can be but little doubt. This spongy substance may be found in almost every temperate country, and especially in Northern Europe, and the land on which it is found is termed a "peat-bog." These bogs are of vegetable origin, and from time to time vast changes have been wrought in their formation and growth.

Various opinions have been brought forward as to the actual nature of peat. Degner,[1] a Dutch author, thought that all peat had been formed by the roots, stems, and leaves of aquatic plants. This is mostly the case with the peat in those parts of Holland to which Degner's observations were chiefly confined. It has been conjectured that the formation of these peat-bogs was, in the early stages of man, coeval with the interruption which took place on the surface of the earth and produced hills and dales.

Scheuchzer was of opinion that peat was only a fossil bituminous earth, and only mixed accidentally with vegetable substances.

[1] Degnerus, *De Turfis*, 8vo.

By many it was supposed that the peat-bogs were produced by bituminous matter received from the sea by the destruction of floating islands previous to the existence of our present fixed continents and islands.

Dr Morton thought that the peat strata in Northamptonshire and other parts of England, with all the trees they contain, had been deposited by the universal deluge of the world.

Again, some scientists went so far as to say that these peat-bogs consisted of organic living substances still growing, but light thrown on the matter by means of careful scientific investigations has conclusively proved that all the above theories are incorrect.

From minute observations it has been ascertained that peat in its natural state consists of aquatic plants, sedges, reeds, rushes, mosses, etc., in different stages of decomposition, and judging from the appearance of the localities in which the peat formation abounds, its presence may be accounted for in the following manner:—

Peat represents one of the phases in the slow decay of vegetable matter. It may be formed in various ways. The changes which plants pass through before and after death are generally similar, and take place for the most part in the same order. During growth the interior walls of the cells are gradually coated with matters which ultimately become so thick as to impede the free transpiration of oxygen and aqueous vapour, the result of which is a lowered vitality and finally death of the cell. At this stage the plant generally begins to decompose, the contents of the cell disappearing first, then the cell wall, and, lastly, the spiral fibres. These steps are marked by characteristic chemical changes. The retention of oxygen in the compounds at the time of death promotes fermentation, especially of the nitrogenous substances which yield ammonia, sulphuretted hydrogen, and phosphuretted hydrogen. The non-nitrogenous substances, such as the sugars and starches, are converted into the various acids generally yielded by decaying vegetable matter. In course of time the cells become so distended with the products of decomposition that their walls burst and the various gaseous compounds escape. With this new condition of things the further chemical changes assume a different character, and the still unaltered vegetable matter is converted into humic and allied acids and carbonic acid, while the soluble compounds slowly pass away in solution. The final result is that the cell is emptied of its contents and deprived of its green colour if it originally contained chlorophyll. The next stage consists of the decomposition of the cell wall, which proceeds more or less rapidly according as it is or is not incrusted with sparingly soluble lime salts, silicates and resinous matters, and according to the strength of the vegetable acid solutions in which it is immersed. By the evolution of oxygen, aqueous vapour, and carbon dioxide, there results a mass which contains a large and increased proportion of carbon, a little hydrogen and a little oxygen in a combined form, generally as a yellow brown ulmin, but often this is subsequently converted by oxidation into the light brown humin. At this stage the vegetable matter is mainly a mixture of ulmin, humin, and spiral fibres.

The last stage, the destruction of the spiral fibres and more resistant tissue, is much assisted by the combined actions of frost and moisture. Frost disintegrates the fibres, and the black mould-like substance absorbs so much water that it becomes waterlogged and sinks to the bottom of the pool or liquid it is in. With the accumulation of this matter it becomes subjected to pressure, to slow carbonisation, and to permeation by bituminous and resinous substances, and after a time becomes what is known as peat.

The formation of peat is dependent upon a special combination of climatic and topographical conditions. The principal factors are: (1) The growth of aquatic and moisture-loving plants, more particularly those that do not produce flowers; (2) a soil or subsoil which will retain water at the surface; (3) sufficiently humid atmosphere to prevent too rapid evaporation; (4) a temperature high enough to allow of a profuse growth of vegetation, yet low enough to check too rapid a decay of vegetable matter.

Most bogs are mainly formed of species of *Sphagnum*, but in some this genus is comparatively rare. Thus in Ireland the principal moss of the higher mountain bogs is *Thacomitrum lanuginosum*; in the more southern parts of South America and contiguous islands the peat is mainly formed of *Astelia pumilum* and *Donatia magellanica*. The general character of the flora is similar in all parts of the world, but in each continental area there are a few species restricted to it, and some species common in one part of it may be rare in another part. For instance, *Paludella squarrosa*, *Arbutus uva ursi*, and *Empetrum nigrum*, are rare in the Jura mountains, but plentiful in the bogs of Northern Europe. The principal genera, in addition to those already mentioned, are *Dicranium* *Meesia*, *Hypnum*, *Splachnum*, ferns, grasses, sedges (*Carex*, etc.), *Drosera*, and other bog plants.

Bogs generally occur in shallow depressions having a clay bottom or when the water rests on permeable matter, like sand; this overlies an impermeable subsoil. The water must be still, but not stagnant nor subject to the influence of rapid currents of water. Hence they generally originate in a lacustrine area, which gradually becomes filled up with silt and aquatic plants, and so becomes fitted for the vegetation characteristic of peat. As a consequence of this, bogs are most prevalent in lowland districts, but they may occur in mountainous country when drainage is impeded so as to form local accumulations of water.

Humidity is a very important regulator of the distribution of bogs. Wooded moors favour the growth of mosses, owing to the air there being moister and more shady than in the open country. Hence it is that the bogs of lacustrine areas in low-lying areas seldom have trees buried in them, whereas in mountain bogs trees are plentiful, the growth of the moss being favoured by the fallen trunk's damming back the water so as to form pools. This opinion is verified by the frequent occurrence of almost every description of tree, such as oak (represented by bog oak), birch, fir, ash, willow, yew, etc., which have been upset by the gradual advancement, and have been discovered in every conceivable position embedded in the bottom parts of the peat bog.

Temperature also is very important. That best suited for peat formation is a mean annual temperature ranging over a few degrees below and above 45° F. This coincides with the degree of latitude, for bogs are rare on the polar side of 45°, and peat gradually diminishes when the annual mean temperature is over 50°, or the latitude much higher than 50°. This generalisation will be borne out by an examination of the general distributions given at the end of this chapter, and noting the temperatures of the districts. One illustration may, however, be mentioned here. Peat formation has almost ceased in Scotland, but is still proceeding in Ireland. The latter country is moist enough, and has a favourable temperature; the former has a suitable temperature, but the humidity has gradually become too low, and as a consequence the peat is gradually wearing away, and natural forests have, for the most part, disappeared.

Peat is the result of the decay of plants, and the character of the peat depends upon the conditions prevailing during this decay and on the nature of the plants. If the air is dry, the temperature warm, and the vegetable matter rich in nitrogen, this matter is almost entirely volatilised and the residue is little more than ashes—that is, mineral salts. If, on the contrary, the matter is immersed in water, the temperature cool, and nitrogen rare or absent, the inorganic parts are left mixed with a carbonaceous material, the carbon proportion in which ranges from 1 up to 50 or 60 per cent., peat representing the higher extreme. The products vary with the supply of air. Thus with a free supply of air the residue is mainly humin; with less air it is ulmin; and when air is excluded it is gein. When oxidised these are converted first to ulmic, humic, and geic acids, and these in turn to crenic and apocrenic acids.

The essential condition of peat formation is that vegetable remains shall be laid down at a rate exceeding that of their decomposition. As a rule, the agents of decomposition keep abreast of the formation of dead organic matter. The chief agents of decomposition are anærobic bacteria, but moulds, yeasts, and the larger fungi also play a part. Physical and chemical agencies are also concerned. In general, the warmer the climate the less likelihood of the accumulation of peat; for although more vegetable remains are laid down in the warmer regions, yet there the general conditions of life are such as favour the healthy growth and rapid reproduction of those organisms which bring about organic decomposition. Hence peat, though not unknown, is rare in tropical and sub-tropical districts. In the colder countries, on the other hand, although, as a rule, plant-remains are laid down more slowly, yet peat frequently accumulates, because here the general life conditions are less favourable. Bacteria are found on the surface of the peat, but not, as a rule, in the lower layers. The process of peat formation once begun proceeds with accumulative rapidity, owing to the preservative properties of the peaty acids formed by the partial decomposition of dead vegetable matter. Could these antiseptic acids drain away, then bacteria would invade the lower layers, the accumulation of peat would be prevented, and the peat already formed would eventually disappear. When these acids cannot drain away, there accumulates that partially but not totally decomposed vegetable matter termed "peat." All conditions which are favourable to the growth and existence of those plants which live in and extend the area of stagnant places are factors in the formation of peat. In settled and civilised districts, stagnation on a large scale is not allowed to occur, and therefore it is only possible at the present time to witness peat formation on a small scale.

It may be said that the process which has operated to convert countless generations of plants into peat bogs has been similar in the case of coal to some extent, but geologically considered it is evident that the oldest peat deposits are of modern formation when compared with the most recent of the coal measures.

Peat was the name employed in Scotland and in the north of England up to the time of the eruption of the Solway Moss, in the year 1771, when it first appeared in the description of that accident, written by an English author. The English word for the substance, up to that time, was turf, which word was used for other substances besides, and therefore was very inappropriate and indefinite. Etymologists inform us that the word "peat" is probably a corruption of the Anglo-Saxon word "betan," which in combination with "fyr" signifies "to mend or repair a fire," "to light or make a fire," "to kindle a fire." In Devonshire, even at the present time, peat is called "beat."

Peat is soft and spongy at the surface, but becomes denser and more valuable with depth, owing to pressure and gradual advance of decay; hence the lowest and oldest part is the most carbonaceous.

Peat includes a great number of substances of very unequal value. The most recently formed spongy kind approaches wood in composition, whilst the dense peaty brown substance obtained from the bottom of the peat bog of ancient formation may be compared with lignite or even, in some instances, coal. Unlike wood, however, it contains incombustible matter in variable but large quantities, from 5 to 15 per cent., or even more. Much of this, when the amount is large, is often due to intermixed sand. When air-dried the proportion of water is from 8 to 20 per cent., but in its raw state it contains, under the most favourable circumstances, a very large amount of water varying from 75 to 85 per cent. of its total weight.

Peat mosses vary considerably in different localities, not only as regards appearance, but also in chemical composition. This difference arises from the climate, the kind of mosses and plants they contain, the amount of rainfall, the evaporation of the water, and the nature of the soil.

Roughly speaking, there are two kinds of peat, namely, "hill peat" and "bottom peat."

"Hill peat" is the one that is formed in mountainous districts, and is identified by the fact that the chief plants of which it is formed consist of *Sphagnum* and *Andromeda*, and several varieties of heath as well as pine trees. The impervious strata on the bottom of these peat bogs is clay, which is permanently covered with water. There is one peculiarity with these peat bogs, namely, that near the edges the peat is very shallow, but it increases in the middle to a very considerable thickness, varying up to 30 or even 40 feet.

"Bottom peat" is to be found near lakes, rivers, and brooks, and consists of a quite different vegetation, mostly *Hypnum*. This kind of peat bog has a horizontal surface, and is usually shallower than the hill bogs. The impervious strata forming the basin is a calcareous ooze. Bottom peat comprises three varieties.

The first is the *dark peat*, approaching to coal; it is usually cut from the lower part, and is heaviest. It shrinks most in the process of drying. This variety of peat burns slowly, and when fifteen sods are burned in a close stove they will leave about a large wineglass full of white ash.

The second is *light in colour* and weight, and is of newer formation.

The third is the *top stratum*, and is of least value except in those cases where it is suitable for the manufacture of moss litter, paper pulp, textile fabrics, etc. The last two varieties of peat leave more ash in burning.

In some places these differences in the quality of peat taken from the top or the bottom stratum do not occur, the moss being uniform throughout.

The mountain peat is generally the purest, the supply being free from sediment. That found in low lands, fed by streams or rivers, is the most varied in quality. The lowest and earliest formed peat is the densest, and frequently mixed with sand, mud, etc.

In Ireland the peat is classed into "lowland or red bogs" and "mountain or brown bogs."

The lowland peat is subdivided into clearing or growing surface; white turf, somewhat similar to the clearing, but of such consistence that it can be cut into parts; brown turf, a variety that can be manufactured into meal and inferior peat moss litter; black or stone turf, the best variety for the manufacture of fuel; black mud or buddagh, the bottom of the bog, which is of very little use for anything.

The mountain bogs are divided into clearing, brown turf, black or stone turf, and black mud.

There is nothing new about peat-burning. It has been used for generations as fuel, but it is impossible to say at what period peat was first used. That it was used, as it is at present, from a very early period of history there can be no doubt, and in the absence of lignites and mineral fuels, its great abundance, and the comparative ease with which it is obtained, its occurrence attracts attention to one of those sources of comfort and convenience which an infinitely wise Creator has laid up in the storehouse of Nature for the benefit of mankind.

Earl Eyner, of Orkney, when the wood ran short in the year 888, recommended the inhabitants to cut pieces of turf, dry them, and use them for fuel, which they did with so great a success that the practice soon spread to Scotland, Ireland, and to many parts of England.

Its value for the purpose of fuel was early understood in Germany, for Pliny says that "the Chaucé pressed together with their hands a kind of earth which they dried by the wind rather than by the sun, and which they used not only for cooking their food but also for warming their bodies."

Beckman, in his *History of Inventions*, mentions a letter of sanction by which the Abbot Ludolph in the year 1113 permitted a nunnery, near Utrecht, to dig "cess-pits" (Anglo-Saxon for turf) for its own use in a part of his *vena* (turf-bog). On the same authority we are told that the words *turba, turbo, turbae,* and *tufa*, occurred for *turf* in the years 1190, 1191, 1201, and 1210. The traffic of this kind of fuel is recognised in the *Leges Burgorum* of Scotland as early as about 1140. *Turbaria*, for turf manure, is found in the writings of Matthew Paris, who died in the year 1259. *Turbagium* is found in a diploma of Philip the Fair, in 1308, where its connection is such as to signify the right of digging turf. Brito, who lived about 1223, is quoted as mentioning turf amongst the productions of Flanders.

Growth of Peat.—The growth of peat varies considerably according to the nature of the plants and trees of which the peat has been formed.

In some bogs the growth appears to have totally stopped, whilst in others, especially on the hill sides, or in bogs which have been carefully worked, the vegetation is still vigorous on the upper surface.

The peat that has been produced by *Sphagnum* and other plants of the same class is most rapid in its growth.

Some of the bogs in Hanover have, from actual observation, been known to grow from 4 to 6 feet deep in thirty years. In other cases exhausted turf hollows have been again filled with new turf plants in from ten to twenty years, and have been formed into a useful turf in from fifty to a hundred years.

A wooden bridge made by Germanicus in his German War was found under a bog, and in Galway a hut and paved passage was found under 30 feet of turf.

The growth of peat mosses, in some places, must be cultivated. The peat in many districts, especially in Ireland, where the cultivation of peat has been neglected, is gradually becoming scarce and worked out, or, as it is called in Scotland, "worn out." This is especially the case where the country people have been and still are allowed to dig or cut the peat at their own free will without any restriction or supervision by a person in authority. From these causes we find in many bogs that the peat has been worked at irregular depths, so that the remaining good peat cannot be obtained although plenty is still left on the bottom of the bog.

Distribution of Peat.—Peat is to be found in all cold and temperate climes, in fact in any part of the world where water is still and the atmosphere moist and the temperature moderate; but where the decay of the plants is great and quick, the formation of any body of the substance and structure of peat is prevented.

It is seldom discovered within the tropics, or in the valleys, even in the south of France and Spain. The late Mr Charles Darwin stated that it is never found nearer the equator than 45 degrees latitude. No real peat or *Sphagnum* peat has yet been found in South America.

It is difficult to give any really accurate data with regard to the sizes and breadth of peat bogs, but we here append some particulars which have been culled from the best and most reliable sources.

Great Britain and Ireland.—The total area of bog land in Great Britain and Ireland is stated to be about 6,000,000 acres. In Great Britain alone there are about 3,500,000 acres.

Synfin Moor, or Syn Fen, on the north side of Swarkestone, in Derbyshire, covers an area of approximately 1400 acres.

The surface soil of about three-quarters of the South Lincolnshire fen land consists of alluvial deposit, the remaining 85,248 acres being peat.

In Huntingdonshire there is about 60,000 acres of bog land, in Norfolk 63,000, and in Suffolk 30,000 acres.

Black Mere Bog, in Cheshire, is about 1100 yards long and 650 yards broad.

Chat Moss Bog, in Lancashire, has an area of about ten square miles. It was in 1793–1800 the scene of the first great and successful effort for the reclaiming of bogs, largely through the means of Roscoe the historian, and in 1829 of one of George Stephenson's great engineering triumphs in the construction of the Liverpool and Manchester Railway. It is very slightly elevated above the sea, and from 20 to 30 feet in depth.

At Fleetwood, near Liverpool, there are two mosses separated by the river Ribble which contain separate peat and forest beds, varying from 2 to 20 feet deep. The upper peat is 12 feet deep and the lower peat from 2 inches to 10 feet deep.

At Huntworth, near Bridgwater, peat appears at two levels. It is of good thickness and contains shells, bones of horses and deer, and wood.

At Holderness, near Hull, there is peat with trees, 2 feet deep, and at Hornsea, near Hull, beds are seen at low tide which contain peat and black root beds 6 feet deep.

The deposits of the Thames Valley include peat and marshy clay.

Prescot Moss, in Lancashire, is 18 feet deep. Egton Moss Moor, in Yorkshire, is 20 feet deep.

Moss Flanders, in Perthshire, Scotland, reaching from the Bridge of Gartmore to the Bridge of Drip, has been computed to contain 10,000 acres. The Black Moss contains about 800,000 cubic yards of peat. Ordee Moss is about 60 acres, but it has only a depth of about 15 inches.

Logie Moss is about 20 acres in extent. Milton Moss is very large and about 20 feet deep.

The Solway Moss, on the western border of England and Scotland, is about seven miles in circumference. These bogs vary considerably in depth.

The vast peat bogs in Ireland amount to about 2,830,000 acres, and have an average depth of 19 feet 3 inches, some being from 30 to 40 feet in depth. The Moss of Shannon is said to be fifty miles long by two or three miles broad.

The immense bog known by the name of the Bog of Allen, or rather a series of bogs, stretches from the borders of the county of Dublin across the County Kildare and the King's County as far as the Shannon, and westward into the counties of Galway and Roscommon, spreading laterally through the counties of Meath and West Meath to the north of Queen's County and the county of Tipperary to the south. It has been computed that it formerly contained 1,000,000 acres, but by means of cultivation and drainage it is now diminished to 300,000 acres.

Crockglass, in the county of Donegal, is 6 feet deep, and

Bloody Foreland, also in Donegal, is from 8 to 10 feet deep. In Knocklaid, in the county of Antrim, the thickness of bog is nearly 12 feet.

Canada.—In Canada peat is abundant on the Carboniferous, Cambro-silurian, and granitic areas, usually occupying the depressions, which were formerly shallow lake basins of small extent, but sometimes covering tracks on the flat surfaces of the Carboniferous formation comprising many square miles. Deposits occur at Lincoln (Sunbury county), Orinoco and Magaguadire Lake, also north of Eel River lakes.

In the parish of Douglas and Bright (York county), especially about the head water of the Keswick and Nackelvicac rivers, there are beds of considerable area.

In Quebec there are large areas of excellent peat in several places. The largest and most easily accessible deposits are those on the line of the Canadian Pacific Railway between St John's and Farnham, and in the vicinity of the St Lawrence near Valley Field and Beauharnois, as well as in Huntingdon.

At Huntingdon, about forty-seven miles from Montreal, there is a peat bog of superior quality covering an area of about 800 acres, averaging in depth from 10 to 18 feet.

In the counties of Perth, Welland, and Essex, in Ontario, there are said by the best authorities to be 100,000 acres of undeveloped peat bog, the largest area being in the county of Perth, about eight miles north of the city of Stratford on the Grand Trunk Railway, which extends from Port Dover to Owen Sound, where the bog covers an area of 40,000 acres, having a depth varying from 1 to 20 feet.

At Mer Blue, in the township of Gloucester, in Ontario, there are two long peat bogs separated by a narrow long reach of higher land occupying each about 2500 acres, the peat being from 8 to 21 feet deep.

In Nepean and Goulbourn are three peat bogs varying from 100 to 300 acres each. In Huntley there are about 2500 acres of peat, which in some places varies in thickness from 8 to 10 feet, whilst in other parts no bottom has been found at a depth of 15 feet.

On the lower St Lawrence peat bogs are found at the River Ouelle, Isle Verte, Daquan, Matanne, Macnider, and other places, whilst on the island of Anticosti an immense bog, estimated at nearly 200 square miles in extent, occurs on the south-west coast, all of which are reported as being of very excellent quality. These peat deposits have a depth varying from 3 to 10 feet.

At the Morse river, also situated at Anticosti, there is a continuous plain covered with peat which extends for upwards of eighty miles with an average breadth of two miles, thus giving a superficial area of 160 square miles.

The well-known Holland Marsh along the Holland river, in the counties of Simcoe and York, contains about 20,000 acres.

In New Brunswick and Prince Edward Island are a great number of peat bogs. The principal bogs are at the mouth of the Kouchibouguac river, the estuary of Aldouane, and Richibucto Head. Along the Kent Northern Railway, from one to five miles above Kingston, there are two bogs. There are also peat bogs at the head of the Missaquash river on the isthmus of Chignecto.

In the Prince Edward Islands there are large bogs along the shores of Richmond and Cascumpec. Squirrel Creek bog covers an area of not less than 500 to 600 acres. At Black Bank, in Cascumpec Bay, there is a large peat bog which along the shore is 10 to 12 feet deep in places. At the mouth of the north-west angle of Drift Wood bend there is a distinct bed, about one foot thick, of imperfect lignite or indurated peat.

Denmark.—In Denmark the peat bogs extend over ninety square miles, or about 4 per cent. of the entire area of the country. The depth of the peat deposits varies from 20 to 30 feet.

France.—The great marsh of Montaire, near the mouth of the Loire, is said to be more than fifty leagues in circumference.

Germany.—The peat bogs in Germany are about 6 feet deep. The mosses at the Ems Valley, which cover an area of 1000 square miles, might furnish the equivalent of 300,000,000 tons of pit coal.

At Carolinenhurst there are about 6½ acres, 58 inches deep, which are cut each season and yield about 3000 tons of moss litter. It is stated upon official authority that a portion of the peat beds of this empire covers an area of nearly 4,942,000 acres.

Hanover.—In Hanover there are from 120 to 130 square miles of peat bogs.

Holland.—In Holland the peat bogs are about 6 feet deep. Near Amsterdam there are about 860 acres of bog.

Hungary.—In Hungary the peat bogs are very shallow, being as a rule not more than from 6 to 8 feet deep, and only one, the Marcazal Marsh, near Hegyes, attains a thickness of 16 feet.

Italy.—It is estimated that the Lombard Provinces, in Italy, contain 1005 hectares (2512 acres) of peat deposit calculated to be capable of yielding forty million quintals (179½ tons) of dried peat. The deepest mosses are those on the Lago d'Iseo.

Oldenburg.—Oldenburg has about twenty square miles of peat bogs.

Russia.—In the Russian Empire there are no less than 135,000,000 dessjatines of peat moor—that is, about 67,000 square miles. The peat bogs on the Crown lands in the provinces of St Petersburg, Moscow, Orel, Riazan, Vladimir, Tambov, and along the Kursk-Kieff line, are supposed to contain 100,000,000 cubic feet of excellent peat.

Southern Bavaria.—This country has an area of peat bogs covering about twenty square miles.

Sweden.—The Swedish bogs have been computed to hold peat in such quantity as to be equal to 3000 million tons of coal. Herr H. Steinmetz, engineer of the Department of Agriculture of Sweden, says:—"In Sweden there are peat bogs covering an area of something like 8,648,000 acres, varying from 24 to 30 feet in depth."

United States.—Immense areas of peat are to be found in the United States, varying in thickness from 20 to 80 feet.

The Great Dismal Swamp of Virginia covers nearly 1000 square miles, having a depth of 15 feet of pure vegetable matter.

CHAPTER II.

SPECIFIC GRAVITY AND ANALYSES OF PEAT.

Specific Gravity.—The specific gravity of peat given by experimenters and analysts is not very reliable, inasmuch as they do not express very plainly, and in most cases not at all, whether it is the apparent or real specific gravity that they give.

TABLE I.

Description of Peat.	Specific Gravity.	Analyst.
Hanoverian light-coloured young peat, nearly unchanged	0·113 to 0·263	Karmarsch.
,, young brownish - black peat, on earthy matrix intersected by roots	0·240 to 0·600	,,
,, old earthy peat, without any fibrous texture	0·564 to 0·902	,,
,, old or pitch peat . .	0·639 to 1·039	,,
Irish peat	0·235 to 1·058	Kane, Sullivan.
,, average of many samples .	0·600	,, ,,
,, Phillipstown . . .	0·405 to 0·669	Sullivan, Gage.
,, Wood of Allen . . .	0·335 to 0·672	,, ,,
Devon peat	0·850	Vaux.
Island of Lewis	1·130	Paul.

Professor S. W. Johnson, in his book *Peat: its Use as a Fertiliser and Fuel*, very clearly explains the difference between the apparent and real specific gravity, when he states:—"The apparent specific gravity means the weight of the mass—the air-filled cavities and pores included—as compared with an equal bulk of water. The real specific gravity of the peat itself is always greater than that of water, and all kinds of peat will sink in water when they soak long enough, or are otherwise treated, so that the air is removed."

Chemical Composition.—The valuable portion of a fuel is its carbon content. In this respect peat is somewhat inferior to coal. It has, however, many advantages over coal and other fuels, which will be clearly set forth in Tables II. and III. (on pp. 20–22), showing the composition of peat, and in the analyses of the different classes of fuel given in Chapter V.

As the authorities have expressed their analytical results in various ways, we have been compelled to make a number of special tables. Some authorities neglect nitrogen, others take oxygen and nitrogen together, whilst yet others give their analyses in combustible matter, volatile matter, water and ash.

Peat, sometimes called bog-earth or heath-mould, is understood by gardeners to be a sharp, sandy soil mixed with the dead, fibrous roots of heath, etc., and is usually of a dark-grey colour, such as is found upon the surface beneath the heath on dry commons, like Bagshot, Wimbledon, etc. This kind of earth is largely used in horticulture for the growing of heaths and plants of a similar nature, requiring a well-drained peaty soil indoors, also for all American plants outdoors, such as rhododendrons, andromedas, and azaleas, etc.

Another description of bog-earth which is found largely in such places as the New Forest, Hants, is of a rich brown colour, contains very little sand, and is one mass of dead, fibrous roots of bracken and other vegetable matter. It is used in the cultivation of orchids, ferns, etc., and many other

TABLE II.—ANALYSES OF PEAT.

	Description of Peat.	Water in Original Samples. Per cent.	Volatile Combustibles. Per cent.	Fixed Carbon. Per cent.	Ash. Per cent.	Authority.
1	Welland. From top to 20 in. depth. Calculated on 15% water contents	82·20	59·27	21·66	4·07	Report of the Bureau of Mines, 1903, Toronto.
	,, 20 in. to clay bottom at 42 in. ,, ,, ,,	87·48	56·78	21·05	7·17	
2	Beaverton. From top to 7 in. depth ,, ,, ,,	62·98	57·13	11·67	16·20	
	,, ,, 7 to 15 in. ,, ,, ,, ,,	83·31	67·58	10·39	7·03	
	,, ,, 15 to 26 in. ,, ,, ,, ,,	84·86	73·60	4·72	6·68	
	,, ,, 26 to 40 in. bottom ,, ,, ,,	82·98	56·93	·40	27·67	
3	Perth. Top. 5 ft. ,, ,, ,,	..	54·72	19·85	10·43	
	,, ,, 4 ft. ,, ,, ,,	..	57·81	18·92	8·27	
4	Brunner. Top. 3 ft. ,, ,, ,,	..	60·10	15·70	9·20	
5	Brockville. Upper stratum, 3 ft. ,, ,, ,,	..	55·08	20·62	9·30	
	,, Part lower stratum, from 3 ft. down to 5 ft. Calculated on 15% water contents	..	57·15	13·73	14·12	
6	Rondeau. Lower stratum beneath surface growth. Calculated on 15% water contents	..	58·56	23·29	3·15	
	Rondeau. Lower stratum beneath surface growth	..	54·60	22·44	7·96	
	,, From stock pile	..	67·99	11·06	5·95	
7	Newington. Sample No. 1. Calculated on 15% water contents . .	87·94	56·74	27·21	1·05	
	,, ,, ,, 2. ,, ,, ,, . . .	86·66	54·42	28·61	1·97	
	,, ,, ,, 3. ,, ,, ,, . . .	87·62	58·70	24·73	1·57	
	,, ,, ,, 4. ,, ,, ,, . . .	90·12	58·15	25·30	1·55	
8	Great Dismal Swamp. Calculated on 20% water contents :—					
	Surface peat	20·00	50·05	24·97	4·98	S. W. Johnson.
	At 4 ft. depth	20·00	52·59	25·44	1·97	,,
9	Driftwood bend. Hygroscopic water 7·74%	..	23·13	22·05	47·08	C. Hoffmann.
10	Peat, Aikman's compressed ,, ,, 3·84%	..	41·22	48·04	6·90	Brown.
11	,, Dickson's ,, ,, ,, 8·55%	..	56·34	31·04	4·07	W. H. Ellis.
12	,, Prince Edward Island air-dried. Hygroscopic water 14·28% . .	..	60·10	21·80	3·28	Dr Harrington.
13	,, ,, ,, ,, ,, ,, 15·10% . .	..	59·10	22·60	3·20	,,
14	,, Hodge's process. Hygroscopic water 16·80%	..	49·80	26·90	6·50	,,
15	,, ,, ,, ,, ,, 17·32%	..	51·65	25·00	6·03	,,
16	Königsbrown, Würtemberg, kiln-dried	..	70·60	24·40	5·00	Berthiér.
17	Airgliana, Italy. Light peat. Dried by 100° of heat	44·19	36·44	16·44	2·93	Toso.
18	,, ,, middle layer ,, ,, ...	38·10	36·09	20·89	4·92	,,
19	,, ,, lower ,, ,, ,, ...	32·41	36·23	21·22	10·14	,,
20	,, ,, artificially compressed. Dried by 100° of heat . . .	26·89	38·38	22·41	12·32	,,
21	Bog of Allen	..	37·53	61·04	1·83	Sullivan.
22	Maine, U.S.A.	..	72·00	21·00	7·00	Ellis.
23	Commander Islands, in the Behring Sea	..	39·53	60·48	3·30	Hoffmann.

TABLE III.—ANALYSES OF PEAT.

Description.	Water Absorbed.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ash.	Authority.
Peat dried at 212° F. .	..	66·55	10·39	18·59	2·76	1·70	Fickenscher, Germany.
,, ,, .	..	57·03	5·63	29·67	2·09	5·58	Regnault, France.
,, ,, .	..	58·09	5·93	31·37	..	4·61	,,
,, ,, .	..	57·79	6·11	30·77	..	5·33	,,
,, ,, .	..	57·16	5·65	33·39	..	3·80	Mulder, Holland.
,, ,, .	..	59·96	5·52	33·71	..	0·91	,,
,, ,, .	..	50·85	4·64	30·25	..	14·25	,,
,, ,, .	..	59·00	5·53	19·50	1.50	14·50	Johnston, Scotland.
Average peat .	21·9	42·7	4·0	27·4	1·6	2·4	Tylvad.
Peat dried at 220° F. .	..	57·0	5·5	31·0	1·5	5·0	Dr Machattis.
Surface peat, Phillipstown, dried at 220° F.	..	58·694	6·971	32·883	1·4514	..	Kane and Sullivan.
Dense peat, Phillipstown, dried at 220° F.	..	60·476	6·097	32·546	0·8806	..	,,
Light surface peat, Wood of Allen, dried at 220° F.	..	59·920	6·614	32·207	1·2558	..	,,
Dense peat, Wood of Allen, dried at 220° F.	..	61·022	5·771	32·400	0·8070	..	,,
Surface peat, Twicknevin, dried at 220° F.	..	60·102	6·723	31·288	1·8866	..	,,
Light surface peat, Shannon, dried at 220° F.	..	60·018	5·875	33·152	0·9545	..	,,
Dense peat, Shannon, dried at 220° F.	..	61·247	5·616	31·446	1·6904	..	,,
Kilbeggan, Westmeath .	..	61·040	6·670	30·47	..	..	Kane.
Kilbuha, Clare . .	..	56·630	6·330	34·48	..	..	,,
Cappoge, Kildare . .	..	51·05	6·850	39·55	..	..	,,
Ockta, in Eastern Russia	..	39·084	3·788	51·088	..	..	Waskrescensky.
Peat, 4·5 feet from surface, Tuam, Ireland	..	57·207	5·655	28·949	3·067	..	Ronalds.
Peat, 3·5 feet from surface, Tuam, Ireland	..	58·306	5·821	29·669	2·509	..	,,
Peat, 2·5 feet from surface, Tuam, Ireland	..	59·552	5·502	28·414	1·715	..	,,
Good air-dried peat, Galway	24·2	45·3	4·6	24·1	..	1·8	Dr Cameron.
Poor air-dried peat, Galway	29·4	42·1	3·1	21·0	..	4·4	,,
Dense peat, Galway .	29·3	42·0	5·1	17·5	1·7	3·8	,,
Air-dried peat, Devon .	25·56	54·02	5·21	28·17	2·30	9·73	Vaux.
Island of Lews . .	23·20	60·00	6·90	30·00	1·30	1·90	Paul.
Bresles	2·17	46·80	5·65	41·15	..	6·40	Marsilly.
,, ...	3·14	47·48	7·16	36·03	..	9·00	,,
Thesy	3·07	50·67	5·76	36·95	1·92	6·70	,,
,, ...	7·20	43·65	5·79	36·66	..	14·00	,,
Bourdon . . .	5·55	47·69	6·01	39·30	..	7·00	,,
Camon	5·59	46·11	5·99	35·97	2·63	9·40	,,
Riemencourt . . .	1·81	12·99	2·22	19·31	..	65·01	,,
Vulcaire	..	57·03	5·63	29·67	2·09	5·58	Regnault.
Lory	..	58·09	6·11	30·77	..	4·61	,,
Framont	..	57·79	6·11	30·77	..	5·33	,,
Friesland . . .	..	57·16	5·67	33·39	..	3·80	Mulder.
,, ...	..	59·86	5·52	33·71	..	0·91	,,
Holland	..	50·85	4·65	30·25	..	14·25	,,
Ramstein . . .	16·70	62·15	6·29	27·30	1·66	2·70	Walz.

TABLE III.—*continued.*

Description.	Water Absorbed.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ash.	Authority.
Steinwenden . . .	16·00	57·50	6·90	31·81	1·75	2·04	Walz.
Niedermoor . . .	17·00	47·90	0·80	42·80	..	3·50	,,
Prussian	15·70	50·13	4·20	31·44	..	8·92	Baer.
,, . . .	21·70	55·01	5·36	35·24	..	11·17	,,
Havel	17·63	56·43	5·32	38·35	..	9·86	Jackel.
,, ...	19·32	53·51	5·90	40·59	..	6·60	,,
,, ...	18·89	53·31	5·31	41·38	..	6·80	,,
Linum	31·34	59·43	5·26	35·31	..	11·99	,,
Hamburg . . .	18·83	57·32	5·32	37·56	..	2·31	,,
Bremen	..	57·84	5·85	32·76	0·95	2·60	Breuninger.
,, ...	..	57·03	5·56	34·15	1·67	1·57	,,
Schöpfloch . . .	20·00	53·59	5·60	30·32	2·71	8·10	Nester and Petersen.
Sindefingen . . .	18·00	45·44	5·28	26·21	1·46	21·60	,,
Irish peat, perfectly dry, average	..	59·0	6·0	30·0	1·25	4·0	P. Dawson.
Irish peat, including 25 per cent. moisture, average	25·0	44·0	4·5	22·5	1·0	3·0	,,
Irish peat, including 30 per cent. moisture, average	30·0	41·2	4·2	21·0	0·8	2·8	,,
Switzerland, air-dried, compressed, average	23·17	40·09	4·53	21·50	2·84	7·87	Goppelsroeder.
Peat, air-dried . .	21·9	42·7	4·0	27·4	1·6	2·4	Tyvald.

similar plants requiring a fibrous, peaty, but not very sandy, soil.

The mass of decomposed moss, etc., almost black in colour, which is dug out of wet fenny places, dried, and afterwards used for fuel, is of very little use for horticultural purposes.

Peat suitable for use in the cultivation of plants, with few exceptions, is thus constituted:—

TABLE IIIA.

Fine siliceous sand	156 parts
Unaltered vegetable fibre	2 ,,
Decomposing vegetable matter . . .	110 ,,
Silica (flint)	102 ,,
Alumina (clay)	16 ,,
Oxide of iron	4 ,,
Soluble vegetable and saline matter . .	4 ,,
Muriate of lime	4 ,,
Loss	2 ,,
	400

CHAPTER III.

METHODS OF DIGGING, CUTTING, AND DREDGING.

Method of Digging, etc.—The oldest known method of obtaining peat consisted in digging it out of the ground with an ordinary spade, forming it into round balls by kneading it with the hands, and stacking them in the open air to dry.

After that, the method was adopted of digging the peat, which is still practised, with a spade, and cutting it into rectangular shaped blocks in the form of bricks. The spade, called a "slane" in Ireland, consists of an ordinary spade blade (fig. 1), but provided with a wing, A, so that it cuts two sides of the sod at once and a man follows cutting it to a given thickness. Another form of "slane," as used in America, is illustrated in fig. 2. In some parts of Holland a "slane" as illustrated in fig. 3 is employed. In this case it has two wings, A and B, so that three sides of the sod are cut at once instead of two. After the cutting, each block is placed on the side of the bank to drain till it can be handled. The blocks are then taken away on wheelbarrows and stacked to dry in the open air. After remaining in that state for a few days, the stacks are turned so that the bottom sods come to the top. This operation is repeated over and over again according to the state of the weather, but under the most favourable circumstances six weeks is, as a rule, the shortest time, and then the peat contains, on an average, 20 per cent. of moisture. This class of peat is called "dug peat."

In Holland and several other places the peat gets so wet that it cannot be dug in the above way. In such cases the peat is dredged out by a kind of scoop consisting of a canvas

Fig. 1.—Irish Slane.

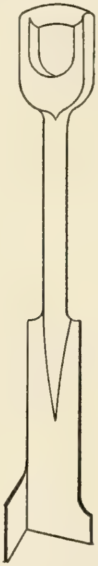

Fig. 2.—American Slane.

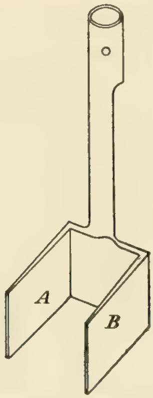

Fig. 3.—Dutch Slane.

bag strengthened at the top by strong rings fitted with teeth so as to drag the peat and fill the bag. The peat is emptied on the edge of the bog to drain, and left in that state till it commences to crack in drying, when it is beaten or trodden by men or women with boards attached to their shoes. When it has been trodden so that a man's foot will not make any impression on it, the peat is cut in the usual manner with a spade, stacked, and dried in the open air.

The spade is of the shape shown in fig. 4, the blade of which is 8 inches wide by 10 inches deep; the handle is about 22 inches long, made of wood, and crutch-shaped.

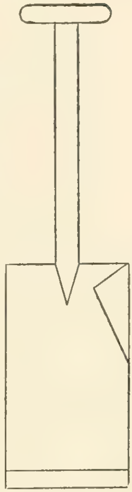

FIG. 4.—Dutch Spade.

In Mr Hodge's method, instead of cutting the sods in the above manner, the whole surface was cut transversely by means of curved knives six inches apart and mounted on a frame in the shape of a sledge as illustrated in fig. 5, which was drawn to and fro over the whole surface until it was scored with furrows. Two men, one on each side of the peat bed, were required for this operation. A few days after, or according to the state of the weather, it was cut in transverse lines with the former furrows. The instrument used in making this cutting was a sheet-iron disc, which was forced down through the thickness of the peat to the bed underneath. The blocks were cut in pieces 18 inches long.

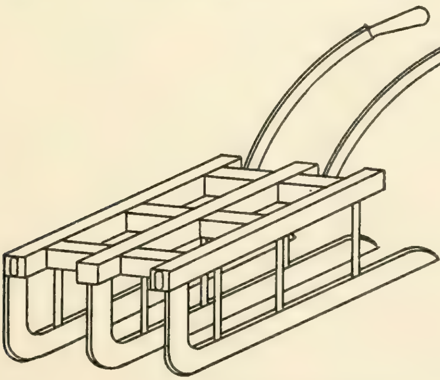

FIG. 5.—Hodge's Peat Cutter.

In some places the peat is taken out of the bog with an ordinary dredger and delivered into a hopper of a pug mill, in which it is macerated, parting with some of the water, and by means of a travelling belt is delivered on the banks of the bog, after which it has to pass through the same process as before described.

This kind of peat is called "dredged peat."

Another process for manufacturing peat fuel consists in preparing the peat after the two methods just described and afterwards consolidating the sods by passing them through a press, and in some cases the peat is compressed to such a degree that it compares favourably with coal as regards specific gravity.

This kind of peat is called "pressed peat."

Cut Peat or **Dug Peat**.—At the present time there are four methods adopted in working cut or dug peat, in Ireland, namely, horizontal cut or breast slane, downward cut or foot slane, Ballinrobe turf, and hand and foot turf.

Horizontally cut or *breast slane* is done by slicing the bog by means of flat wood slanes tipped with iron, the blade being about 2 feet long. The peats are 2 feet long, 6 or 7 inches wide and 6 or 7 inches thick, and when properly air-dried they have shrunk to from 12 to 15 inches long, 4 inches wide, and 3 inches thick.

Downward Cut or *Foot Slane*.—In this case the peats are cut short and thick with a flanged slane, in the lowland bogs; but in the mountain bogs they are longer, because the peat is tougher. They are cut from the brown peat 12 inches long by 6 inches square, and will shrink during drying to 8 inches long by 4 inches square. It is denser than the horizontally cut peat, on account of the men trampling on it during the process of cutting.

Ballinrobe turf is only met with in the county of Mayo. The peat is cut by two men, one at the breast and one above, so that it will be seen that this method of cutting is a combination of the horizontal and downward methods.

Hand Turf and *Foot Turf.*—These methods will be described under the head of "Dredge Peat," because they are only used for soft peat, or peat made into a pasty form by admixture of water.

As far as we can gather, the systematic reclamation of peat bogs was first commenced by the Netherlanders, and dates as far back as 1680. About that time it was determined that they should use their peat as a native fuel upon a most extensive scale. By means of canal communication, boats conveyed the fuel, not only to places in Holland, but even to neighbouring countries.

On the high level moors of Holland, the top layer of grey, and the lower one of black, soil vary considerably in thickness. On an average the grey is 3 feet thick and the black from 6 to 9 feet. The manner in which the peat or turf was manipulated in the grey layer consisted in cutting it with spades and other implements. The peats were placed in a saturated state, often containing 500 to 600 per cent. of water, end on against each other in the open air to be dried, partly by the sun, but principally by the wind. When they became sufficiently hard to allow of their being handled, without breaking them, they were arranged horizontally in rows on and near each other to a height of about three feet, which process was termed *stacking in pyramids.* The object of this arrangement was to thoroughly dry the peat. After some time they were re-stacked in a similar way, the upper ones being placed at the bottom of the new stack, and the lower ones at the top. When perfectly dry, or at least as dry as they could be obtained by this means of drying, they were stacked in large heaps.

In the neighbourhood of Amsterdam, at that period, the manner of obtaining the fuel was considerably varied. After the removal of the top layer, *i.e.* the grey turf, in the form of bricks, it was dried in the air and sold in bricks, ranging in size from 12 to 20 inches long by 4 to 6 inches broad and 2 to 3 inches thick. The manner in which these peats were cut horizontally was as follows:—A plank was laid so far from the edge of the face of the peat as was required for the length of the block. The peat was then cut along the plank with a sharp spade by one labourer, whilst a second labourer cut the turf to the required thickness of 3 to $3\frac{1}{2}$ inches, loaded it on a wheelbarrow, and brought it to the drying ground. When the work was completed on the staked-out ground, the plank was moved a length further back, and the operation of cutting repeated.

When the turf was cut perpendicularly, the peat cutter worked at the edge of the peat-face downwards with a sharp-edge spade, or slane, with rectangular corners, the dimensions of which were the same as those of the required peat blocks. These were often cut away on the lower edge with the so-called cutting iron, and were placed on wheelbarrows, taken to the drying ground, and treated similarly to the previous case.

In the common way of digging, one man can dig and lift 10 tons a day to a height of 5 feet. If a greater depth has to be worked, an additional hand has to be employed, but the quantity raised is the same, the first man casting a height of 5 feet, and the second raising it the second 5 feet.

In one of the methods adopted in gathering peat in the various parts of Germany, and permanently at the important peat bogs under State management, the turf is cut by gangs of four men. One cuts it from the top with a square-ended spade, the second man commences from the side following the first man, and at the same time dividing the turf into lengths as he cuts it. This latter operation is generally performed with a round-ended spade, but sometimes, though rarely, a three-sided square-ended spade is used. The third man follows the second, digs the sods out with a four-pronged fork, the handle of which is bent upwards to an angle of 45°, and lays them in rows on the moor behind the cutting. The fourth man wheels away the cut blocks.

About thirty years ago an attempt was made to get the peat out of the bog quickly and cheaply. A canal was made all round the peat bog, and in this two boats were placed each fitted with an engine, one being placed on each side of the bog. Between these two engines travelled a plough of the balanced type, but built on a sledge instead of on wheels. In the centre were placed circular discs cutting lines across the bog, and the mould boards of the plough up-ended the strips of peat, which were afterwards cut into short pieces by hand.

The great objection to drying the peat in the open air is the uncertainty of climate, since if exposed to the rain, as frequently is the case, a sufficient quantity of peat to supply the market cannot be dried during the summer months. Many attempts have been made for overcoming this, and amongst others the building of extensive sheds under which the wet peats are placed to dry; but there is one objection to this, namely, that the peats being close together, very little of the wind will act on those in the centre, and hence the time of drying is prolonged.

At the London Peat Works, situated at Little Eggleshope, Middleton, Teesdale, the drying arrangements, designed by Mr C. E. Hall and Mr C. E. Bainbridge, consisted of six sheds each 15 feet span of roof, making a total width of 100 feet open side, inclusive of covered space. These sheds were 200 feet long, covering an area of 20,000 square feet, and were fitted with racks placed back to back, leaving a pathway between. There were twenty racks six tiers high holding 672 trays each, or a total of 13,440 trays; a tray weighing

56 lbs. and one of dry peat 14 lbs., giving an evaporation of 75 per cent., whilst the remaining fuel held 20 per cent. of moisture.

The cutting of the peat in the Highlands of Scotland is usually different from the method adopted in cutting peat bogs. The first process is to cut open trenches each about ten yards apart from one another, and, according to the nature of the ground, from 50 to 400 or even 500 yards long, after removing the surface sods at the positions where the peat is cut for a width of about 3 feet along the whole line of the trenches. The peat cutter digs it out with a peculiar shaped tool in slices about 12 inches square and 3 or 4 inches thick. As quickly as the slices are cut a labourer takes them off the peat iron and throws them on to the surface of the bog to drain off the water. In this manner prisms of peat 3 feet in width and depth are cut out at intervals of ten yards, and the number of slices cut out of each trench are as many as the man can throw on both sides of the trench without altering his position, except along the trench as the cutting advances. One advantage of this method of gathering the peat is that it is not necessary to move the peat in barrows to the spreading-ground, which is attended with very considerable expense and labour.

Another method of drying is to stack the peat on trays made of wood attached to a pole about 7 feet high. In drying turf, four poles are placed in a rectangular form covered with a roof. Between these poles are five drying hurdles, one over the other, each carrying twenty bricks, and the turfs remain on these until sufficiently dry to be piled up in heaps.

Digging the peat appears very simple, and is so under ordinary circumstances, but the water frequently interferes with the process unless the bog is well drained. When the digging has been proceeded with to a depth of 4 to 5 feet, the sides often have a tendency to cave in, and, of course, the greater the depth the greater becomes the danger. When this is the case the best plan is to sink shallow pits and pump the water out as the digging proceeds.

The peat is sometimes cut by machinery. In North Prussia, Brosowsky's machine has been extensively employed, and upwards of thirteen hundred were made for Mecklenburg and Pomerania during the first five years of its introduction. This apparatus consists of a frame sharpened round the bottom edges, which, by its weight and by means of a crank and rack, and rack work operated by men, is forced down into the peat to any depth up to 20 feet, or according to the length of the rack. This machine can only cut at the edge of a ditch or excavation, and when it has penetrated to the required depth a spade-shaped knife is driven in under the cutter by means of a lever, loosening a mass of peat 10 to 20 feet long and a cross-section of about 24 inches by 28 inches. This column of peat is lifted by reversing the action of the crank handle, and is, when brought to the surface, cut by a spade into blocks 14 inches long by 6 inches wide by 5 inches thick. Each mass of peat cut to a depth of 10 feet makes 144 sods, and can be cut in about ten minutes. Four men can cut and lay out to dry 12,000 to 14,000 peat sods per day, or 3100 cubic feet.

The mode of operation of this machine is as follows:—It moves in a frame attached to a prolongation of the tramway in such a manner that six or seven pillars of turf, the length of which corresponds with the depth of the stroke of the machine, can be cut. It is worked by means of a cog-wheel. The pillars of turf thus separated are cut off at their base by pulling down an arm of a lever. A plank on the tram is brought into a vertical position. The whole pillar is then raised by turning the hand wheel so that it is pushed along the plank. The cutter is then turned, together with the plank and pillar of turf, and held in its place by suitable bars. Letting the top end of the plank down, the pillar of turf remains laying on it and is carried on a tram over the tram line to the drying place, where it is cut into bricks. The cutter is then again brought into a vertical position and pushed on one division further, and the process repeated. It will be noticed that only one labourer is required for holding up the turf and placing it on the tram. A second man cuts the turf into bricks and piles them for drying. This machine is generally constructed for a depth of 4 to 6 feet if for Holland; but the makers also construct them for all depths, even up to 40 feet. The principal advantage of this apparatus is that it can be employed to raise peat from a bog below water-level without the necessity of draining.

Mons. Lepreux, of Paris, made many improvements in the Brosowsky machine, by means of which two men can raise and cut 40,000 sods per day, which is equal to 5600 cubic feet.

Herr Karl Weitzmann's peat cutting machine is illustrated in side elevation, fig. 6, and front end view, fig. 7. The special feature or improvement in this machine over Brosowsky's is the feed and tilting motions. The rack E, slide and cutter C, can be brought into such a position that the greatest weight is nearest the guide D, and the slide has only one support, A, so that a heavy weight of great length can be easily raised. By tilting the frame, and consequently the cut and raised peat, the latter can easily be removed from the machine, without the plank necessary when the Brosowsky machine is used as previously described. Two steps, A, and tappets, F, secured to the tooth-rack guides permit the rack to turn on its centre into the horizontal position. The cutter is forced down into the peat, and raised out of it with the cut peat by hand wheel, spur wheel, and pinion.

Dolberg's Hand Peat-cutting Machine.—This machine consists of a three-sided underframe, the cutter attached to the toothed rack and pusher, and the windlass arrangement. The underframe is made of oak, and is provided with tram

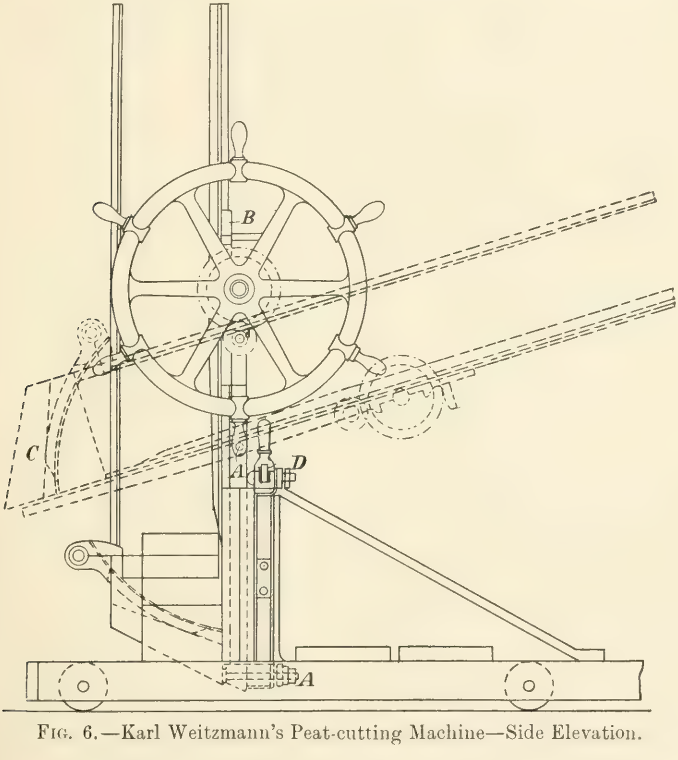

FIG. 6.—Karl Weitzmann's Peat-cutting Machine—Side Elevation.

wheels which run on rails. The underframe is also furnished with a strong upright channel iron frame which carries the cutter and winding arrangements. The tooth rack consists of two rolled channels with the necessary stay bolts, which latter form the teeth of the rack. The upright frame also forms the guides for the cutter and rack. At the bottom end of the toothed rack is arranged a curved hoe-shaped knife which can easily enter the peat. This cutting knife is operated by the working gear, whereby the resistance of the peat cutter is reduced and the peat can be cut with ease to the depth of 6 feet 6 inches. The gear can be worked by one man at the handle.

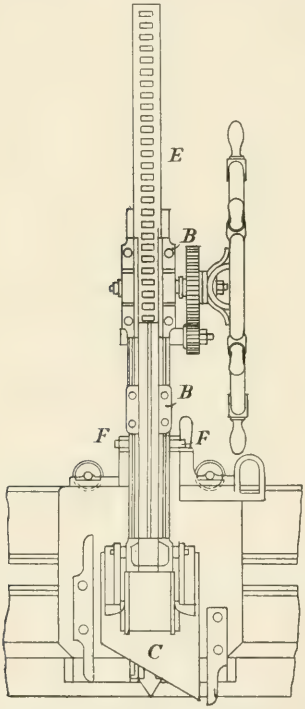

Fig. 7.—Karl Weitzmann's Peat-cutting Machine—Front-end View.

Dolberg's Small Peat-cutting Machine.—This is worked direct by being pressed down by hand, and the mass of peat is cut off at the base by means of a disc rotated by a handle at the top.

Peat trucks or *cars* are used for removing the cut peat turfs, or peats, from the bogs, usually on light tramways.

They are made of various materials, such as wood, iron, or steel. They consist of two or more shelves on which the peat sods are laid. The one illustrated in fig. 8 is made of iron with wood cross-bars.

Dredge Peat.—This kind of peat is sometimes called mud peat. It is the peat which is so saturated with water and so incoherent that it cannot be cut. To obtain this kind of peat it must be dredged from the bottom of the bog, and this is effected by means of a massive iron ring to which is secured a bag made of strong sacking, the whole being attached to a long handle and dragged along the slope of the bog. When full it is brought on to the land, emptied, and the peat left to drain and dry. In some cases an iron scoop, in the shape of a pail, is used, having its upper rim made sharp for cutting the peat, the pail being secured to a long handle. The bottom of the pail is formed of sacking. The peat mud is emptied on to a prepared ground, nicely levelled, and enclosed with boards 14 inches wide set on edge. The partially dried peat is emptied into this prepared place and left till it cracks on the surface. It is solidified by men with boards attached to their feet, who tread on it until the foot

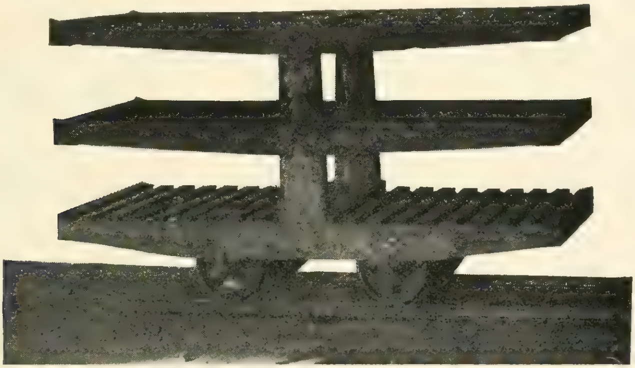

FIG. 8.—Peat Truck, or Car.

leaves no impression. Next, the peat mud is cut up in the manner already described, either by sledges or sharp spades.

The method frequently, even at the present time, adopted by the Irish farmers for supplying themselves with peat fuel consists in, first, roughly levelling the drying-ground, and stripping the place where they intend to dig. When this is done, four men commence to throw the mud peat from the hole they have dug out, and two men break and mix it with a fork, continually trampling on it and turning it over. This mixing is necessary, as all the different qualities of peat are employed, to make an even and uniform fuel. When the mixing is completed, the mud is wheeled on hand-barrows to the drying-ground, where it is spread out to a thickness of from 9 to 12 inches; after which one man shapes the mud with his hands, cutting it into blocks or sods by drawing his hand across, at intervals of about 12 inches.

The cost of manufacturing turf by this process is approximately 10s. per ton, delivered, stacked, and covered over with thatch on the farm.

This method is mostly employed in the County Cavan, Ireland. The digging commences at the end of May or the beginning of June, and the harvest is completed in September or October, although when there has been a wet season, such as that of 1903, fuel made in June was still so wet on the bog in October as to be quite useless.

CHAPTER IV.

DRYING PEAT.

The greatest problem encountered in the manufacture of peat fuel is the extraction of the moisture from the peat. Many methods have been tried, but none of them, up to the present time, have given perfect satisfaction.

There are three general principles that have been resorted to in all the methods that have been adopted, namely, air, pressure, and heat.

Air Drying.—This method is probably the best for small quantities and during a dry season. Sun is not necessary; the wind drying is the best because the strong heat from the sun dries the outside crust of the peats, and it takes a longer time to dry the interior of the blocks. The wind dries the blocks gradually, without hardening the surface, therefore the moisture from the interior has an easier access to the exterior.

A great amount of labour must naturally be expended in turning the peats over, especially in rainy seasons, and they must be placed in such a manner that the wind has a free access to them, so as to shorten the time of drying to a minimum.

Sheds have been employed for protecting the peats from rain during drying, but the expense was great, not only in the first cost, but also in placing the peats on the shelves; and the access to the wind being impeded, the time occupied in drying was prolonged.

Drying by Absorption.—This process was tried at Lexington, Mass., U.S.A. By this method the drying-ground was covered with a layer of porous bricks, on to which was spread pulped peat as it came from the macerating mill. The bricks absorbed part of the moisture on the underside, and at the same time evaporation was effected at the top by the wind. The process was naturally going on when the bricks were dry, but the bricks also absorbed the moisture from the ground they rested on, and the rain above would also fill the pores of the bricks with water, which prevented the expected result from being realised. Besides this, the expense of the drying-ground was enormous.

Drying Non-bituminous Turf.—One method, employed at Buchscheiden for non-bituminous peat containing 3 to 5 per cent. of ash, was as follows:—The turf was cut into bricks about 10 inches square and 3 inches thick, which were allowed to remain on the drying-ground for two or three days, in order to attain sufficient consistency. These peats or sods were next fixed on poles. The apparatus consisted of wooden poles 3 to 4 inches in diameter, on to which were secured eight or nine horizontal cross-bars 1 inch in diameter and 2 feet 6 inches long. The cross-bars were pointed at both ends. On each half of the bars were placed four or five sods of peat, the sods having a hole in the centre, made for that purpose, through the 10 by 10 inches surface, so as to make them hang parallel to the central poles, reducing the exposure to the rain. These poles and cross-bars were placed in rows about 5 feet apart. The drying by this method occupied about three to eight weeks, usually four to six weeks, and was repeated, at Buchscheiden, about five times in the year. Bituminous peat contracts about two-thirds of its volume in the process of drying, and the light non-bituminous peat one-third.

Exter Drying Process.—The peat is gathered in a fine or powdery state from the surface of the bog. The layers or slices break up at once before the peat is collected into heaps and partially dried upon the bog. It is then removed to a shed, provided with a roof but open at the sides, where the drying continues by evaporation.

The best air-dried peat still contains 12 to 15 per cent., and in many cases as much as 25 per cent., of moisture, although the sods feel perfectly dry to the touch.

Jacobson's Field Peat Press (*Frontispiece*).—This field peat press is quite a new implement, pressing the peat directly on the drying field. The peat is thoroughly mixed and disintegrated in the usual way, and comes from the mouthpiece into common dumping cars, which are driven round the field, by means of a rope line. From the cars the peats are dumped into the field press, which, by means of another rope is moved slowly forwards, thus spreading and pressing the peat against the surfaces of the field, leaving it behind, formed in smooth columns, which afterwards, by means of special knives, are divided into clots, each containing the mass of one peat.

This method saves much labour, in fact, six to eight men, and the bad and dirty work by handling the pallets and laying out the columns by hand is quite dispensed with. The peat also dries better, and becomes a more regular shape than by other methods.

Drying by Pressure and Centrifugal Force.—Drying by pressure has been tried, but has given very poor results. When the peat is exposed to pressure, a hard crust is formed on the surface, and the moisture in the interior cannot get away.

Centrifugal machines have been tried, and with great success so far as getting rid of the moisture is concerned, but the time taken for removing the peat after the drying is too great; hence this method is too expensive, and has therefore been discontinued.

Drying by Heat.—The apparatus employed for drying by heat may be divided into three classes, namely:—

First, drying in a chamber by means of heat radiated from stoves or by means of piping, which is termed "drying by radiation."

Second, drying by means of hot products of combustion, or "drying by smoke."

Third, drying by artificially heated air, or "hot air drying."

The most important point to be borne in mind when drying peat by heat is, the watery vapours evolved must be carried off, especially if a great quantity of hot gases pass through the oven and the temperature is kept uniform.

One of the most advantageous ovens for drying peat for fuel is probably the one employed at Lesjöfors, in Sweden. In this, the hot gases are conducted from the roof downwards, by means of an exhaust fan, thus producing a uniformly-dried peat.

The drying apparatus employed at Neuberg, in Styria, in about the year 1869, consisted of a drying chamber 36 feet long, 16 feet wide, and 13 feet 6 inches high, having an arched roof. On one side was provided a fireplace, and on the other a chimney 2 feet square and about 24 feet high. The fireplace and chimney were connected by two tubes 12 inches in diameter, placed 2 feet 3 inches from the bottom of the chamber. These pipes conveyed the hot gases into the chimney. Square openings were provided in the arched roof for removing vapours.

An example of the apparatus heated by the gases from a furnace is one which has been employed at Lesjöfors. The chamber for drying the peat was built of bricks made of blast furnace cinder, and well secured by irons. The oven bottom was made of iron lattice work, and constructed in the form of a roof. This bottom was fitted with a number of slides for the purpose of removing the dried peat. The waste gases from a refinery hearth were conducted into the chamber through flues below the roof, provided with a sliding door. The gases were first passed through a chamber where sparks were caught so as to prevent any danger of the peat being set on fire.

Dobson's Dryer.—This dryer consists of a sheet-iron cylinder or barrel, 3 feet in diameter by 30 feet in length, set at an incline of 14 inches in the length, fitted inside a rectangular brick chamber. A shaft enters the cylinder for a distance of 12 feet at each end, passes through the brick-work, and is carried in plummer blocks. The cylinder is furnished in the interior with six rings of 3 by 3-inch angle iron, secured horizontally, leaving a space of 3 inches from the plate to the angle iron. The cylinder is rotated by a sprocket wheel and a detachable link chain, at a speed of $1\frac{1}{2}$ revolutions per minute, thus allowing the peat to remain in the furnace twenty minutes. The dryer is fitted with a suitable fireplace with necessary chimney. A funnel, or hopper, is provided through which the peat is fed into the cylinder. The peat is continually turned over and passed along by the angle irons and the inclination of the cylinder, and delivered, dried, through the funnel. The products of combustion from the fireplace pass along under the cylinder to the back end, and then return through the cylinder up the chimney.

A furnace of this description was tested for a day of ten hours at Beaverton Works, Canada, with the following results, given in the *Report of the Bureau of Mines*, Toronto, 1903:—"Weight of air-dried peat charged into the dryer, 29,300 lbs., containing 34·21 per cent. water; weight of peat discharged from dryer, 23,000 lbs., containing 16·61 per cent. water. The weight of water evaporated was 6300 lbs. Air-dried peat containing 34 per cent. water was used as fuel at the rate of 3145 lbs. per day."

Simpson's Peat Dryer.—This dryer consists of two parallel revolving cylinders placed one above the other. These cylinders are 30 feet long, made of $\frac{3}{8}$-inch iron plates, and furnished in the interior with L-irons, as in the Dobson dryer, for lifting and stirring the peat during drying. The peat first passes through the lower cylinder, from whence it is discharged into the elevator and on to the conveyor, which transfers it to the front end. From thence it is elevated by chain and buckets into the top end of the cylinder. When it has passed through the latter cylinder it is discharged through a shoot. A fan is provided for exhausting the vapour arising from the drying, the vapour being led to it through apertures. The upper cylinder is rotated at a speed of three revolutions per minute and the lower cylinder nine revolutions in the same time, by sprocket wheels and link chain. The dryer is furnished with a suitable fireplace and chimney. The gases of combustion pass from the fireplace along and around the lower cylinder and second compartment, and next into the upper chamber containing the cylinder. From this it will be seen that this dryer belongs to the "Radiator" class.

CHAPTER V.

PEAT FUEL MANUFACTURE.

Manufactured Peat.—Peat that is not cut into brick-shape, but pulverised and afterwards formed into blocks of any shape and size, is termed *manufactured peat.*

Challeton's System.—It appears that the earliest attempts at making dense turf by mechanical arrangements were those of M. Challeton in France. In the year 1860 the first works of this system were erected at Mantanges, near Paris. The turf was cut from the bog and brought to the works. The raw peat was dumped into a hopper of a tearing machine consisting of cast-iron rollers 1 foot 6 inches in diameter and a length of about 4 feet, the surfaces of which were fitted with knives 4 inches in length. Whilst passing through the machine water was mixed with the peat, so that the peat came out of the machine in the form of a thin pulp. The pulp was elevated to the upper floor by a chain pump, where it was run over a fine sieve to free it from all coarse fibres and other foreign matter. The fine peat pulp was run into vats varying in size, the smallest being 40 feet square and from 12 inches to 2 feet deep, having their bottoms covered with coarse grass or rushes, which formed a porous bed and allowed the surplus water to drain off. In a short time the pulp became dry enough to be cut into blocks. The blocks were then dried either by artificial heat or by the air. The cost of production was about 13s. per ton.

Robert's System.—A plant according to this system was erected at Pekin, N.Y. The machinery consisted of a 13-horse-power semi-portable engine and a revolving elevator and conveyor. The elevator was 75 feet long from the top of the machine to the ground, where the peat was dug up and dumped into a revolving wheel, which separated the stones and coarse fibres from the peat and delivered them on one side, after which the peat was mixed with water and passed through the machine, where it was made into the consistency of a paste. The paste was discharged on to a conveyor about 100 feet long, which carried it that distance and then dropped it on the ground to a depth of 5 to 6 inches. When sufficient paste had covered the ground, the conveyor was turned round about 2 feet, and work commenced again till the fresh space was covered. This process was continued for the distance of two rods in length and 2 feet in width. This paste had to lie a week on the ground, when it was cut through with knives, at the expiration of which time it was turned over and allowed to lie another week, it usually taking three weeks before it could be removed. It was then taken up and put in a shed, and in about one week more it could be used, but the longer it was kept the better fuel it made. This machine turned out from 20 to 30 tons of peat per day.

Siemen's System.—This system was invented in the year 1857 by Professor Siemens of Hohenheim. It consisted in dumping the peat into vats made by boards of wood, in which it was soaked and worked with water, after which it was elevated into a pulveriser. This was performed in a machine of the same type as used for pulping potatoes and beets for sugar-making. This broke up and grated the peat to a fine pulp. After this process it was delivered into moulds, which were next emptied, and the peats carried away to the drying-ground, where they were air-dried in the usual manner. By this system 10,000 peat blocks were made by eight men in one day. Professor Siemens calculated that the peat fuel prepared by his system cost about one-third more than the ordinary cut peat, but the extra cost was recouped by the additional heating effect obtained.

This system was invented for peat mixed with shells and

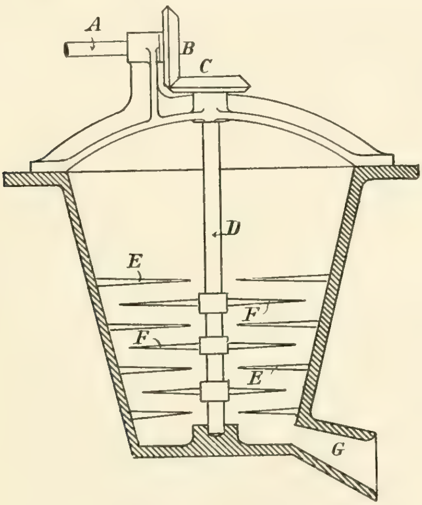

Fig. 9.—Weber's Vertical Pug Mill.

clay, which destroy the coherent property of peat, and the peat which had been exposed to the cold weather, from the ditches, that could not be worked in the ordinary manner.

Weber's System.—This system consisted of a vertical pug mill, illustrated in fig. 9, in which rotated a vertical shaft D, fitted with cutting knives F, which revolved between other knives E, fixed in the interior of the cylinder of the mill, by which means the cutting up of the peat was performed. The peat was cut from the bog, cleaned of sticks and the thick roots. It was raised to the hopper of the pug mill by an elevator, and by the action of the knives it became cut and torn, and was delivered from the orifice G in the bottom in the form of a pulp. The cylinder was made of iron in the form of a cone 2 feet in diameter at the top and 1 foot 6 inches in diameter at the bottom, and 3 feet 6 inches high. After the pulp had been delivered it was moulded and dried, either in the open air or by artificial heat in a drying chamber.

One of these machines was at work at Staltach on very light peat, the moor being about 475 acres in extent, and varying in depth from 12 to 20 feet.

A good method for moulding, adopted by Professor Siemens, is illustrated in diagrammatic form in fig. 10. It consisted of a pair of rolls A and B. The roll B had a series of moulds on its periphery, which were provided with sliding bottoms. The peat was pushed into the moulds by two rolls C and D. On the roll A were projections E E, which corresponded with the moulds in roll B, and when the rolls revolved the projections E E compressed the peat. As each mould passed, the excentric G, acting upon the pin F, forced the movable bottom of the moulds outwards and discharged the peats upon an endless band, by means of which they were removed from the press.

Schlickeysen's System.—This system was intended to be an improvement on Weber's system. The machine consisted of a vertical cast-iron cylinder having a central revolving shaft fitted with knives for mixing and tearing the peat. The shape of these knives was such as to force the peat downwards during the time that they tear it. The peat was in this manner forced out through a moulding piece situated at the bottom of the cylinder. In this moulding piece there were three openings, each about 3½ inches square. As the stream of peat passed out of the mould they were cut in pieces about 10 inches long by hand. The peats were then placed on boards, and removed on barrows to the drying-ground or a shed provided for that purpose. The peats on

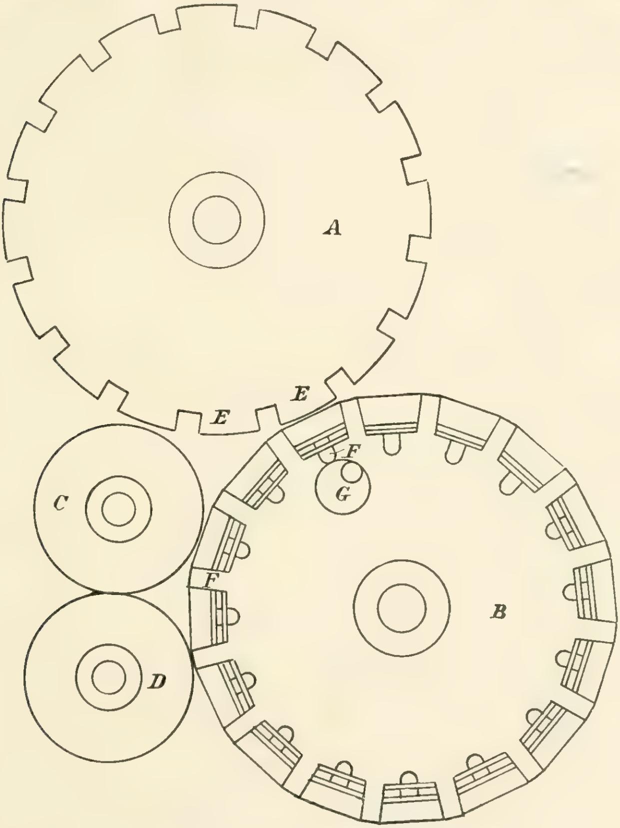

FIG. 10.—Professor Siemen's Peat-moulding Machine.

drying were reduced to one-fourth to one-sixth of the original bulk. This machine is illustrated in fig. 11.

Gysser's System.—This is a hand machine which can be worked on the bog, on the spot where the peat is cut, but is not suitable for peat containing heavy roots or that which is of a fibrous nature. This machine is shown in elevation, fig. 12, part sectional elevation, fig. 13, and plan of cylinder, fig. 14. A is a cast-iron conical cylinder, surmounted by a wrought-iron hopper B. On the revolving shaft G are six knives secured in a spiral form, some curved upwards, and others downwards. Another series of knives is secured to the cylinder. The shaft, when rotated by the

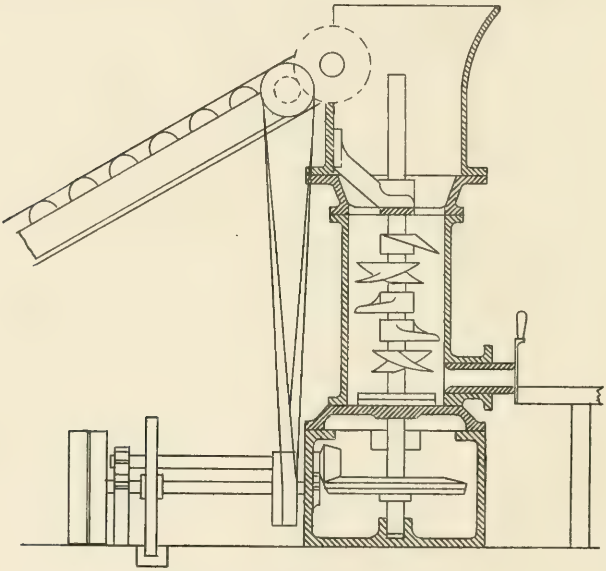

Fig. 11.—Schlickeysen's Machine.

bevel wheels L and M, is turned by the crank handle K. The fixed knives work between the knives on the revolving shaft, and move in the contrary direction. Beneath the knives on the shaft is a spiral iron scraper, which forces the peat out through the opening E at the bottom of the conical cylinder A. The opening is cylindrical, and has at its centre a cone F, held central by two sharp-edged ribs, so that the peat comes out in the form of a tube, which is broken off in lengths of about 14 inches. Two men and two boys can produce 2500 to 3000 pieces per day, which shrink in drying to $9\frac{1}{2}$ to 10 inches in length and $2\frac{1}{2}$ inches in diameter, and weigh about 1 lb. each.

Leavitt's System.—This machine is described by Mr T. H. Leavitt in his book *Facts about Peat*, from which we borrow

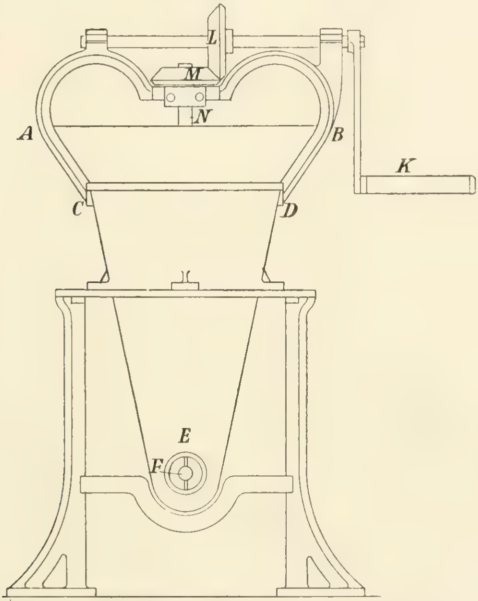

FIG. 12.—Gysser's Hand Peat Machine—Elevation.

part of the following description. The process is similar to the Weber's method, except there is no drying by heat employed. One of these machines, erected for the Boston Peat Company, consisted of a cistern 3 feet in diameter by 6 feet high, supported on a framework about 4 feet above the floor, at a place near the bog. The building was constructed on a hillside, so that an easy access was had to the lower storey on one side from the bottom of the hill, and to the second storey on the other side. The top of the cistern was open, and level with the floor of the second storey. Inside the cistern, and firmly fixed to the side, were numerous projections of forms adapted for the treatment of the material in its several stages as it progressed through the mill, which was divided into three compartments. Through the centre of the cistern revolved an upright shaft, to which were secured knives varying in form to correspond with the fixed ones in each compartment. Below the cistern was a

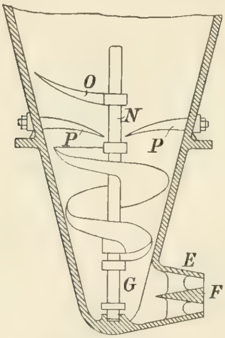

FIG. 13.—Gysser's Hand Peat Machine —Part Sectional Elevation.

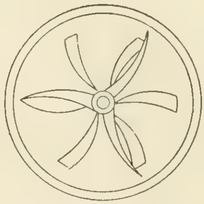
FIG. 14.—Gysser's Hand Peat Machine—Plan of Cylinder.

hopper, and under this a moulding machine, 2 feet in width and 12 feet long, of a similar construction, which received the condensed material from the hopper, and delivered it in blocks of any form and size.

The crude peat was dumped into the mill. The treatment was such that the original form of the peat was entirely destroyed. In the second stage the air contained in the peat cells was ejected, and the mass was condensed in its moist state in the lower part of the mill, and was discharged in a continuous line of moulds, which were fed into the back of the machine at the rate of from 50 to 100 tons per day of ten hours, and the weight of dry hard peat produced per day was from 12 to 17, or 25 to 35 tons from the two sizes of machines respectively.

German System.—The following system was, and is even now, frequently used in Germany. The wet turf, as cut from the bog, is put into a breaking machine, which cuts and grinds it quite fine. The *mull*, as it is called, is dried by passing it through a cylinder carrying exhaust steam from the engine; the inside of this cylinder is fitted with large steam pipes and continually revolved, the cylinder being placed at an angle. From this cylinder the mull is passed into a hopper of a pressing machine. The press makes eighty briquettes per minute, or 35 tons per day.

Clayton's System.—This system consists in cutting peat into fragments in its raw and moist state, draining off all free water, masticating the fibres and the whole mass of peat together in a machine, until it is impossible to detect the fibres from the humus.

This machine consists of a cutting, kneading, and moulding machine, which is driven by a belt pulley through a double cone friction clutch, which latter drives a shaft on which is keyed a pinion, gearing into the spur wheel upon the shaft. On this shaft is keyed another pinion, gearing into a spur wheel keyed on to another shaft, which traverses the cutting up and kneading cylinder. The lumps of peat are thrown into a hopper, and first reduced in size to some extent by the action of blades; but the cutting up and kneading is mainly effected by propelling arms forcing themselves through the peat and carrying it again and again between the knife blades, whilst it is firmly compacted between the feeding worm, which has a quick pitch, and the delivery worm, which has a comparatively slow pitch. It will be noticed that the knives are placed closer and closer together in passing from the feeding to the delivery end of the cylinder, and, to correspond, the propelling arms are widest at the feeding end. All the propelling arms are flat on the face, and their spiral arrangement is such that they act effectively to keep the peat in motion rapidly forward through the machine.

This machine has five moulding orifices which are all formed in one die, bolted to the mouth of a chamber. Beneath the chamber is a roller table, on which boards or trays are placed to receive the moulded peat. The boards or trays of peats are conveyed along the roller table until they are opposite drying racks, when they are lifted off on to and placed on the latter, where they remain about three days. After that period of time the peats are placed upon open shelves for final drying. On an average it takes about three weeks before they are well dried and ready for use.

Gwynne's System.—This system consists in depriving the peat of a large percentage of water by means of a centrifugal, after which it is ground to powder, and passed through a series of cylinders revolving in a heated chamber, to evaporate the remaining part of the water. When the peat has been subjected to a temperature of about 180° F., it is compressed into blocks.

The peat to be manufactured into fuel is fed into the mill, where it is prepared. From thence it is passed by a chute into an elevator, from whence it is conveyed by elevator buckets to the top pair of a series of cylinders. These cylinders are driven by a pulley, and the rotary motion is transmitted throughout by a series of spur wheels keyed on to the ends of the cylinder shafts. A furnace gives the necessary heat to the cylinder for effecting the drying of the material. The interior of the cylinders, for the purpose of agitating, mixing, and propelling the peat under treatment, was fitted with ribs or screw blades. As the cylinders revolved, the peat travelled along them and fell from one to another until it arrived at chutes, through which it passed into a chamber thoroughly dried.

After this operation the dried peat was ground and passed into the compressing machine. The main driving shaft is carried in bearings on vertical frames, and has keyed on to it a driving pulley and fly-wheel. This shaft carries also two spur pinions, which give motion to spur wheels, keyed on to the ends of the shafts. A strong cast-iron standard bolted to beams carries the shafts in the bearings. Each of these shafts is fitted with an eccentric, which is connected with compressing plungers by tightening brasses. The moulding table is actuated by a spring catch, which consists of a lever, working loose on a tubular centre underneath the table. A spring catch fitted with a projecting pin is fixed to this lever by a screw. The pin projects through the lever into indirect grooves, formed in the raised portion of the table. One edge of the lever is inclined for the purpose of raising the end of a spring detent, which is secured at its extremity to the standard. This spring is fitted with a stud pin which is pressed into one of a series of holes formed in the table; by this means it is held steady during the compression of the peat, which is effected in the rectangular openings; the outer end of the lever is attached to a connecting rod, which is jointed at its opposite extremity to a vertical lever arm. This lever works on a fixed centre, and is guided by a forked or slotted guide, bolted to one of the beams. The necessary vibrating motion is transmitted to this lever by a connecting rod, which is attached at one end to the free extremity of the lower arm, and at the other end it is connected with a crank fitted on the end of a short shaft; a steam pipe communicates with the interior of the moulding table for the purpose of heating the same. To effect this the table is cast hollow, with a plate or cover bolted over it, the waste steam passing off by a pipe. The compressing plungers work in fixed guides, which are bolted to the frame; each carries a stud which passes through a lever, working on a fixed centre on the side of the lever frame. This lever is fitted at its end with a discharging plunger, which works vertically in guides also carried by the frame. A portion of the frame is made to project laterally beneath the table, so as to form a bottom to the compressing apertures which are under the feeding hoppers, thereby enabling the aperture to be filled with peat to be compressed, and retaining it in its chamber until it is brought under the compressing plunger.

The operation in working the compressing machine is as follows:—The peat is fed into the hoppers, and an intermittent rotating motion is communicated to the table by a lever and connecting rod; on moving the rod in one direction the knife edge of the lever is brought underneath the end of the fixed spring, thereby raising the stud pin out of the series of holes in the table. The same movement of the lever slides the pin up the inclined groove or slot, until it arrives at the commencement of the next hole, into which it passes by the spring. By this time the pin is completely free from its hole, and the return or back stroke of the lever propels the table round until the pin drops into the next succeeding hole. When the required compression has been made by the plungers, the table is moved forward one aperture, thereby bringing another chamber with a fresh supply of peat to be pressed; at the same time that the fresh apertures are brought beneath the compressing plungers the aperture containing the compressed blocks is brought underneath the expressing plungers, which descend simultaneously with the compressors, and force the compressed peat out of the aperture on to a travelling belt. This machine makes a very dense fuel, and it is a machine embodying many details which are now used in the latest machines, on which account we have described it so minutely.

Aschroft and Betteley's System.—In this process of manufacturing peat fuel the inventors separate the fibrous from the thoroughly decomposed portions of the peat by combing, by that means reducing it to a pulp, which is conveyed to a tank, where it is allowed to remain till, by its own weight and pressure, it becomes sufficiently dense to be formed into blocks.

The plant of the American Peat Company, of Boston, had a triturating machine 36 inches in diameter by 4 feet 6 inches high. A central shaft was provided with cutting knives, and the cylinder was furnished with fixed knives in the usual manner in this class of machine. At the bottom of the cylinder was a sliding door, worked by a lever, through which the peat was discharged into the combing machine. The combing machine consisted of a semicircular cistern 6 feet long and 3 feet 6 inches in diameter, inside which was a revolving shaft fitted with arms placed at about $1\frac{1}{2}$ inch pitch, the arms being 1 foot 8 inches long, reaching, therefore, within 2 inches of the bottom and sides of the cistern. Another shaft, provided with arms of similar dimensions, was placed at an angle of 45° with the former; the centres of the two shafts were 2 feet 2 inches. The arms of the two shafts were arranged to run between each other, and both shafts revolved in the same direction. The second shaft was made to rotate at twice the speed of the former. At the bottom of this apparatus was fixed a grating through which the cleaned peat was discharged into the kneading machine. The kneading machine consisted of an iron cylinder 16 inches in diameter by 7 feet long, provided with a spiral screw consisting of discs having a pitch of 6 inches.

Versmann's System.—This consisted of a perforated conical wrought-iron cylinder, inside which was rotated a cast-iron cone A, fig. 15, provided with two spirally shaped knives. The peat was introduced through a hopper K, and cut and forced downwards by the spiral knives, and squeezed through the perforations in the cone. The peat which passed through was collected on the inclined cone in the chamber D, from which it was removed by means of a screw conveyor to the moulding machine. The fibres and heavy stuff passed away through the tube E into the space C, from which place it was returned to the hopper of the machine, to be reduced till it could pass through the perforations. F is a central

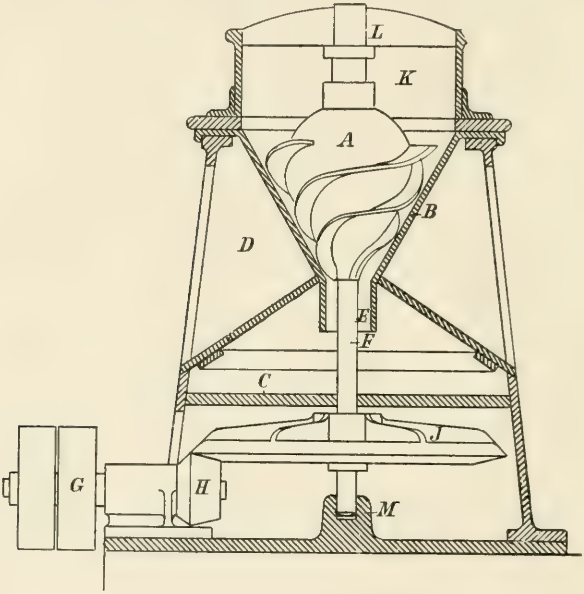

Fig. 15.—Versmann's Peat Machine.

shaft guided at the top in the bearing L, and at the bottom in the footstep M. The shaft is rotated by the pulley G, pinion H, and bevel wheel J.

Buckland's System.—This system consisted of a solid cast-iron cone having round its exterior surface a spiral-shaped groove, rotating inside a vertical hollow wrought-iron cone. The peat was introduced into a hopper and passed down between the two cones, and by the rotation of the inner cone the peat was forced through the perforations in the outer cone. According to Professor Johnson, a machine of this description was tried near Boston, United States, but was abandoned as being uneconomical. The ground peat was moulded by hand.

Hodge's System.—This system was invented by Mr James Hodges, of Montreal, Canada. It consisted of a floating barge on which was erected the whole of the necessary machinery; it was about 80 feet long, 16 feet beam, and 6 feet deep. The hull of the vessel was fitted with screw excavators in the front end of the barge, which were 11 feet in diameter, driven through gearing by an engine placed in the stem of the vessel. These screws cut their way through the bog, forming a channel 19 feet wide and from 4 to 6 feet deep; and as the water flowed into the channel as fast as the peat was taken out, the vessel floated and moved onwards as the screws advanced, usually at about the rate of 15 feet per hour. The screw elevators were arranged with shields, cutting plates, knives, gauge plate, and scrapers. The rate of feed given to the excavators could be increased from 1½ up to 4 inches per each revolution, according to the density of the peat. The peat was delivered into the barge, and two men were employed to clear the peat of any pieces of wood, roots, or other useless material fed in by the excavators. When the peat was cleaned it was elevated by chain and buckets into a hopper, into which the material was discharged. At the bottom of this hopper was a screw which passed the material on into a feeder, in which a shaft, reaching from end to end, was rotated; the shaft was provided with blades. Within the feeder were fixed bars, so applied as to direct sticks and similar refuse matter out on one side, acting in conjunction with the revolving blades. A trap was arranged so as to regulate the exit opening from the feeder, according to the amount of refuse to be separated from the peat. A receiver for the refuse matter was fitted with a valve which was opened from time to time to let out the refuse. The material was delivered as it passed out of the feeder into a trough fitted with fixed knives and a revolving shaft with knives, and at intervals at its bottom were sliding doors which could be opened at pleasure for the escape of the material on a previously prepared ground along the banks of the channel that was cut out, and distributed in layers.

When the peat was sufficiently dry, it was cut into regular blocks. The barge was propelled forward, as the cutting proceeded, by means of a drum worked by the steam engine. The rope was secured to an anchor ahead of the barge.

The screw excavators were driven in opposite directions, their shafts being geared together by a cross-shaft which was geared with another cross-shaft, and from this, by an inclined shaft and suitable gearing, was driven the elevator.

The peat, which was fed into the hopper in lumps, was broken up in the feeder, into the separator, and by means of a hand pump sufficient water was added, if necessary, to ensure the thorough pulping of the material in the trough. The shape of the knives in the feeder and in the distributing trough was such that whilst one edge of each revolving knife cuts the fibre of the peat between itself and one of the fixed knives in the manner of a pair of shears, the other edges of the knives crush the fibre between itself and the flat side of the next diaphragm, against which it is forced by the spiral action of the revolving blades.

Hodgson's System.—Mr C. Hodgson employed for compressing peat a machine patented by him which he described as a horizontal reciprocating ram, working in a cylinder 5 feet long; as the ram was drawn back at each stroke the powdered peat fell into it, and filled the whole length, considerable friction taking place against the sides of the cylinder before the frictional resistance of the column was overcome. The whole mass moved on, so that the blocks formed at one end were successively discharged at the other, at the rate of sixty per minute, making in an hour about 15 cwts. of compressed peat fuel, equal in density, it was said, to coal. A machine of this description was in operation at Derrylea, near Monasterevan.

Zohrab's System.—The system invented by M. E. Zohrab is illustrated in sectional elevation, fig. 16. The peat is crushed in a mill A, then it is kneaded and moulded in the machine B, and finally dried in the chamber C. The peat is crushed by means of cast-iron blades E fitted to the vertical revolving shaft F, rotated in bearings G and H, and the blades J attached to the interior surface of the cylinder A. The vertical shaft is rotated by the bevel wheel and the pinion, keyed on a horizontal shaft. The crushed peat, in a plastic condition, is forced through the perforated plate N by the Archimedean screw O, falls on to the travelling belt P, and is carried to the moulding machine B. The peat is kneaded in this machine B by the arms R, mounted on the vertical rotating shaft S, and worked between the fixed arms T. The peat is forced through the lateral moulding aperture U by the screw V and cut into blocks by a knife, wire, or other suitable means. The blocks are carried away by the travelling belt W through the drying chamber C, supplied with hot or cold dry air by pipes arranged at intervals along the sides of the chamber.

Gerard's System.—A very elaborate installation for the manufacture of peat fuel was invented by J. M. A. Gerard. The peat, after it had been cut from the bog, was disintegrated by a pug mill, and the disintegrated peat, mixed with water, was run into settling tanks, in which any sand or clay present with it subsided. The peat pulp was next made to travel upon a metal gauze band, mounted on an

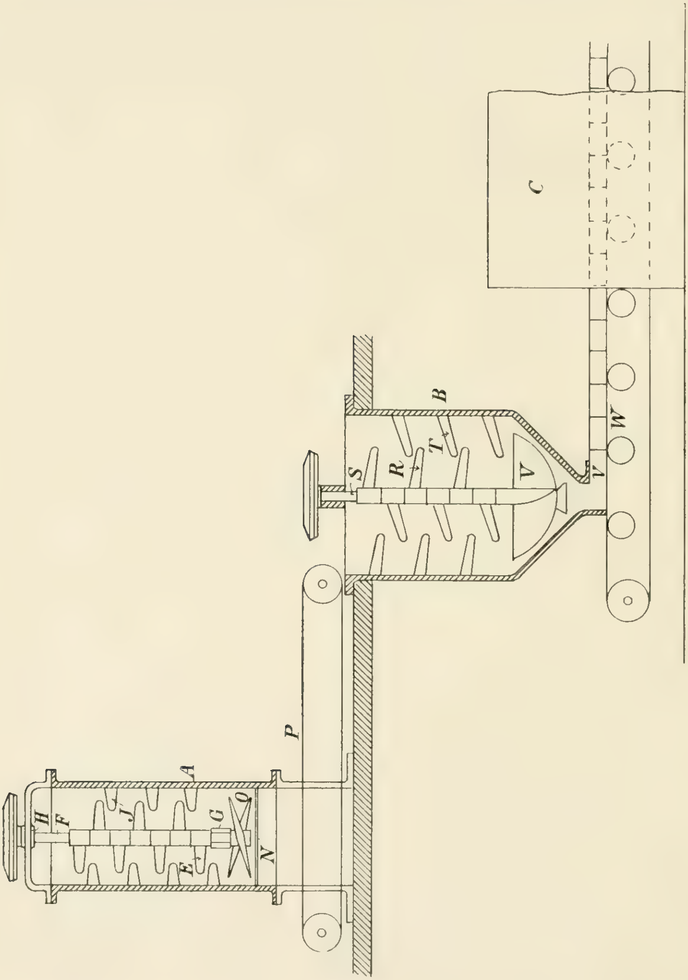

Fig. 16.—Zohrab's Peat Mill.

oscillating frame. On leaving the frame the layer of peat passed under a roller, between that and an additional

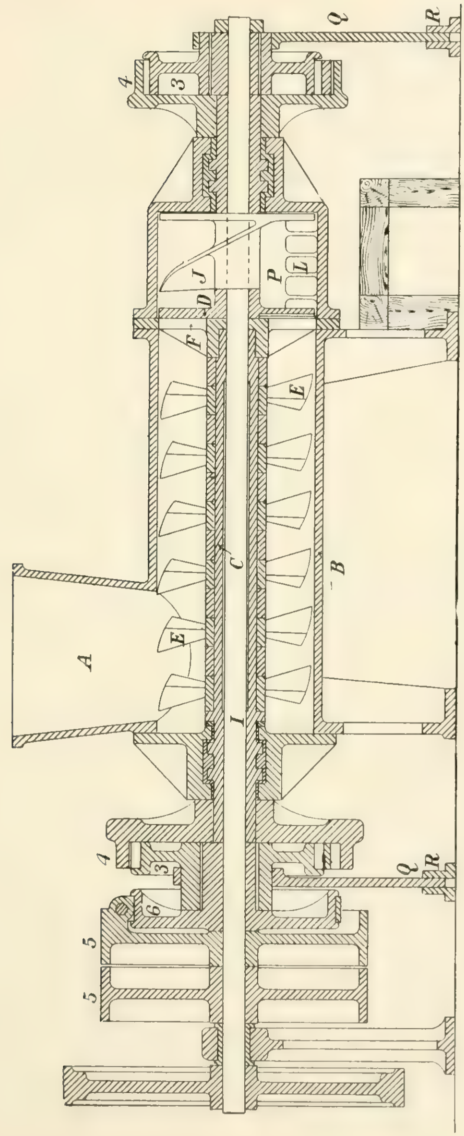

Fig. 17.—Hall-Bainbridge Peat Machine—Sectional Elevation.

band, when a portion of the water was squeezed out. A further quantity of water was extracted by means of a vacuum produced in a casing over which the band passed. The partially dried peat, held between the two bands, was passed between two cloths of felt, or any absorbing material, which passed between rollers, and was afterwards dried by means of pressing rollers and drying chambers. The peat was finally dried and carbonised in a

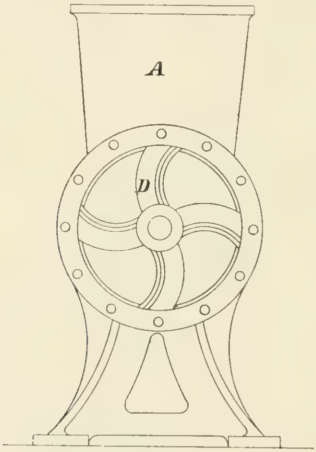

FIG. 18.—Hall-Bainbridge Peat Machine—Vertical Cross-section.

stove, strongly heated by a furnace, through which the bands passed in a zigzag course. When a peat of good quality was being operated upon, it was passed between pressing rollers, and thence led between the felt and finally through the stove. The dried and partially carbonised peat was conveyed to a pug mill, where it was mixed with agglomerating substances previous to its being moulded into block fuel.

Hall-Bainbridge System.—The machine employed by these inventors is illustrated in sectional elevation, fig. 17 ; fig. 18

is a vertical cross-section taken behind the diaphragm plate, showing the construction and action of the rotary cutter; fig. 19 is an end view illustrating the action of the differential gear and the delivery of the condensed peat on to the trays mounted on a trestle; fig. 20 shows an end view of the delivery orifice and the counterbalance cut-off knife with balance weight; and fig. 21 is an elevational plan. It will be seen that the machine consisted of a cylindrical casing or

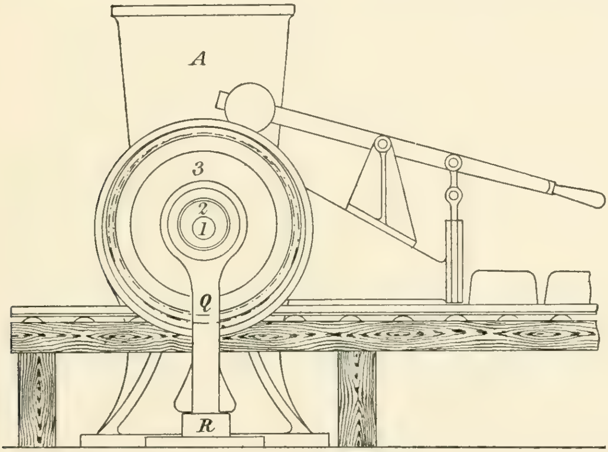

Fig. 19.—Hall-Bainbridge Peat Machine—End View.

barrel B, about 1 foot 8 inches in diameter and 4 feet long, with a hopper A at one end. Through the centre of this barrel worked two shafts on the same axis, and marked respectively I and C, having thrust-bearings at each end of the machine. The high-speed cutter shaft I worked through the hollow or pug shaft C, and turned in the same direction. The pug shaft C was of octagonal form outside, and upon it were placed screw-like blades, which passed between projections attached to the casing. The outer shaft C took its bearing in the diaphragm or port plate F, through which the peat was forced by the blades E. A four-winged cutter D, similar to a chaff cutter, rotated past these ports, and cut off into short lengths the slowly protruding peat which was held close up against the four arms or cross-bars. When the delivery was at right angles as shown, the cutter shaft I had a slowly revolving screw-like wiper J in the delivery casing P, and with this was cast the circular end-plate, against which the condensed peat was forced and delivered at the orifice L. The wiper and plate J were driven by separate

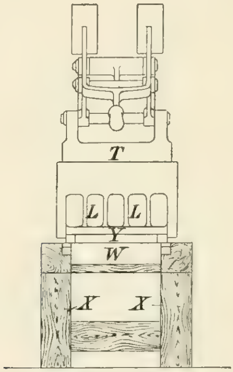

FIG. 20.—Hall-BainbridgePeat Machine—End View of Delivery Orifice.

gearing, and might have a faster or slower motion than the first pugging shaft.

The peat, in a continuous stream, was delivered on to wooden trays Y, placed on a trestle X, having wood rollers W mounted therein. The trays were 3 feet long by 1 foot 6 inches wide, and were propelled forward by the issuing stream of peat. A counterbalanced cutter T, working in guides and operated by the attendant by hand or foot, enabled him to cut the bricks of peat into any length; this dispensed with the wire-cutting frame generally adopted for such purpose. The speed of the cutter shaft I was 110 revolutions per minute, whilst that of the pugging shaft C

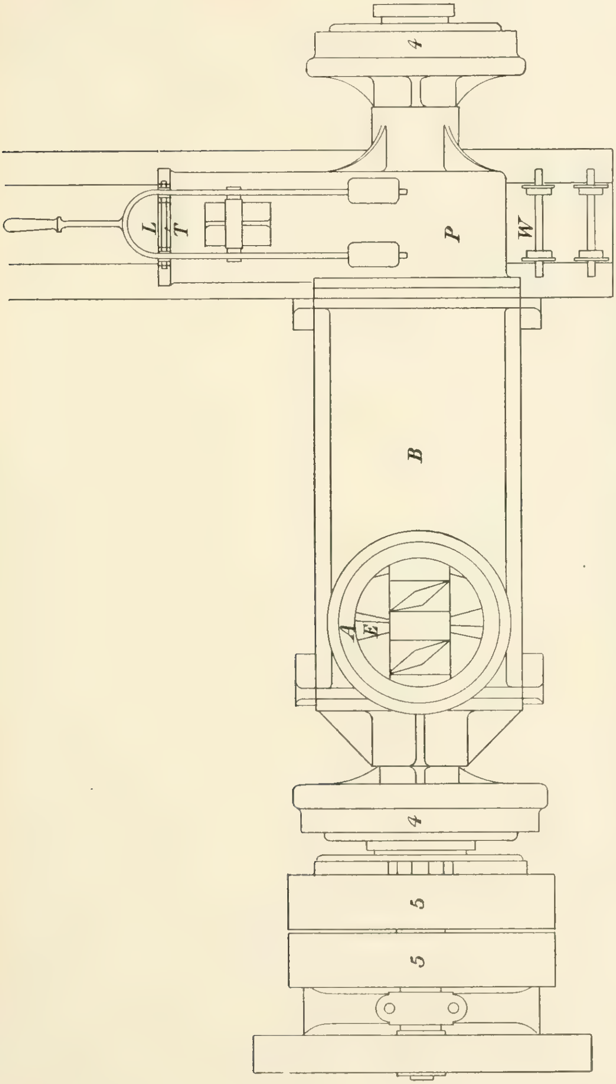

FIG. 21.—Hall-Bainbridge Peat Machine—Elevational Plan.

was 11 revolutions per minute; and these motions were effected by differential gear shown in section, fig. 17, and end elevation, fig. 19. An eccentric, 2, was formed on the shaft I; a wheel, 3, having, say, thirteen teeth, was mounted loosely on it. An internal toothed wheel, 4, was keyed to the outer shaft C, and had thirty-three teeth. The throw of the eccentric was such as to cause the pitch line of the wheels to exactly coincide as the eccentric revolved; but the wheel 3 was prevented from turning round by the tail-lever Q, to which it was firmly secured and held in the bracket R, in which it moved. The action of this was to revolve the outer wheel for each revolution of the eccentrically mounted pinion, in the proportion of the difference of their teeth. It might be termed an internal sun-and-planet motion. Motion was given to the belt pulley, 5, and transmitted through a friction strap and drum, 6, to the pinion, so that the driving could be nicely adjusted to the power

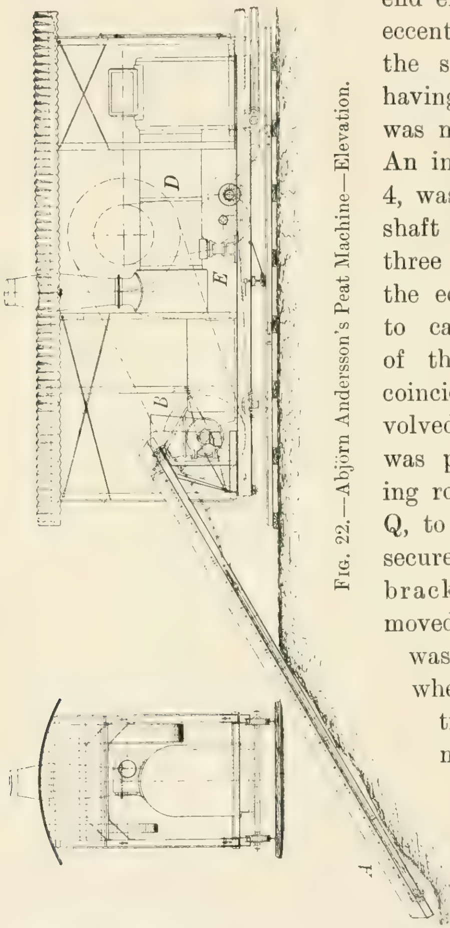

FIG. 22.—Abjörn Andersson's Peat Machine—Elevation.

required for treating the peat; but in the event of any foreign substances being present, or undue strain being brought on the machine, it would slip, and thereby call attention to it before damage was done.

Åbjörn Andersson's System.—This plant is shown in elevation, fig. 22, and plan, fig. 23. This consists of an elevator, A, which digs the peat from the bog into a macerating machine B, in which the peat is made into a kind of pulp and moulded into bricks, which are removed on a roller table C or continuous belt. The elevator, macerating machine, roller, and the steam engine D, or electric motor, as the case may be, are all mounted on a trolley E, which is moved forward on the bog, as the peat is cut out, by means of a small windlass, rope, and anchor.

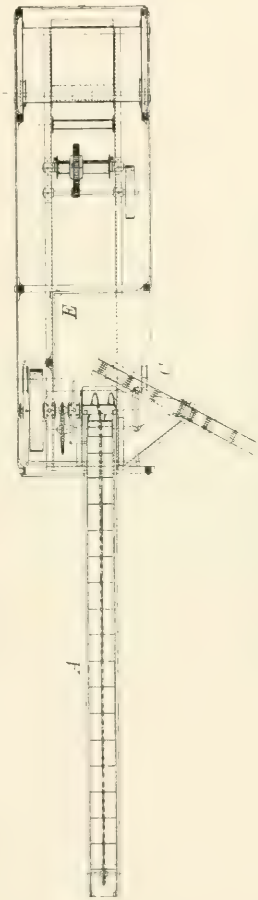

Fig. 23.—Åbjörn Andersson's Peat Machine—Plan.

The macerating machine is illustrated in fig. 24, showing the machine opened for access to the working parts. It consists of a hopper into which the peat is dumped by the elevator. The peat then falls on to a screw conveyor, forcing it into the macerating chamber, where it is forced against knives, fixed radially. The screw at the mouth is provided with a sharp cutting edge, so that the peat is cut in pieces, against an adjustable steel cutter, before it enters the macerating chamber. The screw finishes a distance of from 3 to 4 inches from the end of the chamber, according to the quality of the peat. The fixed knives are joined in the centre to form a bearing for the screw shaft. On the shaft is a boss, brought up to the end of the screw, fitted with a knife which, as the shaft revolves, cuts the peat against

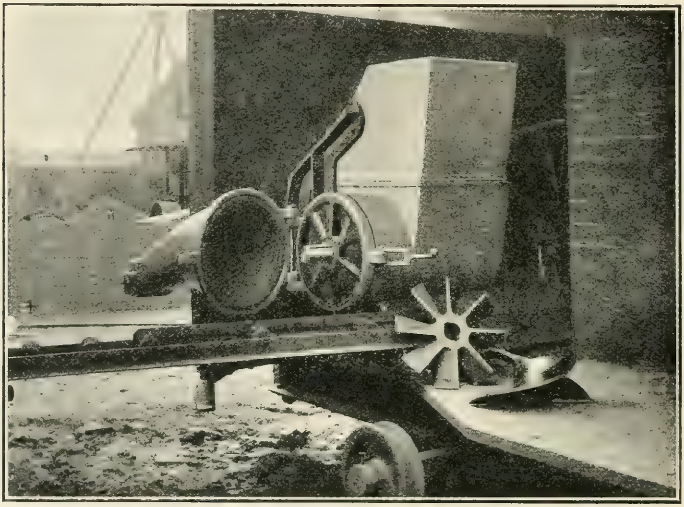

FIG. 24.—Åbjörn Andersson's Peat Macerating Machine.

the edge of the fixed knives as it is forced forward. The fixed knives are also provided on the outer side with cutting edges, against which work radially-placed rotating knives, which are keyed on the shaft. These knives are screw-shaped, so as to assist in propelling the cut peat forward. This macerated peat is then taken hold of by a double-threaded screw, and forced through a taper-piece, and towards the mouthpiece, in the usual manner. If we take a machine

Fig. 26.—Åbjörn Andersson's Peat Plant at work on the Elmhult Bog, Sweden.

Fig. 27.—Åbjorn Andersson's Electrically-driven Peat Plant at work at Stafsjo, Sweden.

with nine fixed and nine rotating knives, one on one side and eight on the other, we get 9 by 9, that is, 81 cuts for each revolution; and when the shaft makes 150 revolutions per minute we get 81 by 150, or 12,150 cuts per minute, and according to the speed of the feed the material is cut in pieces, $\frac{1}{8}$ to $\frac{5}{32}$ of an inch in length, all through the mass. The portion of the machine containing the double-threaded screw and the mouthpiece is hinged so that when examination or repair is required it can be swung out of the way and all the machinery got at.

The rails upon which the whole of the machinery travels are made about 10 feet in length, so that the rails can be pulled up and laid in the front of the trolley before it has been moved too great a distance from the bank of the bog which is being cut.

The various knives and screws are shown in fig. 25.

Fig. 26 illustrates one of Åbjörn Andersson's plants at work on the Elmhult Bog, in Sweden, and an electrically driven plant at work at Stafsjö, in Sweden, is illustrated in fig. 27.

Anrep's System.—The Anrep machine, as manufactured by Munktells, in Sweden, is illustrated in fig. 28. This machine is divided into two parts; the first, into which the peat enters through a hopper, is provided with cutting knives, the other with propelling screws. There are two shafts passing through the machine on which the knives and screws are secured; these shafts running towards each other, being driven by a pulley and two spur wheels, the macerated peat being forced out through a mouthpiece common to the two cylinders. The material is subjected to 7700 cuts per minute, so that any sticks or thick roots are easily cut by this machine and mixed with the peat. The peat as it is forced out through the mouthpiece is cut off in pieces about 13 inches long by $4\frac{1}{2}$ inches wide and 5 inches thick. After air-drying, these peats contain 20 per cent. of moisture—about the same amount as air-dried wood—and shrink to about one-eighth of the original volume they occupy when they leave the machine. Each peat weighs about 1 kilogramme = 2 lbs. 3 ozs.

Fig. 29 is an illustration showing one of these machines on Stafsjö Bog, near Ljubgby, in Sweden. Above five

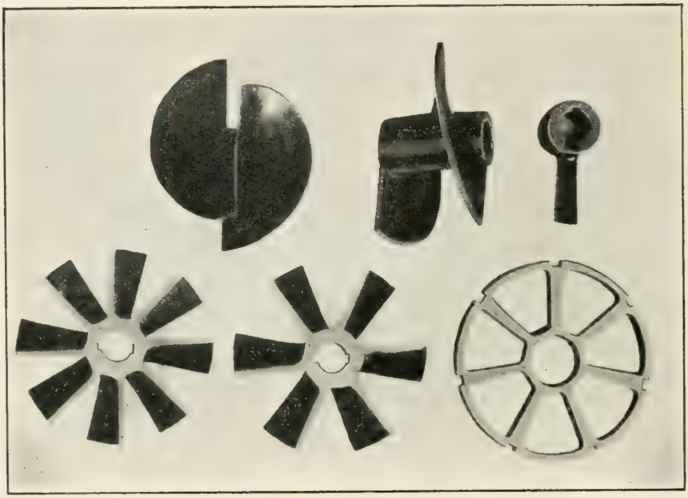

Fig. 25.—Various Knives and Screws used in Åbjörn Andersson's Peat-macerating Machine.

hundred machines of this type have been made, most of which are working in Russia. The arrangement of the plant is somewhat similar to the Åbjörn Andersson's, illustrated in figs. 22 and 23.

The Anrep machine is made in two sizes. One size produces 60,000 peats per day, or about 60 tons of air-dried peat, if the bog is drained and the peat is easily worked, but only about 50 tons if the peat is poor. The smaller

FIG. 29.—Anrep's Peat Machine at work on Stafsjo Bog, near Ljubgby, Sweden.

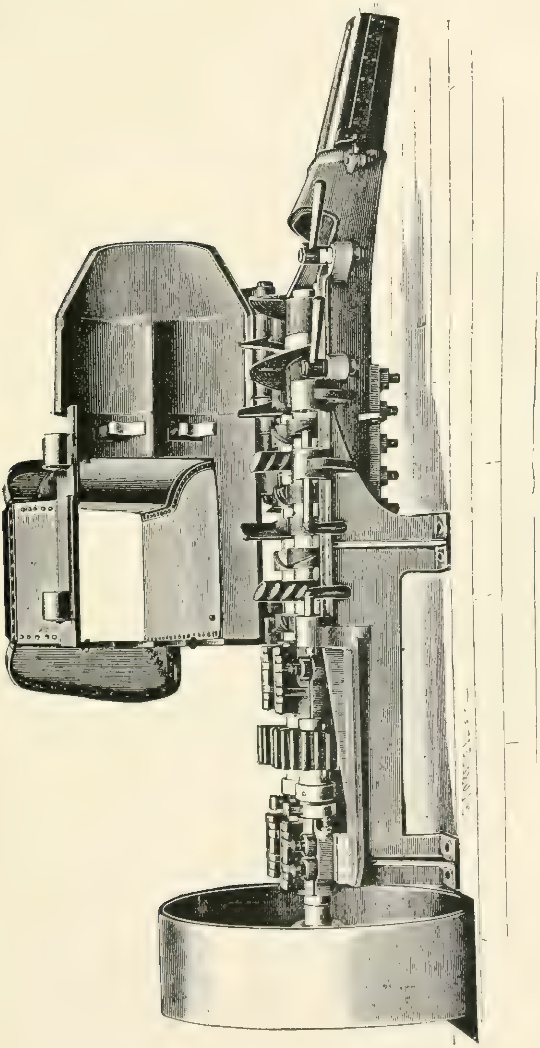

Fig. 28.—Anrep's Peat Machine.

size produces 30 tons of air-dried peat per day, requiring 23 effective horse-power.

The cost of manufacture of the peat by one of these machines at Stafsjö, according to Mr Aug. E. Jakobson, is 2·11 krone (2s. 7d.) per ton. The cost at Hästhagen, according to Mr Thure Björkman, is 2·15 krone (2s. 10d.) per ton.

Åkerman's System.—This is another Swedish machine similar to the last two systems. It consists of an elevator, which is easily adjusted to the varying depths of the bog as the digging proceeds. This elevator delivers the peat cut from the bog in lumps of any size and shape with an ordinary spade, into a hopper of the macerating machine. The hopper is made of thick wrought-iron plates strengthened with angle irons, the sides being made sloping to allow the peat to fall readily into the machine. The sides are also made very high to prevent the peat being thrown over on to the machine underneath. The elevator is driven by means of gearing, sprocket-wheels, and detachable chain from one of the cutter shafts of the machine.

The turf, as it falls into the body of the machine, is cut up and worked to a paste by means of rotating sword-shaped knives, which are secured on to two nearly parallel rotating shafts. The shafts are carried in bearings which on the lower parts are shaped into knives corresponding with the sword-shaped knives. The latter work also against knives placed at the bottom of the machine body. By means of this arrangement of knives the roots and small branches are cut up and kneaded into the mass of turf.

After the turf, etc., has been macerated and worked into a paste it is forced forward and compressed by means of two screw conveyors at the ends of the shafts, through a mouthpiece or mould, and discharged on a roller band of iron. This band or conveyor is fixed immediately under the mouthpiece, at a slight angle to the centre line of the machine, so that the peat frames can be easily placed upon it.

The body of the machine consists of an upper and lower part, which are hinged together and secured by a hasp,

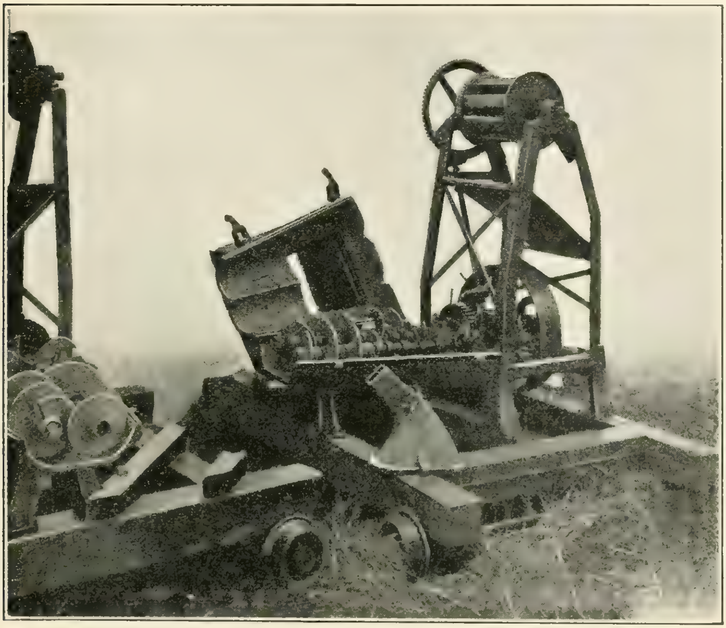

FIG. 30.—Åkerman's Peat Machine, showing Internal Arrangement.

so that it can easily be opened up for examination and repairs.

Fig. 30 illustrates this machine opened out to show its internal arrangement, the mouthpiece being placed at the front end of the wood frame.

Fig. 31 shows the machine at work mounted on wheels.

These machines are made in three sizes. The smallest machine will make about 16 tons per day; 13 actual

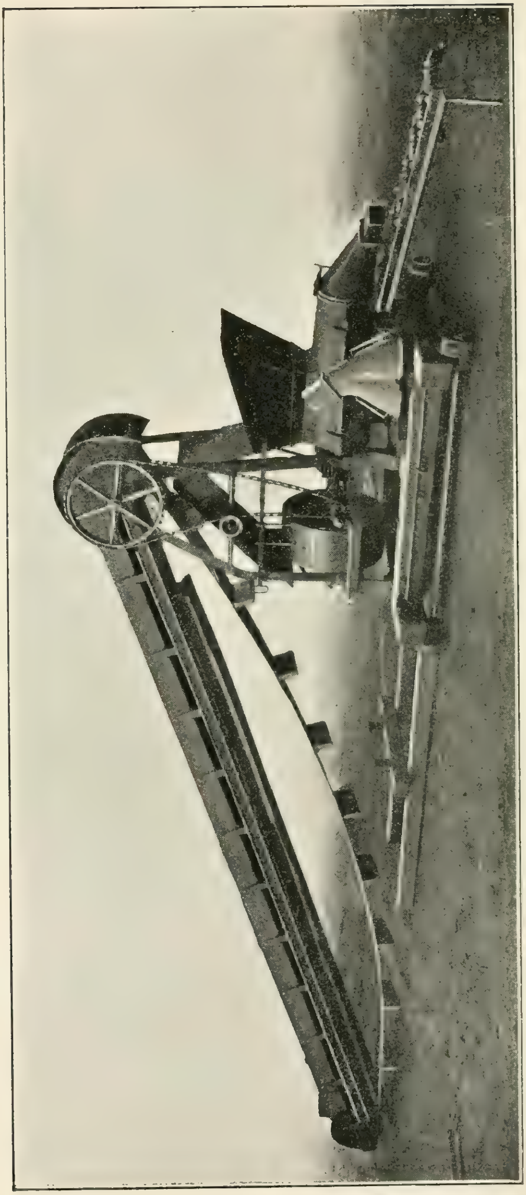

Fig. 31.—Åkerman's Peat Machine at work, mounted on Wheels.

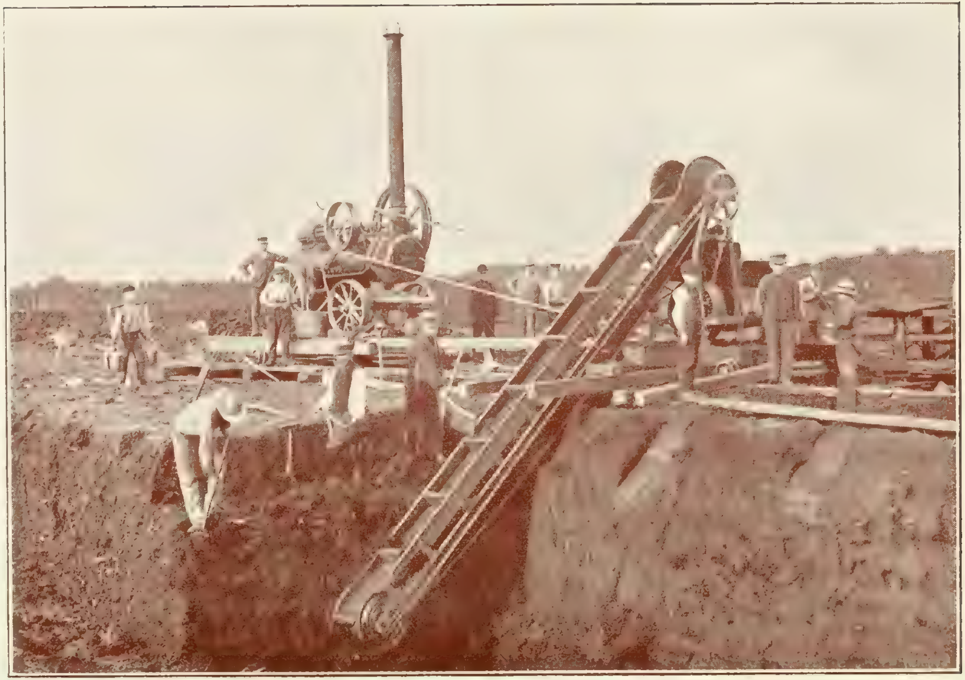

Fig. 32.—Åkerman's complete Peat Plant at work at Hyllstofta, Sweden.

horse-power and 8 men and 2 boys are required to do the work.

The medium size will manufacture about 24 tons per day; 19 actual horse-power and 12 men and 2 boys are required.

The largest machine will produce 32 tons per day; 27 actual horse-power, and 16 men and 2 boys are necessary to attend and drive this machine.

The size of the peat stream issuing from the machine is, in the large machine, $4\frac{1}{2}$ inches by $4\frac{7}{8}$ inches; medium machine, $3\frac{7}{8}$ inches by $4\frac{5}{8}$ inches; and the small machine, $3\frac{5}{8}$ inches by $3\frac{7}{8}$ inches.

Fig. 32 illustrates a complete plant at work at Hyllstofta, Sweden.

Exter's System.—This system was first employed in Germany. The bog was first drained, and the part to be worked was levelled. Next, the surface was harrowed, either by manual labour or by steam power. This harrowed material was partially dry on account of the sun and wind, and was arranged in small heaps in the form of fine mould. The fine loose peat was then removed to a large storehouse, where it was kept, so that it could be manufactured into fuel during bad weather. After this it was removed into another building, where it was artificially dried, and brought forward through a chute into a compressing machine. By this means the fine peat was solidified into a good hard peat fuel.

The most modern design of Exter's machine is illustrated in sectional elevation (fig. 33) and end view (fig. 34). The fine mould is admitted through the hopper A into the mould B by gravity. This mould is made in four pieces of hardened steel. It is held in its place by screws to give the proper tension to the retaining plate C. This is effected by means of the hand-wheel D, worm E, and worm-wheel F. The piston or pusher G is operated by an eccentric and steam engine or other motor. When the piston G is withdrawn, the proper amount of peat mull enters the mould, and on the forward stroke the piston presses against the block left in the mould by the previous forward stroke. These presses make from 65 to 80 strokes per minute, each stroke producing one block at a pressure of about 2 to $2\frac{1}{2}$ tons per square inch.

Dobson's System.—After the surface of the bog has been

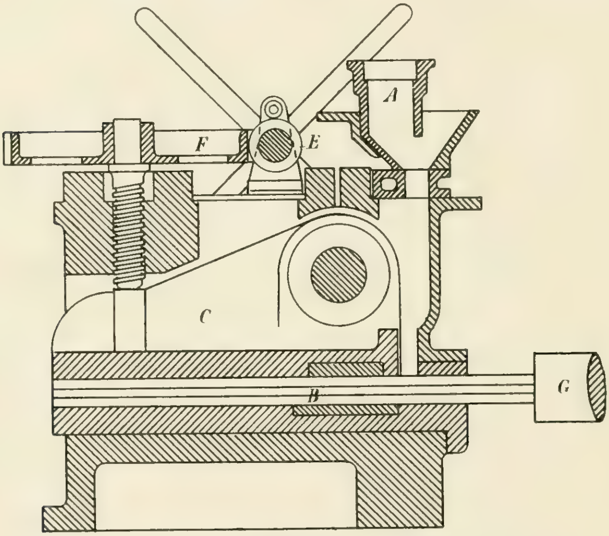

FIG. 33.—Exter's Peat Machine—Sectional Elevation.

stripped of the useless material, the peat is cut by an automatic digging machine. A trench is first cut in the bog, and the machine placed close to the edge, a link belt, furnished with knives and scrapers, overhanging the machine, reaching to the bottom of the workings. These knives and scrapers deliver the cut peat into a hopper, from whence it passes to the other side of the machine by a conveyor. During this process the machine is continuously moving forward very slowly, always presenting a fresh cutting surface, in the banks of the bog, to the knives and scrapers. The machine is mounted on very wide road-wheels. The peat, as it is discharged from this machine, is raked out into beds and allowed to rough dry. When it is ready it is thrown into wagons and drawn into the mill. The peat is next thoroughly dried in Dobson's Patent Dryer, explained and illustrated in Chapter IX. From the dryer the peat is dumped into a breaking machine, and lastly pressed in one of Dobson's presses.

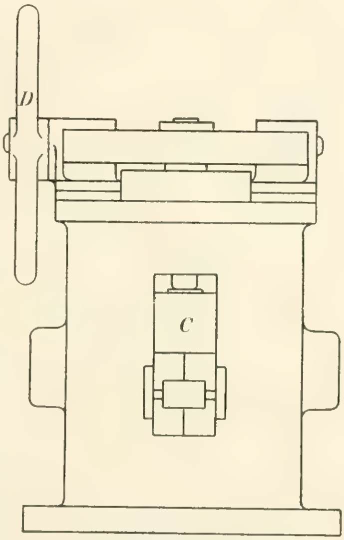

FIG. 34.—Exter's Peat Machine —End View.

The Dobson Press is of the vertical closed tube type, the die resting on a solid base. The briquettes are allowed to remain in the dies for one cycle of the system, and are then subjected to another compression by a second briquette formed on the top of it. There are two formers or punches in each machine, and to each former a die block containing eight dies. The frames are actuated by eccentrics. The die blocks and press-bed of one of these presses is shown in elevation—half sectional—fig. 35, and plan, with one of the die blocks removed, fig. 36. A and A are the formers, B the expelling punch, C the resistance block, which yields when the stress exceeds the working pressure, the springs D taking up the excess pressure and preventing any breakage. E and E are the two die blocks, which are rotated by the reciprocating lever F and the ratchet G. H is an oil-swab which

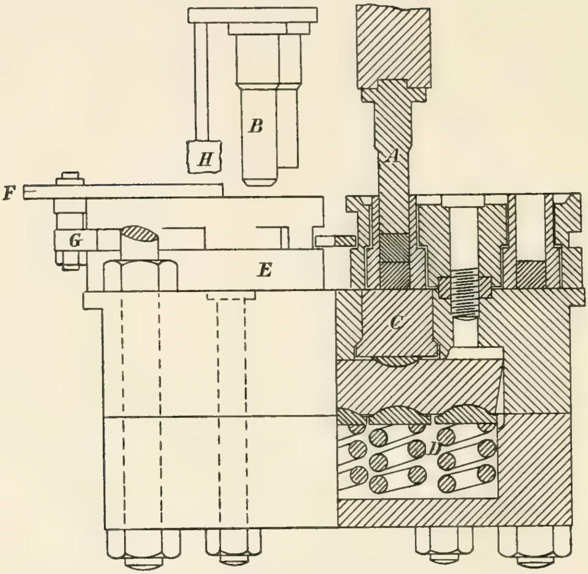

FIG. 35.—Dobson's Peat Machine—Half Sectional Elevation of Die Blocks.

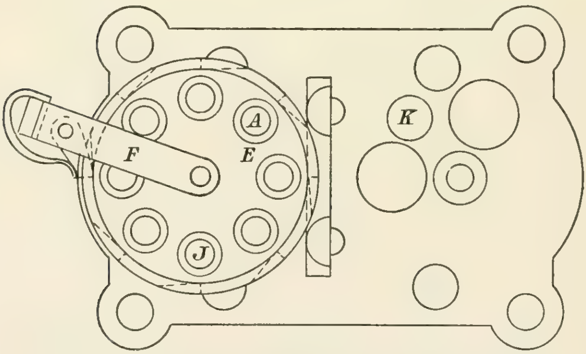

FIG. 36.—Dobson's Peat Machine—Plan, with one of the Die Blocks removed.

lubricates the die before the peat enters it. J are the dies, and K the discharge hole.

Dickson's System.—In this process the peat is dug out by a dredge, and is piled in heaps on the bank for air-drying. After two weeks or so, according to the state of the weather, it is removed to barges, which are towed to the works. The amount of water is then reduced by a pressure of 300 tons applied to one ton of peat at a time. These solid blocks are delivered into a screw conveyor and broken up, so that they can be transported by a chain conveyor, which delivers the peat into a breaker. This machine consists of a number of arms or knives secured to a shaft in such a manner that when the latter revolves the arms of the former shaft fly out by centrifugal force and beat violently any lumps within their reach. By this means the peat is reduced to powder and fibres and passed into a dryer.

After drying, the peat fibres and powder are introduced into one of Dickson's Peat Presses, to be made into blocks. The die-block is illustrated in sectional elevation, fig. 37. The action of the press is as follows:—Steam being admitted on one of the cylinders, the movement of its piston revolves the crank shaft and valves and brings the other cylinder into operation as well; then the pistons proceed to work in opposite directions, imparting such movement to the formers A that one will be exercising the formative pressure upon one charge of material in one tube, while the other is receding and another charge of material is falling to the mouth of the other tube. When the tubes are fully charged, which becomes the case after a few strokes of both formers, one new block is formed at the upper end of each tube against the yielding resistance by the previously formed block, still retained, and one finished block, or more, according to the thickness of the blocks, which varies according to the difference in density of the raw peat, is ejected at the lower end of each tube at each stroke of its former. In the machine for operating upon cold dry peat the total approximate length of the forming tube may be taken as 12 inches, and the actual entrance stroke of the former limited to 5

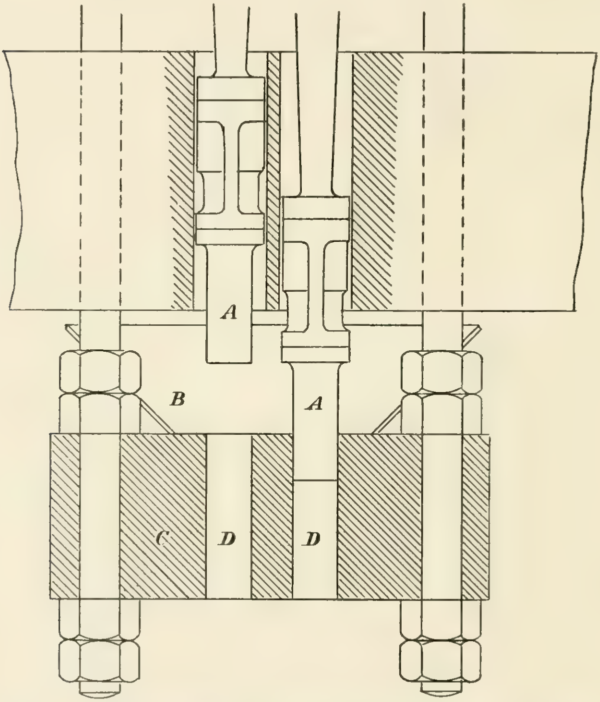

FIG. 37.—Dickson's Peat Press—Sectional Elevation of Die Block.

inches, and as the stroke of the piston is 14 inches and the travel of the crank 21 inches, it will be seen that in the double press the whole power of both cylinders is transmitted through the crank shaft and imparted to each block formed, 23 inches travel being free from resistance in each engine, one of which comes into play midway of the other's travel, and thus does not impair the speed of operation of the double machine.

The material is fed into the dies by a separate hopper B for the two dies, arranged immediately above the die-block C, and so designed that the feed of the material may gravitate between the two die-members in successive charges. The die-block has two forming tubes D and D, provided with parallel steel bushes, so that the peat does not receive any lateral compression after it has been set into a block by the vertical stroke of the former. The die-block is made hollow, and a stream of water is allowed to circulate through for the purpose of keeping it cool.

Each punch or former makes fifty-four to sixty strokes per minute, and the combined output of one press ranges from $8\frac{1}{2}$ to 9 tons per day of ten hours, or an average of $8\frac{3}{4}$ tons of briquettes per day.

Düsseldorfer Eisenwerk Aktiengesellschaft System. — This company has adopted the Schlickeyesen or Dolberg press, shown at A in fig. 38, into which the moist fresh-cut crude peat is fed, and converted into a homogeneous pulp, which is discharged from the copper mouth of the press, as a continuous stream of fibrous material, about 2 feet wide and from $1\frac{1}{2}$ inches to 1 inch in thickness. From this it is carried forward by the conveyor belt to the cutting table C, which cuts it into lengths of about 2 feet and $1\frac{1}{2}$ to 2 inches thick. The blocks are next delivered into an intermittently revolving apparatus D, which in turn discharges them through a shoot F into a bagger arranged in such a manner that the blocks of peat are entirely untouched by hand. The bagger consists of a pillar G, carrying a double arm, with the shaft J, and the stretcher bars K K, all mounted so as to be able to be rotated. Two men are required to work the bagger, one on each side of the machine. The man on one side places an empty bag on the stretchers K K, and sets these latter in

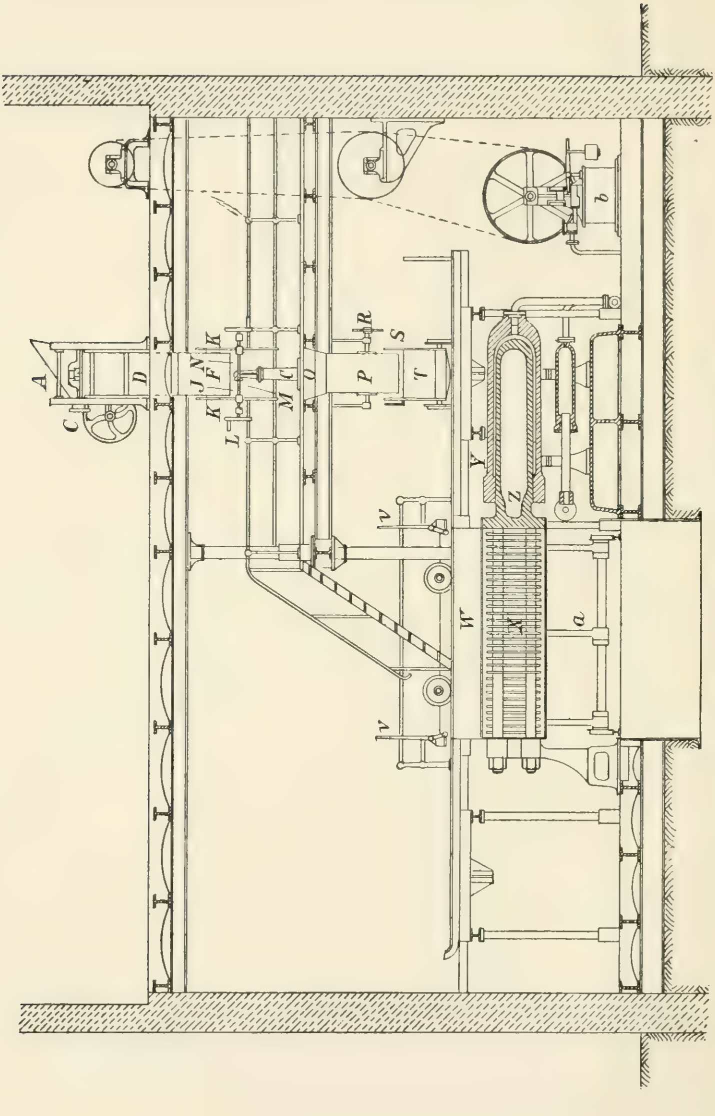

FIG. 38.—Schlickeyesen or Dolberg Peat Press.

tension, so as to fasten the bag in position; when this is done he turns the hand-wheel L, in order to turn the double arm H in the opposite direction. By this movement the wheel M revolves on the wheel N, and the stretcher bars, which were directed upwards before the commencement of the movement, are turned downwards, thus bringing the bag into the proper position for receiving the blocks of peat. As soon as the block is in the bag on that side, the man releases the stretcher bars K K by means of the hand-wheel L, and the bagged block falls through hopper O into a rotary double chamber P, which is divided by a central partition. At the same instant the double arm H is again turned, thus bringing the stretchers on the opposite side into position for setting on a fresh bag.

The rotary double chamber P receives the bagged peat blocks in such a manner that on turning the hand-wheel R the 4 inches or so of bagging that projects beyond the end of the block is laid against the sheet-iron casing S, thus closing the mouth of the bag. The latter with its contents is then discharged into a truck T, divided into about thirty compartments, and moved forward automatically as soon as each compartment is filled. When the truck is loaded, it is run into position over a hydraulic press into the compartments of which the contents of the truck are discharged by moving levers V V, so as to displace the slotted plate forming the bottom of the truck, and thereby open all the compartments at once. The bagged blocks of peat thereupon fall down the guide compartments W, and enter between press plates X into the press, which chiefly consists of the cylinder Y and the ram attached to the ram-head Z. The plates of the press are connected with one another and the ram-head by means of chains, so that when the pressing is finished, and the ram and the ram-head return, the plates are drawn out again to their original position. Under the press plates is a truck A, which is mounted on wheels and runs on a railway, for the purpose of preventing the bagged peat blocks from falling out of the press before pressure has been applied. One truck is sufficient for a number of presses. By means of pressure generated by the pumping engine *b*, the press ram is driven forward and thus squeezes the water out of the bagged peat blocks.

The pressed peat blocks now contain about 50 to 60 per cent. of water, fall down out of the press on to a conveyor, and are delivered to a floor where they are emptied from the bags. After this process they are passed through a disintegrator and conveyed to the drying ovens, where their water is further reduced to about 12 to 15 per cent., and whence they are transferred to the briquette presses. The advantage of this form of press for this purpose over the common form is that the bags can be changed without any loss of time.

One of these presses, employing two horse-power, can deal with 324 cubic metres of crude peat in ten hours at a cost, inclusive of digging the peat by hand, of seventh of a penny per cwt.

Lennox's Peat Fuel Process.—In this process it is not necessary to drain the moss or bog, as the patent squeezer removes in one operation much more water than any draining will do. This is a most important item, as the cost of cutting and keeping open the drains runs to an outlay of many thousands of pounds on some of our largest mosses. The peat turfs can be cut any size or shape, or dug by a grab dredger, and it does not matter what the size of the blocks or lumps of wet peat may be, as the squeezer will at once remove the loose moisture and deliver the peat in flat cakes ready to be pulped.

The first machine is a squeezer and pulper combined, and consists of two running converging bands, both travelling in the same direction. The lower band runs on shafts mounted on a rigid frame, and is driven by spur and pinion gear. The top band is fixed to a swinging frame on another driving shaft at the feed end of the machine, and the free end of the frame over which the band passes works under powerful springs. This end of the band and frame can be set down by screws to touch the bottom band running on the fixed frame. The feed opening between the two bands can be made any height according to the size of peat turfs thrown in. The top band is driven by spur wheels from shaft of bottom band. As soon as the peat is thrown on to the bottom band it is immediately carried up between the two bands and gradually squeezed to a flat cake, removing from 20 to 24 per cent. of loose or free water from the wet peat, and the machine will take the peat as quickly as it can be fed into it. When the squeezed peat leaves the machine it falls into a pulper, where it is instantly pulped to the desired consistency, and from the pulper it either falls into drying waggons which, when filled, are pushed straight into the dryer, if the peat is required for making litter or dust, but if required for fuel it is carried to the briquette machine to be made into briquettes.

The converging bands are set at an angle of about sixty degrees to allow the water to run off after it is squeezed from the peat.

Pulping Attachment.—The pulping attachment consists of a number of running knives which are spaced to suit the grade to which the peat has to be pulped. On the present machine the knives are set three-quarters of an inch apart and give excellent results. As mentioned above, if the peat is required for litter it falls straight from the pulper into one of Lennox's patent bogies which fall automatically. These bogies (illustrated in fig. 41) consist of a number of vertical pockets made of strong wire netting, and the pockets are set about two inches apart to form air spaces between each, so that the hot air in the dryer can be driven all round them, thus coming into direct contact with the peat. The bottom of the pockets is closed with a sliding door so that when the peat is dry and has to be emptied the bogie is pushed over a pit, the sliding door drawn, and the dry peat allowed to fall straight into the pit. The bogies are 6 feet long by 4 feet wide, each with ten pockets 2 feet 9 inches long by 6 inches wide and 4 feet deep. The pockets can be made any required size and depth. This method reduces the handling of the peat to the smallest possible amount.

Briquette Machine.—This patent machine consists of a series of mould boxes in groups, or singly, as required, hinged together to form one continuous or endless band driven by cant wheels from spur gearing. At the bottom of each mould box is a movable plunger fitted to a spindle passing through the bottom of the mould box. On the end of the spindle is a cross-head, and on the spindle between this cross-head and the bottom of mould box is a spiral spring which keeps the plunger at the bottom of the mould box. On the top of the machine, directly above the running band of mould boxes, is a feed box into which the peat to be moulded is fed; and by movable flaps, inside the feed box, driven either by the band itself or by gearing from the driving shaft, the peat is forced into the empty mould boxes as they pass under the feed box. The filled mould boxes then travel along and pass under a wheel on which there are dies or panels which fit into each mould, and these dies press the peat firmly into the mould boxes. On leaving this wheel the mould boxes pass over the cant wheel and travel mouth downwards directly above a running band travelling in the same direction and at the same speed. On to the same band are fed palette boards for receiving the moulded briquettes when ejected from the mould boxes;

Fig. 39.—Digging the Peat.

Fig. 40.—Empty Palettes for Air-drying Peat.

Fig. 41.—View showing Patent Lifting Bogie; also wet Peat lying ready to go on to Elevator to Squeezer.

Fig. 42.—Air-drying Gantrys.

this is accomplished by means of a striker gear, under which the mould boxes have to pass at the point where the briquettes have to be ejected from the mould boxes, and the cross-head fixed to the spindle comes in contact with the striker gear which depresses the spindle and plunger and pushes out the briquettes on to the palette boards travelling beneath. The filled palettes travel along from under the machine and are lifted off and stacked on bogies ready to go into the dryer. These machines will turn out 6000 wet briquettes $6 \times 6 \times 4$ per hour.

Dryer.—The drying, which is the most important operation of all, is done in Lennox's patent dryer with superheated moist air. This dryer can be worked at any desired temperature necessary for the operation, and can be run to dry the peat quickly or slowly as required. It consists of two drying chambers of suitable height, width, and length, into which the bogies full of wet peat or briquettes are run. The floor is fitted with grating over an endless flue or duct, and at the end of this flue is fitted a special patent heater, and at the other end is a fan, by means of which the air is circulated continuously through the heater and through the wet peat. As it takes up the moisture from the wet peat, this moist air in passing through the heater is turned into steam, and by the outlet and inlet valves and passages the steam can be let out and fresh air admitted into the chambers.

This dryer can be regulated to work at any desired temperature according to the nature of the material to be dried and the rapidity at which it has to be dried.

Fig. 39 shows the digging of the peat in the moss; fig. 40 illustrates a stack of empty palettes for air-drying the peat; fig. 41 is a view showing the patent lifting bogie, also wet peat lying ready to go on to elevator to squeezer; fig. 42 shows the extensive air-drying gantries.

Air-drying.—In this system the stacks of palettes are put out on the gantries and dry rapidly, as shown in fig. 42, where thousands can be stacked for drying on a small area of ground.

They are conveyed to the drying gantries on the Lennox patent bogie, and dropped on to the drying gantries from the lifting bogie, by two or three turns of a wheel on the bogie. One man with this bogie can lift and convey from the briquette machine to the drying gantries 10,000 briquettes in ten hours.

Pressed Peat.—The great objection to peat fuel in its natural state is its bulkiness. To obviate this, pressing of

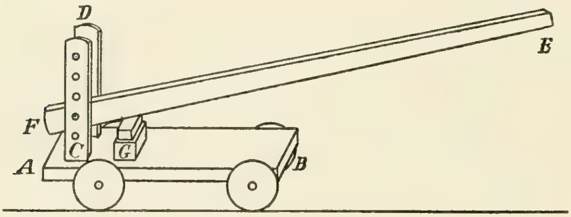

FIG. 43.—Todd's Peat Press.

the blocks has been much resorted to. This method was first tried about the year 1821 by a Saxon gentleman named Pernitzsch, who subjected the wet peat blocks to a heavy pressure.

The next attempt we find was made by Mr Walter Todd, of Longhope, near Hawick, who in the year 1839 constructed a very rude press of timber, illustrated in fig. 43. This machine consisted of two pieces of wood, C and D, at a distance of about two inches from one another, which were merged into the plank A B, at the end A and at right angles to A B. Between the uprights C and D was inserted a strong beam E F, 12 inches long, and secured by means of an iron bolt passing through the uprights, which latter was provided with a number of holes to admit of raising and depressing the beam E F at pleasure.

Two boxes, one made of wood and the other of sheet iron, were employed. The wooden box was about 12 inches long, 4 inches broad, and 4 inches deep; the sheet-iron box was 14 inches long, $3\frac{1}{2}$ inches broad, and $3\frac{1}{2}$ inches deep. The boxes were provided with lids which just fitted them, about three inches in thickness, and heavy enough to sink into the boxes.

Each box was alternately filled with peat newly dug, the lids adjusted, and the box placed in the machine at the point G. The man stood at the end of the lever, and as the box was placed in the machine he bent his whole strength and weight upon the end of the beam, and by this means a great pressure was instantly applied to the box by a single effort. Two women filled and removed the boxes. By this method a man and three women could compress about eight cartloads in a day; one man digging and the women throwing out the peat to keep this process in full operation. The peats when taken from the machine were piled like small stacks of bricks, but so arranged as to admit a free circulation of air.

About this time Mr Slight, Curator to the Highland and Agricultural Society of Scotland, introduced before the Society a machine for compressing peat. It was illustrated and described in the Society's *Transactions*, vol. xi. p. 458, from which we have, by kind permission, extracted the following account:—

For the purpose of compressing peat-moss for fuel, Mr Slight's objects were of a twofold nature—that of constituting it into a species of manufacture for the supply of fuel for towns, factories, and other like purposes; and secondly, for the supply of local or home consumption only, among cottages and families resident in the peat district. For fulfilling the object of the former, machines of great power, and proportionately great expense, may be required. In the latter case, machines of simple construction are to be recommended, as they are not liable to get out of order, and their cost is

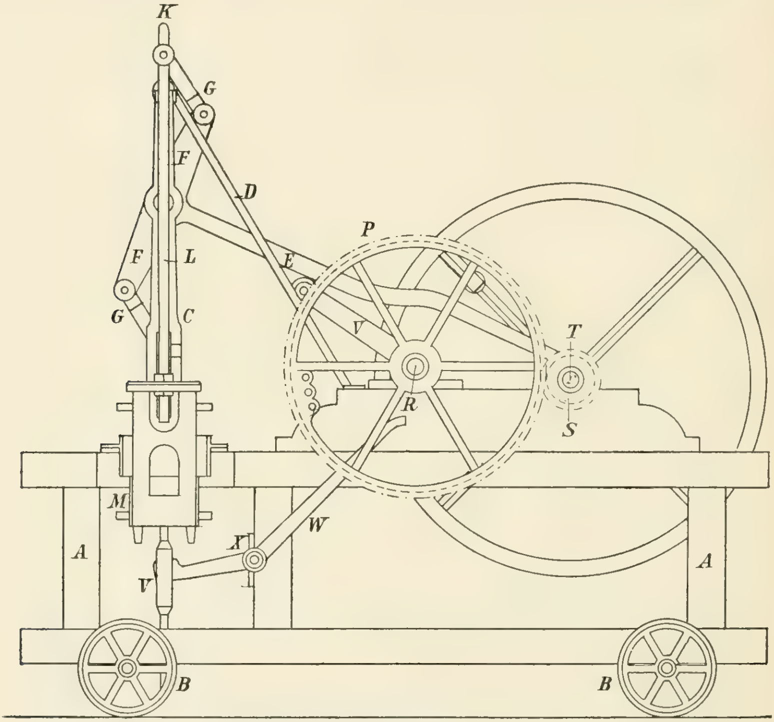

FIG. 44.—Slight's Peat Press—Elevation.

small, yet capable of pressing the peat as perfectly as the other machine.

Mr Slight's machine is shown in elevation, fig. 44, and front-end view, fig. 45. This machine was intended to follow the cutting of the moss, and was therefore mounted on four small wheels. The carriage A, which was made of timber, ran on the wheels B. The leading principle of its action was that of the bent lever. The long arm of the lever, when acted upon by a wiper, worked by a spur wheel and pinion, gave the required pressure. The second or upper bent arm of the lever was added, not as a means of increasing the power, but for the purpose of facilitating the operation. C and C were two upright frames of cast iron, supported by braces D, and completing the framework. E is the long arm of the lever; F F the heads to which are joined the two connecting links G and G; H and H are two cross-heads, jointed to the links G and G, the lower cross-heads being movable on the guides J and J, and the upper ones on the guides K and K, and both working in a vertical direction. L and L are two side-rods of malleable iron, attached at the top to the upper cross-head and at the bottom by an adjusting screw to the movable table M, which latter carries the peat moulds N and N.

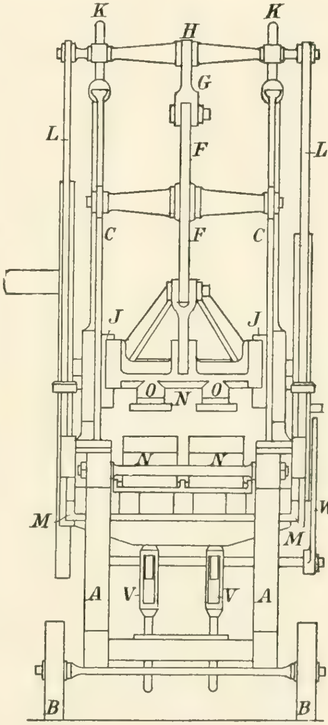

FIG. 45.—Slight's Peat Press—Front-end View.

To the lower cross-heads are attached the pistons O and O of the mould boxes. By this arrangement of parts it is easily seen that, when the arm of the lever is lifted and brought towards a horizontal position, the heads of the lever are thereby brought into a vertical line, and their progress has the effect, by means of the connecting links G and G, of raising the upper cross-head and the table, and of depressing the lower cross-head with its pistons O and O until the latter are brought within the moulds and the required pressure produced. The fall of the end of the lever reverses the motions, separating the pistons from the moulds to an extent sufficient to admit a charge of moss being thrown in from a shovel, when a repetition of the motion already described gives effect to the next compression. In order to increase the power of the machine, the spur wheel P, keyed on the shaft R, is introduced. The wheel is actuated by the pinion S, keyed on the shaft T. On the shaft R is also keyed the wiper V, provided at the end with a friction roller. The wiper during one-quarter of each revolution operates in raising the lever to the horizontal line, thereby giving the pressure; during the next one-quarter of the revolution it allows the lever to fall, separating the pistons and moulds, and in this position they remain during the remaining half of the revolution, thus leaving one-half of the time spent in each revolution of the wheel for the purpose of removing the compressed peat and refilling the moulds. For the greater facility of removing the peats from the moulds, the latter are furnished with false bottoms, which are attached to the rods V. These rods move vertically through guides, and are lifted by the lever W, which is acted upon by a stud in the side of the spur wheel. The lever W turns upon the fulcrum X, and to it are attached the opposite arms of the lever, to suit slots in the rods V and V. When the compression has been made, and the lever W properly adjusted, it begins to act when the wiper has moved a little way past the centre, and goes on until the movable bottoms are raised as high as the top of the moulds. One of the attendants then removes the peats with a shovel, and the continued progress of the wheel allows the lever to fall off the stud, when the bottoms fall back into their natural position to receive another charge of moss.

Shortly after Mr Slight's machine was brought before the public, Lord Willoughby D'Eresby invented a machine for compressing wet peat as it came from the bog. It is illustrated in isometrical perspective, fig. 46. It is composed of a bottom frame A A and two uprights B B, with a cross bar at top, all being made of timber, and two wrought-iron stays C and C, to support the uprights. Upon the two uprights is bolted the mould D, formed of two cast-iron plates, placed one on each side of the frame. The plates of the mould are perforated with very narrow vertical grooves or slits, one-half inch apart, and so narrow as to retain the moss, while they allow the expressed water to escape. Their width is about $\frac{1}{15}$ of an inch, widening into vertical channels, opening outwards only at top and bottom, though in the illustration they are, for the sake of clearness, shown as open throughout their whole length. A cast-iron plate is fitted to slide backwards and forwards in the slot E, and forms the bottom of the mould. It is moved by means of the levers F, jointed at their ends and to the sliding bottom by shackle joints. G and G is a movable frame composed of two racks, connected at top and bottom by the bars G and G. The lowermost of these bars is fitted to slide accurately, but easily, into the mould, the racks being acted upon by two pinions upon the horizontal spindle H, which is turned by means of the spokes on the wheel J. The rod passing through the upper bar of the frame G, with its shifting nut at bottom, serves to regulate the extent, in depth, to which the peat is to be compressed by stopping the upper bar of the sliding frame when it has made the desired descent. The process of working is as follows:—The moss is cut with a proper spade into blocks adapted to the size of the mould, into which they are thrown one at a time; while the wheel in turning round brings down the sliding frame, until its lower bar presses on the contents of the mould. The surplus

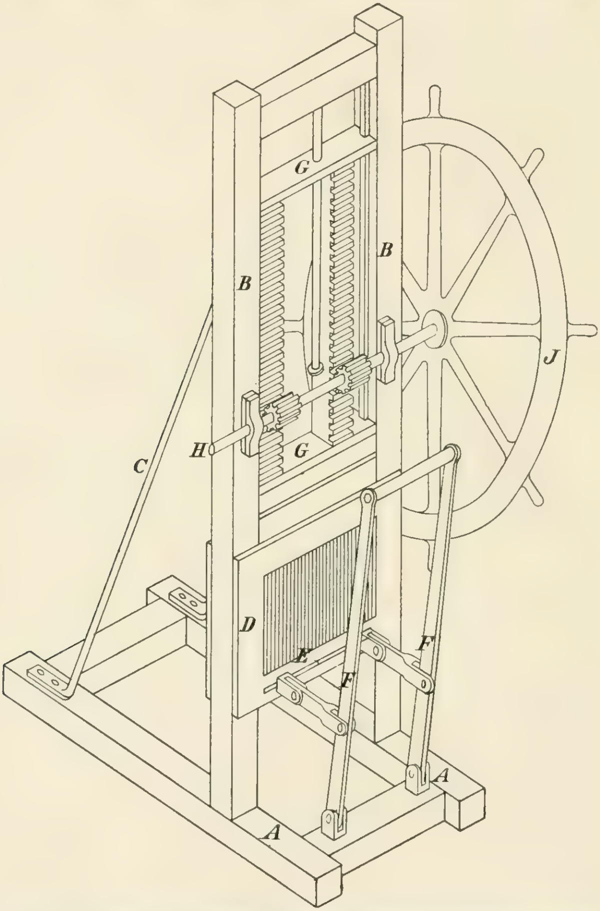

Fig. 46.—Lord Willoughby D'Eresby's Peat-compressing Machine —Isometrical Perspective View.

water is thus squeezed out, and escapes through the slots of the mould. When the pressure has been sufficiently exerted, the sliding bottom is withdrawn, and the peat falls out ready for removal to the drying shed. As soon as the peat is discharged, the sliding bottom is returned to its place, the sliding frame raised, the mould charged with another block of moss, and the operation repeated.

At this stage of the manufacture of peat fuel, hydraulic processes were tried, and a company was formed for the purpose. The machinery consisted of a four horse-power engine, four hydraulic presses, having rams 6 inches in diameter, with appropriate moulds, each capable of pressing three blocks of peat, 2 feet square by 3 inches thick, at each stroke; and a pair of heavy edge-runners for triturating the turf previous to compression.

Mr Linning adopted a somewhat similar method, for which he secured a patent. The bog intended to be worked for the season was first drained by making ditches through it, to allow as much of the free water as possible to flow away. Next the turf was cut by an ordinary spade, thrown into a mill, and, after passing through it, was removed in wheel-barrows to the next operation. This consisted in filling wooden moulds with the triturated peat in the same manner as clay is placed in the mould when hand-made bricks are produced. From the moulding table the blocks of peat were laid out on the surface of the bog to consolidate. In two or three days they were ready to be handled and carried to a shed, where they were spread out on shelves to dry, or to a drying-house, artificially heated by means of flues, and fired by peat fuel. In a few days more the peats were ready for use. It was estimated that the cost of production of this peat fuel was approximately 5s. per ton.

This peat fuel was tried in the firebox of a locomotive engine, with its train, on the Glasgow and Garnkirk Railway. The distance travelled was eight miles; and the consumption of peat on the whole journey was just double the weight of coal required to fire the same engine over the same distance, but the engine travelled at a somewhat greater speed than its ordinary rate when a coal fire was used. The engineer was of the opinion that if the furnace had been properly adapted for peat fuel three-quarters would have been sufficient.

In a letter written by Mr Slight, published in the *Transactions of the Highland and Agricultural Society of Scotland* in 1838, he makes the following remarks:—"The results of all my observations on this subject may be summed up in the five following points:—

"1*st.* That peat-moss in which the vegetable structure is entirely or nearly decomposed, or that which is usually called 'black moss,' is improved little or none as a fuel by either compression or trituration, nor can its ultimate bulk be sensibly reduced by any practicable degree of compression.

"2*nd.* That brown fibrous moss is very much improved as a fuel by trituration, probably arising from some chemical action between its exposed fibres and the atmospheric air, but, in whatever way, a more compact and carbonaceous texture is produced; but that while subsequent pressure may draw off part of its water, it will neither materially improve its quality as a fuel, nor sensibly reduce its ultimate bulk.

"3*rd.* That very fibrous moss may be reduced in bulk to a small extent, will be sooner dried, and partially improved, by simple compression.

"4*th.* That there is no decidedly approved machine at present in use that will by one operation produce the greatest possible improvement in the quality of peat fuel, either on a large or small scale.

"5*th.* That since compression cannot be conducted by any means with which we are yet acquainted, without an envelope of cloth during the act of compressing, to prevent the escape of the moss, we cannot expect to exercise that agency with advantage until this be removed."

A compressing machine invented by Mr Stone is illustrated in side elevation, fig. 47, and plan, fig. 48. It consists of two cast-iron rollers A and B, the former of which is fitted with adjustable bearings D to regulate it to the thickness required, by a screw, the latter rotating in fixed bearings C. The adjustment of the roller A is done by the screw E,

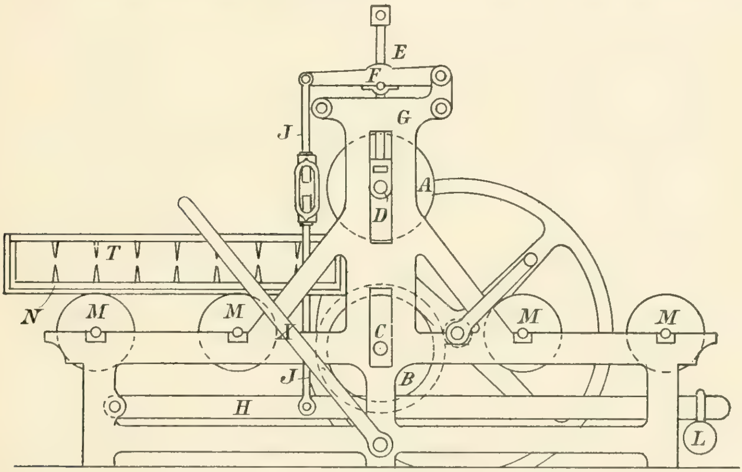

Fig. 47.—Stone's Peat-compressing Machine—Side Elevation.

the nut for which has its bearing in the lever F, the fulcrum for which is provided at the top of the side frame G ; the other end of the lever is connected to the long lever H, by the adjustable connecting rods J and J, the adjustment being performed by a right and left-hand screw socket; the weight L can be moved along the lever H to give suitable pressure. M M M and M are friction rollers for supporting the pressure-box N, before and after it has passed through the squeezing rollers A and B. O and O are the spur pinions, keyed upon the shaft P, these pinions gearing into the wheels R and R, upon the shaft of the squeezing roller B; they also gear into two racks provided on the underside of the pressure-box N. Inside this box is provided another box T, which is divided into compartments, eight in length and two in width, making in all sixteen compartments; to form these the bottom of the box T is fitted with a number of knives. The straight sides of the knives come in contact when they are pressed together; these knives do not reach right across the box, a space being left in the middle for the dividing knives U and U to pass between the ends of them,

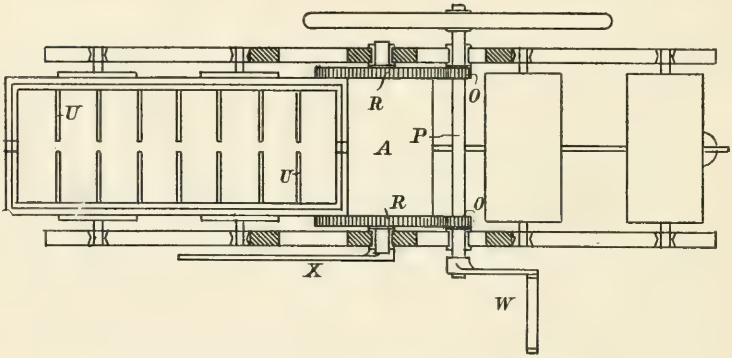

Fig. 48.—Stone's Peat-compressing Machine—Plan.

dividing the peat longitudinally after the box has passed through the squeezing rollers. The outer box is plain and made strong. The levers X and X are for raising the lever H and removing the pressure entirely from off the pressure-box. The handle W is for giving motion to the machine, but it can, of course, be worked by any kind of motor.

The action of this machine is as follows:—The box T is filled with peat, and then placed inside the box N, with the lever H raised and the squeezing rolls A lifted. The machine is then put in motion and the lever H let down so that the roller A will be brought in contact with the lid of the box T; the lid will then assume an angle of from 10° to 15°, varying until the box has passed the centre of the squeezing rolls, when it will begin to assume a horizontal position and give a uniform pressure to all the blocks in the compartments. When the box has passed through between the rollers, the inside box is removed and another filled and placed in the machine and the handle turned in the opposite direction, when the new box is passed through between the rollers.

The process of pressing the peat in a wet state was soon given up, because it was found that, on account of its elasticity, the blocks again expanded and absorbed a great amount of water. This led to the class of peat known as "manufactured or machine-made peat." Two processes for pressing wet peat, besides those mentioned above, were found to give a partially satisfactory result, one being that invented by Mannhardt, and the other the Neustadt process.

Mannhardt's Process.—This process consisted in passing the wet peat between a pair of perforated rollers covered with cloth made of hair; the best cloth was made of goat's hair. The rollers were 15 feet in diameter by 6 feet 6 inches long, made of perforated iron plates, set one inch apart, and revolved about once in seven minutes. The peat was in this way deprived of some of its water and came out of the rolls in a thin sheet, when it was cut up into blocks 12 inches long by 5 inches wide and $1\frac{1}{4}$ inches thick. The block weighed about $1\frac{1}{2}$ lbs. The sheet of compressed peat was divided transversely by narrow slots, which were secured horizontally round the rollers and longitudinally by circular saws, under which the peat passed as it was released from the rolls. The peats were soft when they passed away from the machine, and five or six days' air-drying was required to harden them.

Neustadt Process.—About the year 1860 loose-textured fibrous peat was manufactured by this process. It consisted in passing peat turf between ordinary iron rollers, which reduced its thickness to about two-thirds of its bulk, gave a very firm charcoal, and withstood carriage tolerably well. The peat was first cut into sods in the usual way and then fed into the rolls. As it burnt regularly, it was used for metallurgical purposes.

Hall-Björling Peat Press.—The difficulty with ordinary revolving roller machines has been to take up the wear which takes place in the gearing, as it is impossible to cast two wheels of the same hardness. This difficulty has been met by the arrangement of the gearing so that the half moulds in the two rollers can be adjusted to the thirty-second of an inch.

This machine is shown in part sectional elevation, fig. 49, and plan, fig. 50. It consists of two rollers A and A, which have their faces furnished with recesses with very small spaces between. These recesses, or cavities, are made of any shape or size to suit the requirements. The rollers are identical with one another, and the fuel is produced by the pressure obtained when it passes down the hopper B between the two rollers. To assist in drying the peat the rollers are sometimes made hollow, and steam, or hot air, admitted into them through a hole provided in the spindles. The rollers are driven by means of worm wheels C and C and worms D and D, either right-handed or left-handed as found most suitable for the position of the machine in relation to the motive power. The worm spindles are rotated by bevel wheels or mitre wheels E and E, according to the speed required for the motor. The bevel wheels or mitre wheels are again actuated by a mitre wheel keyed on the upright shaft F. This shaft has also keyed on it a bevel wheel G, which gears into the bevel pinion H, keyed on the spindle J. This spindle is actuated either

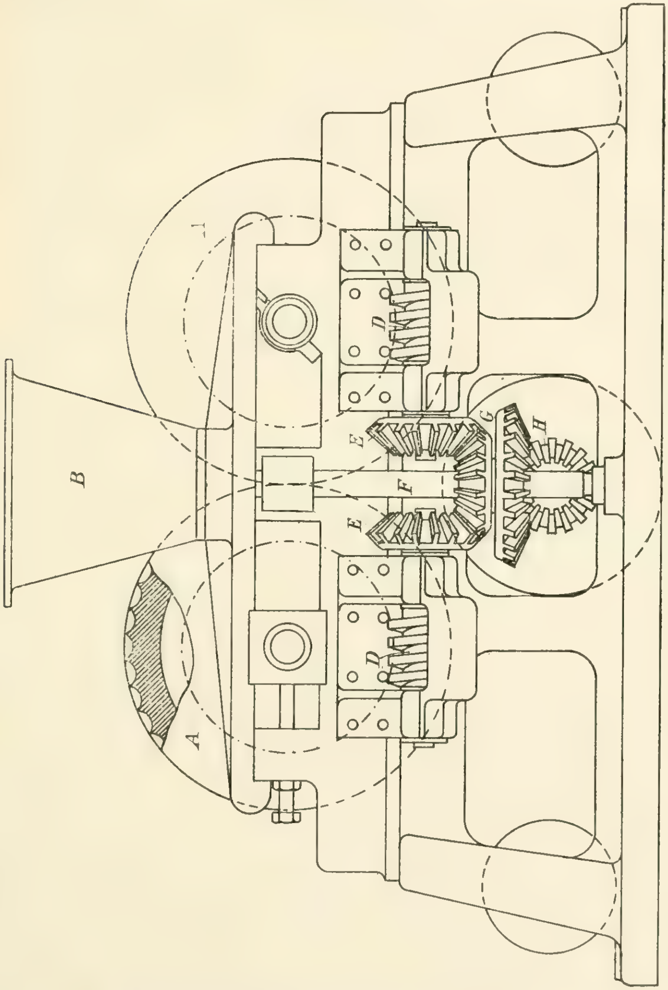

Fig. 49.—Hall-Björling Peat Press—Sectional Elevation.

by a belt pulley, or any other means, from a motor of any kind.

It will be seen that by simply shifting one of the teeth of

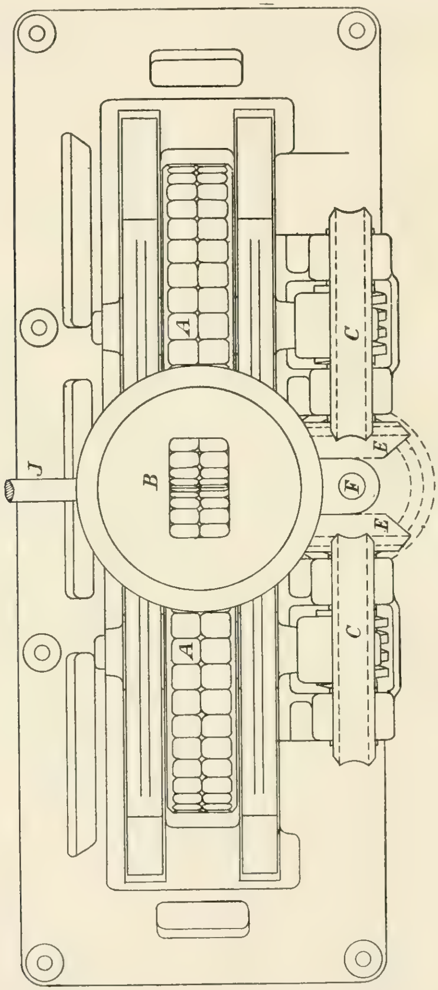

Fig. 50.—Hall-Björling Peat Press—Plan.

the mitre wheels or bevel wheels E, the relative positions of the two rollers can be adjusted to the thirty-second of an inch, by that means preventing unsymmetrical shapes of the pressed peat blocks.

Electrical Process for making Peat-coal.—This is the latest process for converting peat into fuel. It has been invented by Mr J. B. Bessey, and a complete plant for the manufacture of electro-peat-coal, the name given to this fuel by the inventor, has been erected at Kilberry, near Athy, Co. Kildare, Ireland, upon the estate of his Grace the Duke of Leinster, and a similar (preliminary) plant is, at present, in course of installation at the Rattlebrook Peat Works, Dartmoor, Devon, upon property acquired under lease from H.R.H. the Prince of Wales, in right of his Duchy of Cornwall.

The plant at Kilberry is capable of dealing with 300 tons of raw peat per day.

In this process the peat is taken from the bog by means of an excavator, fitted with a "grab scoop," which delivers the crude peat into small tip-wagons running over a light railway, by means of a wire-rope haulage, between the bog and the factory. The wagons, when they arrive at the factory, are emptied into a large hopper A, shown in the elevation, fig. 51, and plan, fig. 52, of the general arrangement of the machinery and buildings. The hopper is formed in the ground, from which the peat is raised by means of a belt-conveyor B into the feed hopper of a rotary hydro-eliminator C, shown in figs. 51, 52, and 53, in which the peat is subjected to a gradually increasing pressure. This hydro-eliminator is shown enlarged in fig. 54. In this machine all the "free" water is ejected.

The eliminator is continuous in its action, the wet peat passing in at the top, and the partly dried peat leaving at the bottom. The peat is then passed, by means of the conveyor D, into the electrifying machine E, also shown in perspective in fig. 55. The peat falls through a hopper

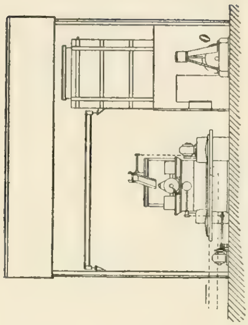

Fig. 53.—End View.

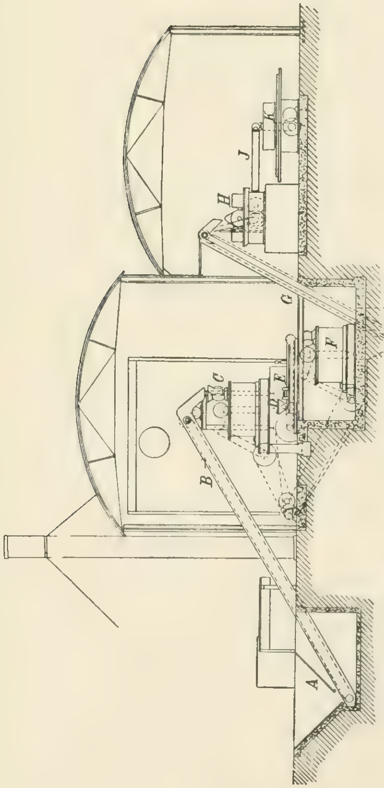

Fig. 51.—Elevation.

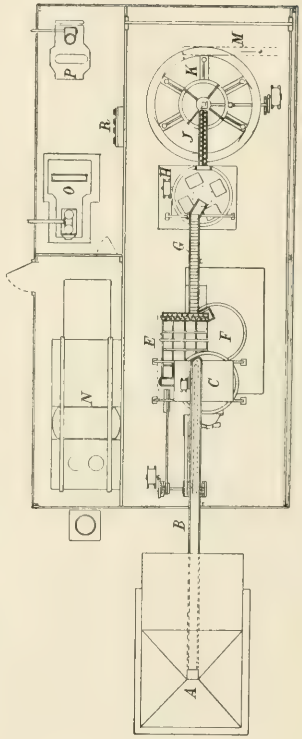

Fig. 52.—Plan.

Plant at Kilberry Electro-Peat-Coal Works.

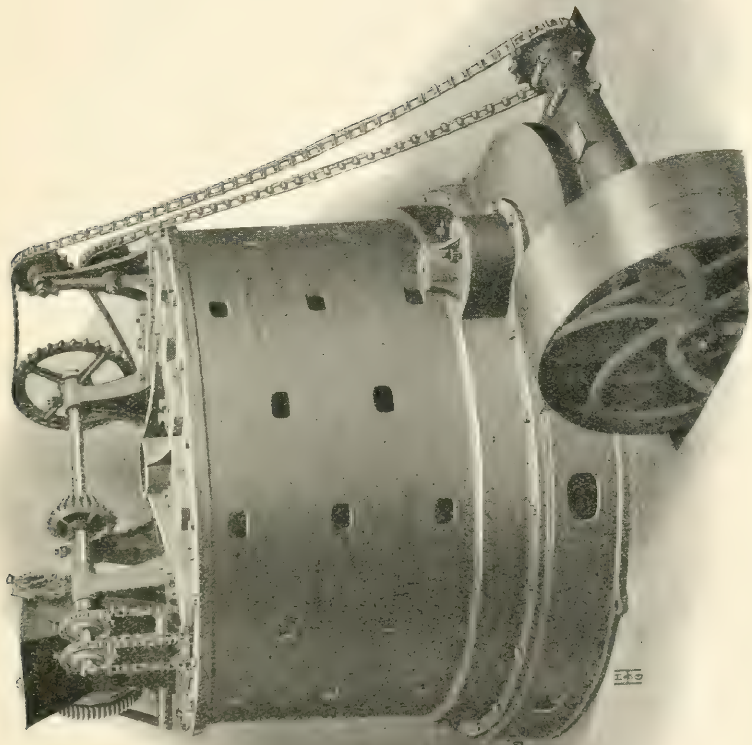

FIG. 54.—Rotary Hydro-Eliminator.

into the trough of the machine, and is pushed forward a short distance by means of a reciprocating plunger, in some-

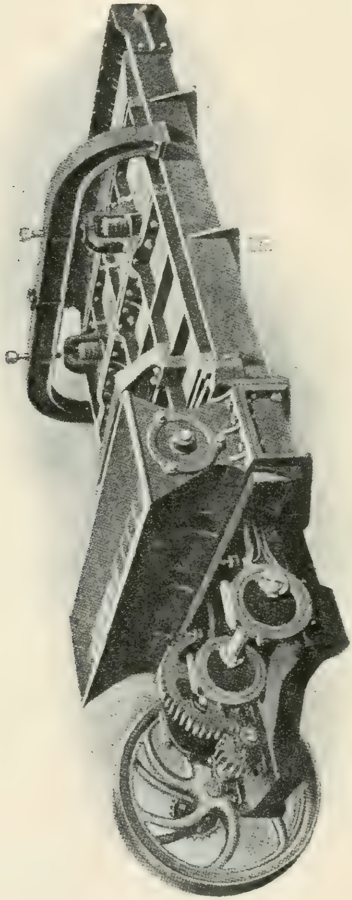

Fig. 55.—Electrifying Machine.

what similar manner to the "Exter" briquette press, each stroke carrying forward another small charge, the result being practically a constant stream from the outlet. While this is going on an alternating electric current is passing through the peat. The effect of this current is to liberate the "latent" water contained in the cells of the peat fibres, and bring the peat into such condition that the released water is easily extracted.

For the latter purpose the peat is passed through a second hydro-eliminator F, exactly similar to C, placed below the electrifying machine E.

When partly dried the peat is discharged from the second hydro-eliminator, and is lifted by the bucket elevator G into the hopper in the centre of a breaking-up and kneading machine H, in which the fibrous material is torn and worked into a plastic or putty-like mass.

The kneading machine, fig. 56, consists of a large pan, similar to that of an ordinary mortar-mill or edge runner, over the surface of which revolve four heavy runners. The peat is fed into the centre of the pan and is gradually worked over to the outer edge by means of adjustable scrapers, and is eventually discharged from the side of the pan into the screw conveyor J, which delivers the macerated peat into the moulding machine K.

The moulding machine K, shown enlarged in fig. 57, is of the open mould type on the same principle as Max Everard's briquette press, having six dies arranged in such a manner that six blocks are turned out at each revolution. The peat is next conveyed from the kneading and breaking-up machine by a screw conveyor, delivered into a hopper at the top of the moulding machine, directed into openings over each die, and on the return stroke of the plungers the peat is passed forward into a long die, from whence it emerges in the form of briquettes, several charges being in the die simultaneously, so that it is kept under pressure some time. This machine delivers 7200 briquettes per hour. They are delivered from the mouth of the dies on to a revolving table, from which they are deflected by means of a scraper on to a belt conveyor M, which carries them into the stores.

All the different machines are operated by separate electric

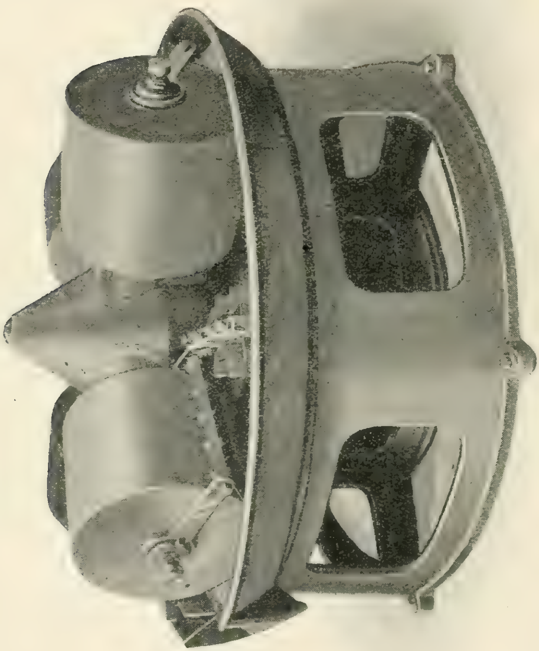

Fig. 56.—Kneading Machine.

motors. N is the steam boiler; O, the engine for working the dynamo P; R is the switchboard. A pump for discharging the water extracted from the peat is provided in the pit in which the second hydro-eliminator is fixed.

The steam for the engine is generated in a water-tube boiler, with a fire-grate specially designed for burning rough peat turf, which has been cut from the surface of the bog (hence utilising material which is generally wasted, and in many cases burnt on the bog) previous to commencing cutting out the peat proper.

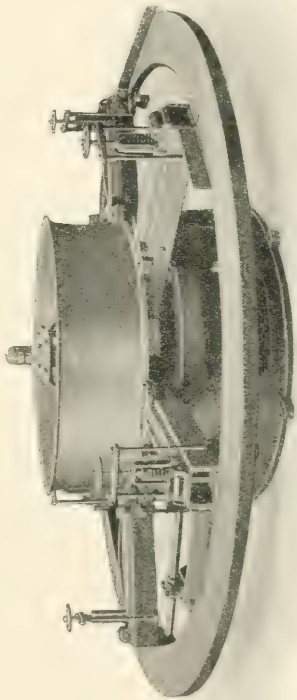

FIG. 57.—Moulding Machine.

It is estimated that the cost of manufacturing this fuel is such that it can be sold at a very large profit; this profit will, of course, vary according to circumstances, such as distance of the factory from the bog, depth at which the peat is taken from the bog, and the price of labour in the neighbourhood.

From the above description it will be seen that the principal feature is the application of electricity to free the peat from its latent water by breaking up the cells in the fibre.

The fuel produced is hard, dense, heavy, and comparatively smokeless.

Ordinary coal averages 45 cubic feet per ton and 50 lbs. per cubic foot in weight.

Electro-peat-coal averages 30 cubic feet per ton and 75 lbs. per cubic foot in weight.

Practical Tests.—The following results of carefully conducted experiments show the comparison, as to bulk and weight, between electro-peat-coal and the various descriptions of pit-coal enumerated:—

TABLE IV.

	Weight of Cubic Foot.	Space occupied by one Ton.
Electro-peat-coal as to be sold ready for consumption in regular sized pieces	76·15 lbs.	29·5 feet.
Average of thirty-seven samples of Welsh coal	53·1 ,,	42·71 ,,
Average of seventeen samples of Newcastle coal	49·8 ,,	45·30 ,,
Average of twenty-eight samples of Lancashire coal	49·7 ,,	45·15 ,,
Average of eight samples of Scotch coal .	50·0 ,,	49·99 ,,
Average of eight samples of Derbyshire coal .	47·2 ,,	47·45 ,,

Practical Steam-raising Test.—The following is the result of a steam test of $3\frac{1}{4}$ lbs. of electro-peat-coal:—

TABLE V.

30 lbs. of water in boiler, 200° Fahr.

	Pressure.	Time.
Pressure in lbs. per square inch . . .	0 lbs.	0 minutes.
,, ,, . . .	15 ,,	8 ,,
,, ,, . . .	20 ,,	13 ,,
,, ,, . . .	25 ,,	15 ,,
,, ,, . . .	50 ,,	40 ,,
,, ,, . . .	50 ,,	58 ,,
,, ,, . . .	27 ,,	90 ,,
,, ,, . . .	15 ,,	110 ,,
,, ,, . . .	0 ,,	120 ,,

Fig. 58.—View of Kilberry Electro-Peat-Coal Works.

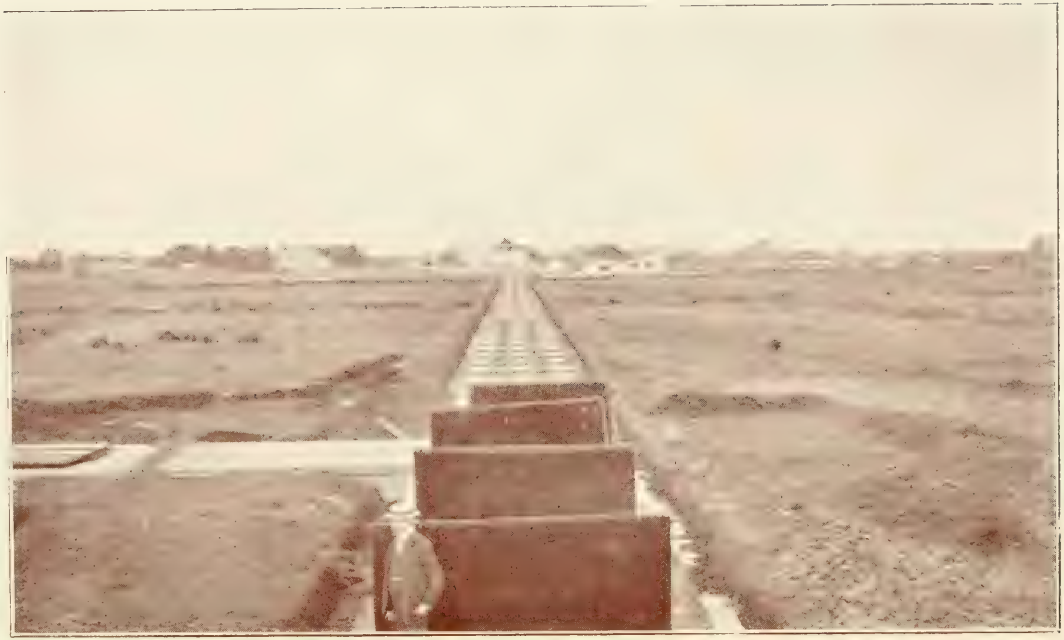

Fig. 59.—View of Kilberry Electro-Peat-Coal Works.

The following table is a comparative result of the steam-raising powers of electro-peat-coal and Staffordshire steam-coal:—

TABLE VI.

	Electro-peat Coal.		Staffordshire Coal.	
	Time. Minutes.	Pressure.	Time. Minutes.	Pressure.
Fire lighted at	...	...	...	...
Water boiled at . . .	35	...	54	...
Pressure in boiler in lbs. per sq. in.	40	12 lbs.	60	10 lbs.
,, ,, ,,	45	20 ,,	72	20 ,,
,, ,, ,,	50	25 ,,	82	30 ,,
,, ,, ,,	60	30 ,,	...	...

This shows nineteen minutes at boiling-point and twenty-two minutes at 30 lbs. pressure in favour of electro-peat-coal.

Figs. 58 and 59 show two general views of the Kilberry Electro-Peat-Coal Works.

Chemically manufactured Peat Fuel.—Many attempts have been made for preparing peat for fuel by chemical methods, but none have, so far, met with any commercial success. Probably the best yet tried has been lately experimented with.

This process consists in mixing the crude peat as it is taken from the bog with a certain amount of lime, which liberates the water from the cellular tissue of the peat fibres; some nitrate of potash, which assists the lime to absorb the moisture; soot, which absorbs the oil of the peat; and saccharine matter, which strengthens the action of the lime by rendering it more soluble in the moisture and causes the briquettes of peat to dry from the centre outwards.

A very slight pressure is required for making a dense, hard fuel, for which it is claimed that it is equal in calorific power to the best coal. The estimated cost of chemicals is from 9d. to 1s. per ton, and the total cost of production about 6s. per ton.

The machinery is perfectly automatic and continuous in action. The crude peat taken from the bog, either by digging, or scooping by machinery, is dumped into a large hopper at one extremity of the factory, passes along from one machine to another by means of conveyors, and is delivered, cut into suitable blocks, at the other end, ready for use.

Various kinds of bonds have been employed for making peat briquettes.

Asphalt or Borax Bond.—After the peat had been well drained, but still retained some water and volatile hydrogen, it was properly mixed with bituminous coal and a certain portion of common salt, after which it was pressed into suitable blocks. The proportions of the different constituents found most suitable were:—

TABLE VII.

Peat	50 to 70 per cent.
Bituminous coal	23 ,, 48 ,,
Common salt	2 ,, 5 ,,

To the above mixtures were sometimes added coal-tar pitch, asphalt or asphaltum, marl, limestone, and borax. When all these substances were added the proportions employed were:—

Peat	10 per cent.
Coal	30 ,,
Coal-tar pitch, or asphalt	7 ,,
Marl	2 ,,
Limestone	2 ,,
Common salt	2 ,,
Crude borax	2 ,,

Instead of taking the peat in the above condition, it was taken dry enough to burn in an ordinary fire grate, and in that state the proportions were as follows:—

Peat	60 per cent.
Coal	25 ,,
Coal-tar pitch, or asphalt	10 ,,
Marl	2 ,,
Limestone	2 ,,
Common salt	2 ,,
Crude borax	½ ,,

Peat fuel was tried in iron puddling and re-heating furnaces, and in steel-making, and the following proportions were used:—

Peat	50 per cent.
Coke	30 ,,
Pure Trinidad asphalt	5 ,,
North Carolina resin	5 ,,
Marl	2½ ,,
Limestone	5 ,,
Borax	2½ ,,

Another kind of mixture that has been tried consisted of—

Peat, of any class	5 cwts.
Sawdust	5 ,,
Bituminous coal dust	10 per cent.
Lime or chalk	30 lbs.
Bitumen or tar	30 ,,
Marl mud or vegetable earth	200 ,,
Water	70 gallons.

Cotton seed refuse has been tried. In that case the composition was of the following proportions:—

Small coal	1 ton.
Refuse of coal, or coal dust	4 tons.
Peat	1 cwt.
Pitch or tar	15 gallons.
Refuse of cotton seed, after obtaining oil-cake	½ cwt.

Peat Charcoal or Coke.—Peat, or turf, can be carbonised in a similar manner to wood.

Peat can be carbonised in three ways: in heaps or meilers, in ovens or in kilns, and in retorts.

Heap, or *Meiler*.—The common and simple method of carbonising or charring the ordinary peat is in heaps or meilers, in the same way as that by which wood-charcoal is prepared. The peat is usually cut into rectangular blocks, and is therefore more easily charred in pits, because the blocks pack better than wood, and the peat charcoal is less inflammable than the wood-charcoal. The blocks, or sods, must be laid as close as possible, and regularly. The blocks are usually made 14 to 15 inches long by 6 inches thick; but for charring in heaps, the larger the blocks are the better. The heaps are made 6 to 8 feet in diameter and 4 feet high, holding 5000 to 6000 large blocks, which equals about 1500 cubic feet of peat. The quantity of charcoal obtained is, on an average, 20 to 30 per cent. of the weight of dry peat.

The meiler, or heap, is prepared in the following manner. The ground is levelled, and a stake, technically called a quandal, is fixed in the centre of a circular space. The ground is next covered with brushwood and waste peat charcoal from the previously burnt meiler. The turf to be charred is then piled on the ground to the required height in a conical shape. The bottom layer of sods is arranged to form air channels, the breadth of which are equal to a single peat, at regular intervals radiating from the centre stake to the circumference of the heap. When the meiler is ready the stake is withdrawn; the space thus left is filled up with brushwood and lighted. The body of the heap is covered with moss and leaves, and on the top of this is thrown sand and peat ashes, or charcoal dust, leaving the stake hole open, forming as it were a chimney for the gases till the mass is perfectly ignited. Then, however, if flames appear at the outlet, the latter is covered up in a similar manner and with similar material to that employed for the cover, and as the heap breaks from the settling down, the cracks must be covered over in the same way. By closing the air-channels the peat will be regularly and evenly charred. From twelve to fourteen days are required to char a meiler before it can be removed. A meiler containing 2500 cubic feet, or about 13½ tons of peat, gives about 700 cubic feet of charcoal weighing about 8 cwts., or about 27·7 per cent. This quantity and percentage varies of course with the quality of the peat and the care exercised by the workmen.

Rectangular ricks were mostly employed in Saxony. In this case the ground was levelled and covered with sand, in the same manner as the circular meiler, and a rectangular space about 50 feet long and 5 or 6 feet in width formed. In the centre of this space a hollow was cut out, and to this, inclined channels were dug out from the ends of the plot intended for the rick. The channels were bricked on clay to prevent the by-products evolved from being lost by percolation through the bottom of the channels. A gutter was provided for leading the tar and ammoniacal liquor to a tank fixed near the rick. When building up the rick, stakes were fixed, about 10 feet apart, in the longitudinal channel, and the rick heaped up to a height of 4 feet, leaving cross air-channels in line with the stakes. The stakes were next drawn out and the rick covered with a mixture of clay, sand, and cut straw or grass. When the coating cracked during charring the cracks had to be immediately stopped up. A fireplace was provided in the central channel, by means of which the rick was ignited. The charcoal prepared by this method was of good quality, and was employed in Saxony and Bohemia for metallurgical purposes.

Ovens and Kilns.—One class of kiln employed for charring peat at Oberndorf, in Würtemberg, consisted of an upright cylinder 5 feet 6 inches in diameter and 9 feet high, having a capacity of 200 cubic feet, and capable of carbonising about four tons of average peat. The top of the kiln was closed by an arch, with the exception of an opening through which the peat charge was introduced. This opening also served the purpose of a chimney till the peat was carbonised. The kiln body was double, consisting of an outer wall made of ordinary brick, and an inner wall of fire-bricks, both having a thickness of 1 foot 3 inches, and a space 1 foot 3 inches wide was left between the two walls, excepting at given intervals where the brickwork extended the whole breadth, for the purpose of stability.

The opening at the crown was closed by a tight-fitting cover when necessary. At the base of the kiln was another opening closed by a cast-iron door, behind which was a space between the door and a plate, which space was filled with sand through an opening, to exclude all draught. There were a number of holes placed at different levels, at a short distance from the bottom of the kiln, through which air was admitted for supporting the combustion during the carbonisation.

In working this kiln the peat was dumped into it and packed closely through the opening, excepting a few channels which were left open, corresponding with the lower draught holes, and a vacant space in the centre. After being filled, fire was thrown in from the top, and the aperture left open.

When the fire had spread through the mass, so as to present a glowing appearance at the lower holes, these were closed with clay, and the combustion allowed to proceed till the same appearance was observed at the next row of holes, when they were plugged with clay ; when the mass appeared white hot at the third row of holes, and no more smoke emanated from the aperture, all the openings were closed, and the peat allowed to remain till cold.

To avoid the delay of cooling in the kiln, a damper was, in some cases, provided at the bottom of the furnace, to allow the red-hot charcoal to fall into a pit below ; the kiln was then ready for another charge of peat.

Mr J. W. Rodgers' furnace for carbonising peat, employed a short time in Ireland, was of a peculiar construction. It consisted of a wooden shed, in the middle of the floor of which there was provided an ash pit extending the whole length of the shed. A line of rails was secured on each side of the pit, forming a track, on which was run small carbonising kilns, mounted on wheels. The furnaces were constructed of sheet iron, mounted on an iron framework, the whole forming a cone, provided with a grate base upon which the peats to be made into charcoal were placed. When the kiln was to be charged, the cone was inverted, the grating removed, the cone filled with peats, and the grating replaced. The cone was next turned over, placed on the framework, and run on the rails into the shed, over the ashpit. The channel through which these kilns travel was formed of sheet iron, which had, at intervals, pipes leading to the top of the building. Within the sheet-iron space were placed movable hoods which covered the kilns and acted like chimneys, and were arranged to be raised or lowered at will. The space between the kilns and the roof of the shed was fitted with shelves for receiving the air-dried peat, to afford the peat opportunity of being more completely dried. The exterior covering was fitted with louvres which could be operated as required. The draught was regulated by means of a damper. When the charring was commenced, brushwood was introduced into the ashpit, and the kilns were run over on to it and thus lighted. When the charring was completed, the chimneys were closed and the kilns and their contents removed. Each of these kilns contained about 600 lbs., which was made into coke in five hours, and yielded from 23 to 25 per cent. of charcoal. Three hours were devoted to the carbonisation and two to the cooling, so that, including the time necessary for discharging, four operations could be made in twenty-four hours. This system, although ingeniously contrived, was too expensive. The cost has been stated to be from £1 5s. to £1 10s. per ton.

In the year 1838 Mr C. W. Williams patented a process for charring peat. He first subjected peat, as commonly prepared, to pressure in a perforated cone made of wood and iron; when so pressed it was put into a cylindrical stove the bottom of which was made in four compartments, in which fires were lighted to ignite the peat in the upper portion. When it was lighted these fires were put out and the stove closed; small holes were, however, left to admit of slow combustion, and when the peat was sufficiently distilled these holes were also closed and the coke allowed to cool. In some cases an oven was employed resembling an ordinary horizontal boiler set over a furnace; the air was admitted into the centre of the oven through a perforated pipe, and the gas passed off through two pipes at the top.

For drying the peat a chamber was employed, in which the peat was placed. This chamber was connected by a number of apertures with a chamber below, into which air was driven by a fan after having been heated by contact with a furnace conveniently situated.

The carbonising or coking plant used by Messrs Hall & Bainbridge, at Middleton-in-Teesdale, consisted of a group of vertical chambers or retorts. There was a large furnace, which was common to all chambers, the product of combustion from which passed under an inverted fire-bridge to the central tube or flue. The necessary oxygen to consume the required quantity of fuel to keep the temperature above 800° F. in the various chambers was supplied through hollow fire-bars, which came to the front; additional air could be supplied through the ashpit door, and between the bars, if necessary. The air passing through the hollow fire-bars was delivered into the air-casing, and from thence at each side of the furnace-casing it was admitted over the fire by the square openings, at a higher temperature. It became evenly mixed with the escaping gases and the hydrocarbons from the fuel, and was drawn downwards through the incandescent fuel underneath the inverted fire-bridge, and thoroughly converted into carbon dioxide (CO_2) at a high temperature. This was admitted by dampers into the annular flues having rectangular openings, and evenly distributed through the chambers and delivered out, having passed through the peat into the annular flue and thence to the exit flue, when it might be further utilised by passing horizontal flues under the drying sheds to the stack, which would serve for several sets of carbonisers. The carbonising chambers were in sections or rings of cast iron bolted together, 6 feet in diameter, and of a total internal height of 12 feet. There was an air space of 8 inches all round, and the whole might be surrounded by brickwork. A hopper surrounded the chamber top, and a bell opened it in a similar way to a blast furnace. When the hopper was filled with peat the bell was lowered and the peat admitted, but it was immediately closed, the lever, to which it was suspended, having at its outer end, attached by rods, a sliding damper which closed the escape orifice. By this arrangement the admission of free oxygen was prevented. The chamber could be charged at all times, and by means of the sliding door or false bottom the finished charcoal was instantly dropped into a cooling chamber. It was calculated that the output from the four chambers would be at the rate of 16 tons per week. The total cost of production per ton of air-dried fuel was 5s. 6½d. The cost of peat manufactured at Middleton was, for labour, 5s., and for interest, 4s. per ton. The cost of carbonising was 26s. 3½d., and total cost of carbonised peat-dust coal for foundry blacking, including everything, was 45s. 6½d. per ton.

Herr H. Eklund, of Sweden, has greatly improved the manufacture of coking peat in a continuous carbonising or coking oven which he patented in England in the year 1890. This oven consists of a top chamber for drying and pre-heating, a middle chamber for coking, and a lower chamber for the cooling. The main portion of the middle chamber is separated by walls from the side compartments; the top and middle, as also the middle chambers, are separated by an arched floor having flues and sliding doors. Suitable doors close the charging holes in the roof of the oven. In the chamber are cooling cisterns, provided with lids and discharging doors. Hot gases from an outer fireplace enter the lower flues from an inlet, and pass through the chamber and flues into a condensing cistern. From the condenser the gases pass into one of the side compartments referred to above, which forms a fireplace for ignition of the gases, the ignited gases finally passing through the flues and chamber. When the oven has become hot, the fire in the side compartments is not required. The gases and vapour from the cooling cisterns are led by pipes into the side compartments of the middle chamber which communicates with the inlet, while the hot air from the lower chamber is led by pipes into the flue.

An oven has been invented by Messrs Soetje and Kahl in which the raw peat as it comes from the bog is dried in a chamber heated partly by steam and partly by hot gases from the coking chamber. The dried peat, when required for peat-coke briquettes, is coked in the double-walled coking chamber. The space between the walls communicates through openings by which the gases from the coking chamber pass along a flue into the drying chamber. The charge hole is closed by a slide.

Retorts.—In W. A. G. von Heidenstan's method of charring peat the peat to be charred is made into brick-shaped sods of suitable size and shape. Some of these sods are laid on the loose part of the plunger around or between the guides, in such a manner that during the entire compression the briquettes will not touch the walls of the retort. The briquettes are covered with a guide plate, on which a fresh layer of briquettes is placed, to be in turn covered by a similar plate, etc. When enough has thus been arranged to about fill the retort, a hood is placed around the whole batch of plates, which is thereupon lowered into the retort. The retort is now closed, and the charge compressed as well as heated in any suitable manner. When the charring is completed the cover is removed by slackening the hinged bolts, the nuts of which are provided with handles for quickly slackening them, and the charcoal mass is subsequently lifted out and allowed to cool in the hood. In place of performing the operation in the hood, it is evidently feasible to lift the charcoal up into the plate hood after charring, and transport the hood to the place where the cooling of the charcoal is to take place. The guide rods fit into the loose top of the ram against a shoulder. It is not necessary to make the material into briquettes before being placed between the guide plates, since it is possible to place the material between the said plates before any compression or shaping has taken place. In the latter case the guide plates have to be provided with flanges to prevent the material touching the walls of the retort.

Herr Vilen, of Gothenburg, heats ordinary peat to from 300° to 520° F., after which he lowers the temperature to between 110° and 130° F. He carbonises it in comparatively small cylinders made of iron plates and embedded in brick-work. The product is a smokeless carbon, which can be plunged into water without injurious results; it has a heating power of 6000 calories, whereas peat turf has only, on an average, 2514. This peat-coal has been analysed, and found to contain nearly 50 per cent. of combustible solid matter, besides over 20 per cent. of gases, in all, more than 87 per cent. The cost of this fuel is 13s. 4d. or 16s. per ton, while ordinary coke in Sweden is 44s. per ton. Its specific gravity is double that of coke, but can be compressed into briquettes or any other shape.

One of the recent carbonising furnaces is that invented by M. Zigler, of Berlin. It has been designed for drying and coking peat and recovering the by-products. The retorts are placed in a line and heated by gas or tar, the gases playing round the outside and passing out through the flues. At the end are placed two or more Cornish boilers which are used for distilling the ammoniacal liquor out of the tar. The gases, which have done their work in heating the retorts, pass through a flue to either of the boilers, according to which of the dampers is open. The gases leave the boiler at a temperature of about 200° C., and are again used for the purpose of drying the peat. For this purpose is arranged a flue, coming from both boilers, which flue is divided into two by a mid-feather, forming two flues. The gases can be passed through either flue by means of dampers; the flues again join into one near the chimney. The air-dried peat is passed by an elevator to a platform, from whence it is delivered into a conical-ended hopper. In the hopper the peat is dried by means of hot air, taken from the flue and forced by a fan through a pipe. This hot air dries the peat considerably. From the hopper the partially dried peat is dumped by means of a sliding door into trellis wagons. These wagons, or trucks, are passed into the flues, where the drying is finished by the gases which have passed through the boiler flues, which gases have a temperature of about 200° C., as has already been stated. In this way the peat is drying in one of the flues, while the dried peat is taken out of, and fresh partly dried peat is put into, the other flue. If the gases are too hot, so that there is danger of setting fire to the peat, cold air can be admitted to lower the temperature to what is required. The dried peat is finally taken, by means of an elevator, to the platform and delivered into the retorts. Peat treated in this manner gives off a great deal of tar, which is recovered by any of the known methods.

In Mrs Angle's process of carbonising peat, the peat is placed in closed vessels without gas exit and burnt at comparatively low temperatures, whereby the product of distillation is retained in the charcoal. The peat is first freed from the greatest part of its moisture. The retort is heated to a temperature of from 50° to 100° during one to six hours. The charcoal produced by this process has a metallic lustre, is very hard and free from soot, and compares favourably with bituminous coal.

CHAPTER VI.

NATURE AND USES AS FUEL.

Burning Peat.—We have already drawn the reader's attention to the unsatisfactory manner in which most of the experiments with peat fuel have been carried out; hence we frequently find remarks of the following kind in the reports: "We do not doubt but that the peat fuel would have given superior results and answered better if the fire-grate had been properly designed and constructed for burning peat fuel instead of coal." From this it will be gathered that the grate was suitable for coal and not for peat, therefore the experiments cannot be said to be comparative; consequently there was waste of time and money.

The principal requirements for the satisfactory burning of peat fuel are:—

A thin fire.

Broad but short fire-grate.

The grate-bars should be placed close together, about $\frac{3}{8}$ of an inch apart, because the peat falling through the bars amongst the ashes is wasted.

The grate-bars should be placed higher up, nearer the flues and the firebox crown, because there is less flame in the peat than in coal; and, Lastly, not too much draught, because the peat is light and with a strong draught passes away through the flues without being burnt, hence a great deal of waste.

The best fire-grate for burning peat for manufacturing purposes is shown in fig. 60, which is a sectional elevation. It is called the "step-grate" or "stair-grate." In this grate any small pieces of waste peat, of any description, can be used as fuel. This arrangement of grate consists of a number

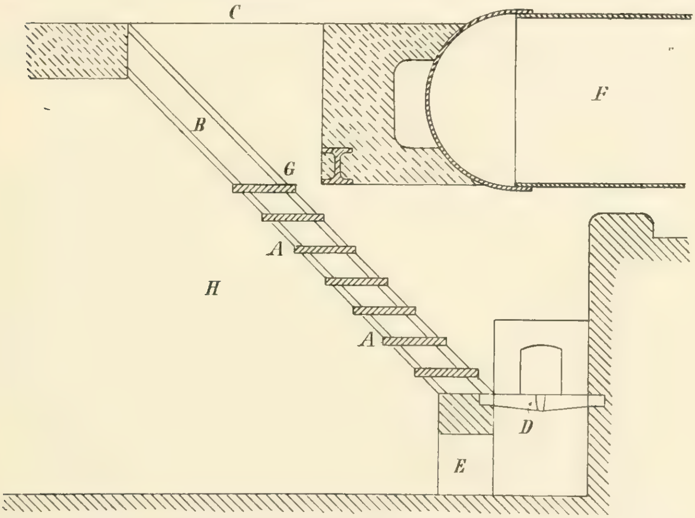

FIG. 60.—Step Grate, or Stair Grate, for burning Peat.

of grate bars A A, about 4 inches in width, placed like the treads of a staircase, supported at each end by cast-iron plates B. The peat is fed into the grate through the opening C. D. are the grate-bars. E is a door through which the ashes can be removed. F is part of an egg-ended boiler. The action of this grate is as follows:—The grate is filled with peat through the opening C and the air is admitted from the space H to the openings between the step-grate, and as the peat is getting consumed it settles down automatically.

The opening C is usually about half the width of the grate D. The throat or space at G varies from 6 to 8 inches, and the inclination of the grate from 40° to 45°.

Undoubtedly the best way of using peat as fuel is to convert it into gas. The late Sir William Siemens stated that he preferred peat to any other fuel for his gas furnaces.

Tests of Peat Fuel.—A great number of tests have been made with this kind of fuel, but none of them have really proved of a satisfactory nature.

The peat fuel has mostly been compared with the very best anthracite coal, and the fire-grate used has been similar to that employed for burning coal or wood.

In testing two different classes of fuel both ought to be tested under the most favourable conditions, or both under the most unfavourable; not one under favourable and the other under unfavourable conditions.

Professor Klasson, of Sweden, one of a Committee appointed by the Swedish Government, published the conclusions reached by him, in an exhaustive report in the Jubilee number of the *Teknisk Tidskrift*, 1896, showing the average composition of different kinds of fuel, together with the mean calorific value of the absolute dry and ash-free fuel, and the average percentage of moisture in its dried state.

TABLE VIII.

Composition.	Wood.	Peat.	Brown Coal.	Swedish Coal.	English Steam Coal.
Carbon	52·0	58·0	66·0	78·0	81·0
Hydrogen	6·2	5·7	4·6	5·1	5·2
Oxygen	41·7	35·0	28·0	14·8	11·5
Sulphur	...	...	...	0·8	1·0
Nitrogen	0·1	1·2	1·0	1·3	1·3
Calories (*a*)	49	57	60	75	80
Moisture	20	22	25	13·5	7·6

(*a*) By calories is here understood the amount of heat required to raise one kilogramme of water from 0° C. to 100° C.

In the year 1868, trials were made with peat fuel on the Grand Trunk Railway in Canada. Several journeys were made with a train weighing, exclusive of the engine and tender, 428 tons, and the maximum gradient of the railway was 1 in 100. The fuel used was dense peat. There was no difficulty in keeping up steam, and it was not necessary at any time to have the firebox more than half full of peat.

The consumption of peat per mile of train run, including the fuel used in getting up steam, was 70·1 lbs.

Number of miles run by train per ton of peat consumed, 31·6.

Price of peat per ton, $3·00.

Cost of peat consumed per mile run, $12, 43 cents.

Average speed per hour, 15·8 miles.

A test of the absolute heating power of peat was made by Professor Galloway of the Royal College of Science, Ireland, on three samples of dense peat for sale near Mountrath, Queen's County, Ireland, with the following results :—

TABLE IX.

Samples of Dense Peat tested for absolute Heating Power.	Absolute Heating Power by Thompson's Calorimeter. Lbs. of Water at 212° F. converted into Steam by 1 lb. of Dense Peat.	Absolute Heating Power by Thompson's Calorimeter. Lbs. of Water at 212° F. converted into Steam by 1 cubic foot of Dense Peat.
Dense peat, No. 1 .	6·05	240·87
,, ,, 2 .	5·50	343·75
,, ,, 3 .	6·33	464·07

M. V. Lamy made a series of experiments with regard to the calorific power of various kinds of fuel, with the following results, in parts :—

TABLE X.

Wood charcoal	75 parts.
Coal coke	66 ,,
Charred peat	63 ,,
Bituminous coal	60 ,,
Charred wood	39 ,,
Dry wood	36 ,,
Raw peat	25 to 30 ,,
Wood with one-quarter moisture . .	27 ,,

During a test of peat fuel as against coal at Horwich, in Lancashire, under a steam boiler, the following results were arrived at. The test was carried out on two consecutive days, the fire having been raked out the night previous to the experiments:—

Coal got up steam to 10 lbs. pressure in two hours twenty-five minutes, and to 25 lbs. pressure in three hours. Peat fuel got up steam to 10 lbs. in one hour ten minutes, and to 25 lbs. in one hour thirty-two minutes; 21 cwt. of coal maintained steam at 30 lbs. pressure for $9\frac{3}{4}$ hours; whilst $11\frac{1}{4}$ cwts. of peat fuel maintained steam at the same pressure for eight hours.

Canadian compressed peat fuel has been tested in locomotives with excellent results, showing that the thermal value of 100 lbs. is equal to 95·13 lbs. of coal. It was also tried at the power-house of the Metropolitan Street Railway, Toronto, and gave great satisfaction. The heat produced was much greater than that of coal, but it was somewhat deficient in lasting power. It has, however, the advantages that there is no smoke, soot, dust, or clinkers, so that boilers will last much longer than if coal was used for generating steam.

As far back as 1847, peat fuel has been used on the southern section of the Bavarian Railway, and has been found both good and economical. In looking over the price, as compared with coal, we are likely to be deceived if we do not consider the cost of carriage by rail.

Ordinary turf at the place where it was produced was	3s. 10d.	per ton.
Pressed turf at the place of manufacture	12s. 5d.	,,
Saxon coal at the station of Hof, Bavaria	13s. 6d.	,,
Rühr coal at the station of Aschaffenburg, Bavaria	15s. 9d.	,,

From a great number of experiments made on the State railways with the object of testing the heating power of the four different classes of fuel, it was ascertained that they bore the following proportions to each other:—

Ordinary turf	100 cubic feet.
Pressed peat	1200 lbs.
Saxon or Rühr coal	700 ,,

The cost of the fuel in proportion to the heating power therefore became:—

Ordinary turf	5s. 10d.
Pressed turf	7s. 4d.
Saxon coal	4s. 8d.
Rühr coal	5s. 5d.

But if we add the expense of carriage of the coal, we get the following results:—

Ordinary turf	5s. 10d.
Pressed turf	7s. 4d.
Saxon coal	8s. 11d.
Rühr coal	9s. 8d.

Mr H. P. Fenton, Her Majesty's Consul at Munich, in a report dated March 1867, "On the use of Turf as Fuel for Railway Engines," gives the following advantages found to be possessed by using the turf fuel in locomotives:—

1. Turf being entirely free from sulphur, produced a much less detrimental effect on the heating apparatus and boiler of the engines than coal and coke; so much so, it was stated, that where turf was used those parts of the engine would last nearly three times as long as where coal or coke was burnt.

2. The dust or ash from the turf, being not nearly so hard or gritty as that from coal, caused much less damage to the engine from friction; it also required less repairing and painting, and was more easily kept clean.

3. The turf, when properly dried, and especially the pressed turf, caused but very little smoke, and none of the noxious sulphurous vapour produced by coke.

At a very early date, fuel manufactured by Linning's process was tested in locomotives on the Glasgow and Garnkirk Railway. The distance run was eight miles, and the consumption of peat on the whole journey was just double the weight of coal required to fire the same engine over the same distance. The engineer was of opinion that if the furnace had been properly adapted for peat fuel, three-fourths of the quantity would have sufficed. The engine travelled at a speed somewhat higher than its ordinary rate with coal fuel. It is much to be regretted that these trials were not more carefully carried out. First, we think that the firebox ought to have been made suitable for the peat, and that the speed should have been kept the same in both cases. For this reason, very little reliance can be placed upon the results obtained.

Some years ago experiments were made on the Hartford and Springfield Railway, when a locomotive engine ran in express time a distance of fifty-two miles with 14,000 lbs. of peat. It was found that two-thirds of a ton of peat was equal to one ton of coal for locomotive purposes. Later on, another experiment was made, an engine and twenty-five empty eight-wheel box trucks starting from Syracuse with a little over four tons of peat. The steam was never below 120 lbs. pressure per square inch; the train was twenty minutes late on starting, which was made up in running twenty-six miles. The peat would have lasted to Fairport, seventy-one miles, but there was detention at

Palmyra by a break-down; 3½ cords of wood would have been used running to Palmyra in place of somewhat less than four tons of peat.

The Imperial Engineers Office of France reported in the year 1871 that practical workings had demonstrated the following:—

One lb. of charcoal is equivalent, in heating power, to
1 lb. of peat charcoal;
1 ,, of coal coke;
1·42 lbs. of best bituminous coal;
1·63 ,, of crude peat fuel; and
2·70 ,, of dried hard wood;

and that it required 2·03 lbs. of crude peat to produce 1 lb. of peat charcoal.

The Vislanda-Bolmen Railway in Sweden, in 1901, made an experiment with compressed and dried peat as fuel with a special train consisting of a locomotive, fifteen trucks, and one passenger carriage. The distance was twenty-two miles, and the time-table was set for lower speed than the ordinary, but this train arrived in due time at the respective stations, and at the final station was fifteen minutes ahead of the proper time. The locomotive in use was built for using coal only. This again shows how indifferently the experiments with peat have been carried out.

A trial with peat was made on the Paris and Lyons railway in France. The steam was got up in thirty minutes, whereas coal required two hours. After they had been running sixteen miles, the flame escaped a considerable distance above the chimney, which became red hot, and the boiler covering taking fire, a stoppage had to be made while the fire was being extinguished. After repairs had been effected, the return to Paris was made at a speed of thirty-eight miles per hour, the heat again increasing as they advanced. The fuel had no smoke, and much gas kept up a constant flame. This trial was made with pressed peat. The generation of steam was so rapid that the engine-driver had his hand on the valve lever the whole of the journey.

Peat for Metallurgical Purposes.—For this purpose both peat and peat charcoal have been used for ages in Sweden and some parts of the Continent of Europe.

At one time the objection to its use was that the charcoal, or peat block, was too soft, so that it crushed under the weight of the iron ore; in fact, it was easily crushed between the finger and thumb. Since it has become the practice to compress the peat into briquettes, which are afterwards made into charcoal, a firm charcoal is obtained which is much superior to wood charcoal.

At some ironworks a certain percentage of coal is mixed with air-dried peat. Experiments with the mixture of peat and coal were made at the Caledonian Ironworks, Canada. The usual proportion of coal to the ore was 7 to 1, and two-thirds of the cupola was filled in the usual manner, the remaining one-third being occupied with peat and ore in the proportion of 1 of peat to 12 of ore. The metal was ready for the mould in forty minutes less than the time required when the coal was used by itself, and the iron was of a better quality. Properly dried peat has been used for the last hundred years in the so-called gas puddling furnaces in Sweden and other countries in Europe. The most suitable class of peat is the one containing the least amount of ash, sulphur, and phosphorus. If the peat contains ash consisting of carbonate of lime it can be used, the lime in such cases serving as the flux.

Some authorities consider the statement that peat does not contain sulphur to be erroneous. We admit that in some places where there is a great amount of copper in the peat-bog there is a certain amount of sulphur and phosphorus present, but, as a rule, the amount is very small; in fact, many samples have been analysed in which not the slightest trace could be detected.

Some experiments were made in Cleveland with coke and with peat charcoal, with the following results:—

TABLE XI.

	With Coke.	With Peat Charcoal.
Carbon . . .	3·41 per cent.	0·043 per cent.
Silicon . . .	2·73 ,,	0·199 ,,
Manganese . .	0·37 ,,	0·158 ,,
Sulphur . . .	0·17 ,,	Trace.
Phosphorus . .	1·23 ,,	None.
Titanium . . .	0·14 ,,	None.
Iron . . .	93·66 ,,	98·571 per cent.

From the above it will be seen that peat is quite as good as coal for iron smelting.

Peat Gas.—Gas has been made from peat successfully, both for illuminating, heating, and for Sir William Siemens' regenerating furnaces, and he stated that it was the best fuel for them.

For this latter purpose this gas has always been used most extensively in Sweden for smelting Martin steel, as well as for glass-houses.

At Bofers Company's works, at Wermland, Sweden, there is an excellent peat-gas producer in operation. It consists of an outside shell made of blast-furnace slag bricks 12 inches thick, which is lined with fire-bricks to a thickness of 6 inches. This producer has four ashpits which are supplied with blast-pipes, and a cast-iron water-bosh is provided, through which cold water circulates. It is charged through a cone-shaped hopper, the cover being sealed with water when closed. The gas is led away to a condenser by means of a cast-iron pipe, and on its downward course comes in immediate contact with a spray of water, and finally passes into a flue.

At Motala Steel Works, in Sweden, peat gas has been used for the last thirty years; at first only for puddling furnaces, but subsequently for the open-hearth furnaces. Two large gas producers are constantly employed. The gas is passed to the open-hearth furnaces through a condenser to free it from some of its moisture. They have also small peat-gas producers in the rolling mills, and it has been found that the steel plates scale less when the furnaces are fired with peat gas. The peat gas is, at Motala, dearer than coal gas, but it is preferred before coal gas on account of the small amount of sulphur and phosphorus contained in it.

The peat employed in Sweden for the manufacture of peat gas has the following composition on an average:—

TABLE XII.

Carbon	60·0	per cent.
Hydrogen	6·4	,,
Oxygen	31·7	,,
Nitrogen	1·9	,,

Or, if hygroscopic water and ashes be reckoned:—

Carbon	38·2	per cent.
Hydrogen	4·1	,,
Oxygen	20·2	,,
Nitrogen	1·2	,,
Sulphur	0·0	,,
Ash	8·6	,,
Water (hygroscopic)	27·7	,,

The gas has the following composition:—

CO_2	6·9	per cent. of volume.
CO	26·0	,, ,,
C_2H_4	0·5	,, ,,
CH_4	4·4	,, ,,
H	8·5	,, ,,
N	53·7	,, ,,

The great objection to the peat used in Motala is the formidable amount of water and ash.

Mr Todd made some very interesting experiments with two samples of compressed peat, comparing them with good Vogrie coal, the results of which are shown in the tables given on pages 135 and 136. In the first experiment the peats were carefully air-dried. In this case 137 ounces of this air-dried peat were put on over a fire. The temperature of the room when the peats were put on was 60° F. A thermometer was suspended in the centre of the room and the temperature correctly marked every fifteen minutes till it began to decline, which was in exactly two hours. Three days afterwards, 137 ounces of good Vogrie coals were put on for a fire. The temperature of the room was 62° F. Great care was taken that all the circumstances should be as much the same as possible. The thermometer was suspended in the centre of the room exactly in the same position as before, and the temperature marked every fifteen minutes till it began to decline, which was in fully two hours. The duration of each of the fires was thus very nearly the same.

TABLE XIII.

	Compressed Peat.	Vogrie Coal.
Quantity put on fire . . .	137 ozs.	137 ozs.
Temperature of room . .	60°	62°
1st fifteen minutes . . .	62	63
2nd ,, ,, . . .	64	64
3rd ,, ,, . . .	66	65
4th ,, ,, . . .	68	65
5th ,, ,, . . .	70	66
6th ,, ,, . . .	71	67
7th ,, ,, . . .	72	68
8th ,, ,, . . .	73	68

Table XIII. shows that the peat raised the temperature

5° higher than the coal. The second experiment was with peats merely compressed at the moss as they were dug and put up in a stack to dry without being moved until taken to the homestead; the moss was far from being of the best quality.

Of these peats 137 ounces were put on for fires as before. The temperature of the room when the peats were put on was 59°. Table XIV. shows the result, the thermometer readings being registered every fifteen minutes as before.

TABLE XIV.

	Simple Peat Compressed.	Vogrie Coal.
Quantity put on fire . . .	137 ozs.	137 ozs.
Temperature of room . .	59°	62°
1st fifteen minutes . . .	61	63
2nd ,, ,, . . .	65	64
3rd ,, ,, . . .	65	65
4th ,, ,, . . .	67	65
5th ,, ,, . . .	69	66
6th ,, ,, . . .	70	67
7th ,, ,, . . .	71	68
8th ,, ,, . . .	70	68

Table XIV. shows very nearly the same results as Table XIII., the variation producing no effect upon the general result. It is a great pity that Mr Todd did not also make a comparative experiment between the ordinary cut air-dried peat and those compressed in his machine.

CHAPTER VII.

USES OF PEAT OTHERWISE THAN AS FUEL.

Peat for Illuminating Gas.—For illuminating gas, peat, so far, has not given very satisfactory results. Several experiments have been made in Ireland. Mr R. L. Johnson states that in Queen's County and County Westmeath the gas produced is good and the cost reasonable. With a single pound weight of common peat an hour's light may be produced. He says that after the peat has been made into gas there is a residual of charcoal equal to one-third of the weight of peat employed.

Herr Reisig found, by analysis, that well-purified gas contains—

TABLE XV.

	I.	II.
Heavy carbon compounds	9·52	13·16
Methane	42·65	33·00
Hydrogen	27·50	35·18
Carbon monoxide	20·33	18·34
CO_2 and H_2S	Trace.	...
Nitrogen	...	0·32

It has been found that in some peat there is as much as 14,000 cubic feet of gas per ton. One great advantage of peat gas for illuminating is the small amount of sulphur it contains, therefore less injurious to the health, and if the gas is passed through an alkaline mixture it becomes perfectly free from it.

Mr George Mejlander, of Christiania, Norway, made some experiments in 1897 with Mosschels and Schmelick's turf-coal briquettes as a material for gas-making. The experiments were made at the experimental gas works in that town, with the following results per ton :—

79·2 lbs. coke with 7·2 per cent. ash.
660 lbs. tar and ammonia water.
11,519 cub. ft. of crude gas with 19 vols. per cent. of carbon dioxide.

By purifying the crude gas with lime, 263·6 cubic metres (9295 cub. ft.) of pure gas was obtained, which, when tested with Sugg's standard burner, per five cubic feet, gave 141 cubic metres (4977 cubic feet), and developed a light equal to twenty-four English standard candles.

A ton of ordinary English gas-coal gives—

1543·2 lbs coke with 8 per cent. ash.
44 lbs. tar and ammonia water.
7063 cub. ft of purified gas of fifteen-candle power.

Therefore turf-coal briquettes give about half as much coke as English gas-coal, fifteen times as much tar, ammonia and water, and the gas obtained is 50 per cent. better than from English coal. The comparatively high specific gravity of the turf-coal briquette (1·2) is undoubtedly in its favour as regards transport.

Peat Paper.—Many experiments have been made to manufacture paper from peat.

The manufacture of paper from peat dates very far back. It was made in Ireland in the year 1835, and Mons. J. Lallemand, of Besancon, made peat paper in France in the year 1854.

As far as we can gather, the original process consisted in softening the peat in cold water and agitating it well to separate the fibres, the finer particles being washed away.

The fibres were next digested in cold water with a diluted solution of caustic soda or potash, containing not more than 250 grains of alkali to each gallon of water. This mass was next squeezed from the fibres, after which it was soaked in a solution consisting of 600 grains of commercial sulphuric acid in each gallon of water. After this the fibres were again pressed, and digested in a solution of chloride of lime, of the same strength as employed for bleaching fine rags for ordinary papermaking.

Herr Karl A. Zschorner's method for manufacturing peat paper consists of an apparatus containing five compartments in which the peat fibres are treated by a chemical process. In the *first*, the fibres are treated by a solution of alkali, not higher than 2 per cent. Beaumé, and gradually decreasing in strength by the addition of cold water. This is performed under a high pressure at a temperature of 4° to 25° Centigrade. The *second* compartment, containing a solution of calcium or sodium hypochlorite of a strength not exceeding 2 per cent. Beaumé, is employed, at a normal temperature and under a higher pressure than in the first compartment. The *final* process consists in subjecting the fibres to another treatment with alkali, this time the strength of the solution being only 1 per cent. Beaumé at normal temperature, but still greater pressure. After this the material must be thoroughly washed, when it is ready for making into paper either by itself, or by being mixed with other paper stuff, with any kind of papermaking machinery.

In the Callender method the peat is gathered and left exposed to the sun to partially dry; then it is sorted and all foreign roots and matter removed; the peat fibres are placed in a beating engine, where they are teased in such a manner as to draw out all the fibres contained. The result is a pulp fit for certain grades of papermaking, which can be made into paper, either alone or in combination with other paper stuff. It can also be sized or coloured, or a varying amount of clay, or other filler, added according to the purpose for which the paper is required.

Sometimes Mr Callender takes the peat after it has been picked over, and digests it, either under pressure or not, in an alkali solution, which is preferably, though not necessarily, made caustic. The duration of the digest depends upon the use of the paper, but he finds that about ten hours under a steam pressure of about 40 lbs. per square inch, and with an alkaline liquor testing about 50 per cent. Beaumé and slightly caustic, gives very excellent results. After the completion of the digest the fibres are thoroughly washed. When the fibres are quite clean they are brushed or drawn out carefully in the beater, and are ready to be made into paper. The process produces a brown paper, which can be bleached in the usual way by chloride of lime or any other bleaching agent.

Brin's Process for manufacturing Paper Pulp.—This process is both mechanical and chemical. The peat is passed between a pair of rollers, fitted with teeth which open the fibres, and at the same time, by means of a stream of cold water, frees them from earthy and soluble matter. The rollers are situated in a cistern provided with a strainer beneath the rollers to allow of the water draining away. Combs are provided for removing the fibres which may adhere to the teeth of the rollers.

The fibres in this condition are passed between a pair of squeezing rollers, made of hard wood or any other material not affected by the chemicals used in this process. By this means the water and colouring matter contained in the peat cells is expelled so that the liquors used may enter them. The rollers are fitted with springs on the bearings, and the fibres are passed through the rollers by a screw-conveyor, and are at the same time subject to the action of a hot solution of caustic soda at $2\frac{1}{2}°$ Beaumé, and to a steam pressure of about 75 lbs. per square inch. This apparatus is continuous, so that the fibres are passed repeatedly between the rollers. This operation takes about one and a half hours, when the fibres are discharged into a tank, where they are washed with a cold water spray from a rose, the water being run off through a strainer, made of wire-cloth, at the bottom of the tank. In this tank the mass is kept agitated by a wheel and is conveyed by a jet of steam and gas issuing at a nozzle immersed therein through a pipe to a bleaching tank.

The bleaching tank contains a pair of squeezing rollers between which the fibres are caused to pass repeatedly whilst subjected to the bleaching action.

The gas is supplied by a pipe, and is mingled with the steam from a nozzle within the chamber. The gas is active oxygen or oxychloride of hydrogen.

When the charge has been bleached it is discharged into a tank, afterwards confined in a closed vessel containing a solution of caustic soda at 5° to 6° Beaumé, and water acidulated with 2 to 3 per cent. of hydrochloric acid. The pulp is then ready for papermaking.

Textile Peat.—Lieutenant Eklund of Sweden has experimented with the manufacture of yarn from peat for weaving purposes.

After drying and crushing the peat, the fine particles are separated from the fibres, which latter are washed and freed from the peat dust, when the material is ready for spinning and weaving, and can be bleached in the usual manner. Messrs Doré & Sons, of London, are now selling underwear manufactured from peat. It is also a most excellent thing for bandages and other surgical purposes, because it retards the multiplication of microbes.

Herr Karl Geige, of Düsseldorf, has produced a fibre capable of being spun, which is absorbent, and can be bleached and dyed. His process consists in picking out the fibres from the peat and treating them with acids and alkalies, from which he produces a peat wool consisting of pure cellulose. This is soft and elastic, and can be spun, with the addition of wool or cotton. It is used as a cloth fabric.

The peat is placed in a bath consisting of a weak solution of soda for several hours to remove the humic acid, during which time it is continually stirred. It is then re-dried and passed through an opening machine of any description. The next process is to remove the starchy and albuminoid matter, which is effected by the process of fermentation, after which the fibres are placed in closed vessels where the oils, resins, and fatty matters are removed by means of ether, assisted by heat. When it is desired to expedite the process, pressure is resorted to. The final operation consists in washing, and extracting traces of tannin by boiling it in dilute acid or alkali. These fibres can be bleached if desired, and can be spun and incorporated with natural wool.

M. Forgeot has invented a process for adapting peat fibre for textile manufacture. His method consists in placing the peat on a grating and immersing it in a hot solution of soft soap. Next, the fibres are freed from the soap by jets of water at a high pressure. This latter process also removes all the gummy particles and other incrustations which have been loosened by the first process. Finally the peat fibres are immersed in a cold acetic acid bath, where they are eventually stirred. The peat fibres are then dried in such a manner that the fibres all lie parallel to one another in a similar way as cotton when it has been combed.

Peat Wood.—Peat wood has been manufactured in Germany. The fibrous peat is thoroughly washed and disintegrated, and the dust thus produced is made into a pulp by admixture of plaster of Paris and water. When properly mixed it is put into moulds and subjected to a heavy pressure, after which it is dried in kilns and coated with oil.

Herr Joseph Hemmerling, of Dresden, Saxony, converts peat into wood by adding to the wet peat a binding material, about 5 per cent. of its total weight, then subjecting it to great hydraulic pressure, making it into cylinders, which are exposed in chambers to a high temperature. This peat wood has the features of the best hard wood, can be worked and polished, and is from 33 to 50 per cent. cheaper than oak.

The simplest and most expeditious method of making artificial wood of peat is to wash the peat, without destroying its natural fibrous state, and to mix the resultant mass with a mixture of hydrated lime and aluminium sulphate. It is then pressed in moulds or blocks for a short time, and allowed to dry and harden in the open air. Wood produced in this manner can be used in the open air without painting, as it is not hygroscopic.

Destructive Distillation of Peat.—During the destructive distillation of peat the following products are obtained :—

1, Tar, from which is obtained oils of slight volatility, solid fats, or paraffin, and creosote; 2, Watery liquids, such as acetic acid, ammonia, and pyroxylic spirit or naphtha; 3, Gases for illuminating and heating purposes.

Drs Kane and Sullivan, in the Dublin *Journal of Industrial Progress*, give the following results :—

One set of tests consisted in consuming the peat by igniting it, and the combustion of a portion of the material was supported by a blast of air (Table XVI.).

In the other test the peat was distilled in close vessels (Table XVII.). An ordinary gas retort was used, and by the aid of a series of Woulfe's bottles, attached to the outlet pipe, the larger portion of the tar and aqueous products was collected, the remainder being condensed in a worm which was fixed in a barrel containing water, and by this means the permanent gases were secured. In each test the quantity of wet peat used was 100 lbs., and it was worked off in eight to fourteen charges according to the nature of the peat employed. The relative value of the two methods is given in Table XVIII.

TABLE XVI.—IN A BLAST OF AIR.

Ammonia	0·287
Acetic acid	0·207
Naphtha	0·140
Paraffin	0·125
Oils	1·059

TABLE XVII.—IN CLOSED VESSELS.

	Average.	Maximum.	Minimum.
Aqueous products	30·614	31·678	29·818
Tar	2·392	2·510	2·270
Gases	62·392	65·041	59·716
Ashes	4·197	7·226	2·493
The watery products and tar afforded :—			
Ammonia	0·287	0·344	0·194
or as sulphate of ammonia	1·110	1·330	0·745
Acetic acid	0·207	0·268	0·174
or as acetate of lime	0·305	0·393	0·256
Naphtha	0·140	0·158	0·106
Volatile and fixed oils	1·059	1·220	0·946
Paraffin	0·125	0·169	0·086

TABLE XVIII.—COMPARATIVE RESULTS.

	Close Distillation.	In Blast.
Ammonia	0·268	0·287
or as sulphate of ammonia	1·037	1·110
Acetic acid	0·191	0·207
or as acetate of lime	0·280	0·305
Naphtha	0·146	0·140
Oils	1·340	1·059
Paraffin	0·134	0·125

Peat Moss Litter.—This is not in reality a new application of peat, for its use as a bedding for horses and cattle is of a very ancient date, especially in Sweden, where the inhabitants living in the proximity of the immense bogs have employed it to a small extent. This has been proved by writings published in Germany at the beginning of the eighteenth century.

The most primitive method of obtaining moss-litter, known on the higher moors in north-western Germany for many years, consists in ploughing up and harrowing the soil immediately underlying a surface covered with moss turf, after the heather has been burned. This is done in the late autumn. In the spring the surface is again harrowed, and when the moss is thoroughly dried it is thrown in heaps. This process is repeated as frequently as the weather will permit, and the product added to the heap. Moss-litter produced in the above manner is not of very good quality, as it contains a great amount of dirt and dust.

This was remedied by the process invented by M. Hollmann, of Zappenburg, near Giffhorn, in the year 1878, which process proved so successful that he established a moss-litter manufactory at Giffhorn in 1879–1880, and others in Oldenburg, Hanover, and Holland one year later.

The best part of the year to begin the manufacture of the litter is the autumn or early winter, as after the turf has been expanded or ruptured by the frost it remains permanently soft and elastic. The turf is dried in large stacks in the open air. The sods, when dry, are removed to the factory and fed into a machine called a "Wolf," which tears the sods into small particles. After this, the fragments of turf are passed over sieves to separate the dust, called peat-mull, from the litter. The moss-litter is now finished, except that it has to be pressed into a small compass in a press, being made into bales occupying a space of about two cubic feet. The bales are then secured with six to ten laths of wood and bound round with iron wires; they are then ready for the market.

The "Wolf" consisted of a plain wood cylinder set with nails, and revolving at the bottom of a feed-box shaped like an inverted pyramid.

Messrs Haye & Etzhorn, of Oldenburg, manufactured a machine of this kind, which consisted of a cylindrical drum about 18 inches in diameter and 2 feet to 2 feet 6 inches in length, set with sharp and pointed pins which passed close to an iron rail fixed on one side of the box as the drum revolved. This machine was constructed so as to produce up to thirty tons of moss-litter per day. The same firm manufactures a machine of this description to produce 150 cwts. per day, requiring one horse-power to drive and two men to feed it.

Further improvements in machines of this class have been made, some of them combining with the "Wolf" a sieve for separating dust from the fibre. The sieves generally employed for this purpose are made of wire netting, with meshes of from one-eighth to one-quarter inch. They are either stretched on a frame, which is shaken by a horizontal motion, or are made in cylindrical form, and revolve as the moss-peat is pushed through them. The latter system requires a less expenditure of force, but does not separate the peat dust so effectively.

The pressing of the moss into the smallest possible compass and the most convenient shape is an important condition of its transportation to distant markets. In Oldenburg and Hanover simple lever presses are used, but these have been made so powerful that an ordinary railway truck, as used on the Prussian lines, will now take ten tons of pressed litter. This, however, can only be attained by the use of steam or hydraulic power.

Herr R. Dolberg, in Rostock, manufactures vertical presses which will produce, with hand labour, about forty bales, of

3 cwts. each, per day, or, with steam power, sixty to ninety bales of 3 cwts. each.

Åbjörn Andersson's Mekanisha Verkstad, Svedala, Sweden, also manufacture machinery for the preparation of moss-litter producing from 20,000 kilogrammes (44,092 lbs.) down to 2000 kilogrammes (4409 lbs.) per day, as well as presses for packing the same amounts.

Herr Samuelson, of Marieberg, Sweden, has also experimented for many years past, and has come to the conclusion that it is a good plan to cut the turf in the autumn or winter, or early spring, before the night frosts have ceased, as not only is the work done at a comparatively idle time of the year, but the turf having been frozen once, afterwards, when the warm weather comes, dries much more quickly and thoroughly than it would do if it had not been frozen.

Other Applications of Peat.—*Peat-molasses, Fodder.*—Herr Hugo Bornträger has a process by means of which he can obtain from peat 22 per cent. of sugar—calculated as dextrose—on the dry substance.

Molasses have been used a very long time in Germany for fattening cattle. The difficulty first experienced was to obtain raw molasses containing 50 per cent. of sugar, in consequence of the molasses being subjected to a further process for the extraction of the sugar, after passing out of the original manufactory. Again, molasses only had a purging effect, and in order to counteract this, peat-mull, or dust, was mixed with them. The acid contained in the light or surface peat, especially the humic acid, neutralised the injurious potassium salts contained in the molasses and rendered them harmless; the action of the mull counteracts the severe purging caused by the molasses alone, which is the chief objection to its use as fodder.

The advantages claimed for peat-molasses are, that they are 50 per cent. cheaper than the best fat-producing food, and still equal in nourishment. They tend to keep the animal in health, help the digestion, sharpen the appetite, and are as good as bran. They increase and improve the milk from cows. They act as a stimulant and increase the stamina of horses, and also prevent colic and other sicknesses.

The usual manner of manufacturing peat-molasses consists in heating them to 70° R. (190° F.) and mixing them with mull whilst hot, in the proportion of twenty parts of mull to eighty parts of molasses.

Peat-mull or Peat-dust.—The peat-mull is one of the most remarkable and efficient deodorisers. If mixed with any foul-smelling substance the latter instantly becomes sweet.

The use of mull for closets instead of earth, or the unpleasant smelling chloride of lime, is very effective. It has a great power of absorbing liquids and ammonia, as we have already mentioned in connection with moss-litter. The mull, or dust, is the fine particles obtained from making the moss-litter.

Peat-mull for Packing Purposes.—It is exceedingly valuable for packing and preserving meat of any description, whilst fish, when packed in peat-mull, can be kept perfectly fresh for weeks in a hot place.

Experiments have been made with barrels filled with ice packed with peat standing exposed in the midsummer sun without melting.

Peat-mull for Sewage Purposes.—Its use for this purpose has also been experimented with. By filtering the effluent water containing saline ammonia and other dissolved salts through the peat-mull it is rendered perfectly pure and harmless. Sometimes peat-charcoal is used for the same purpose. When the charcoal has become saturated with saline matter it should be calcined, and is then ready for being again used.

Poudrette.—What is termed "poudrette" is manufactured in Sweden. A machine for this purpose is at work in Gothenburg. In this, peat is mixed with sewage and burnt in a large rotating furnace. The gases and flames pass through another furnace, where they are consumed. When the gases have passed away the residue is the "poudrette," which is sold as a fertiliser, and has proved most excellent for growing barley, and has been found nearly as good as Peruvian guano.

There is also a poudrette factory in Malmö, in the south of Sweden. One of the principal features is Herr Lavander's Separator, where sewage and the residue of fish are treated so as to produce valuable manures. This is done by quickly drying the mixture by artificial heat, and disinfecting it by the addition of creosote.

Peat Candles.—These are manufactured from the paraffin distilled from the peat. A factory for their manufacture was established in Brazil, with machinery capable of extracting twenty tons of paraffin from peat per week.

The best candles used in the Roman Catholic churches in Germany are made from peat paraffin.

Peat Charcoal.—This is used for pyrotechnical purposes, also in the manufacture of gunpowder.

Peat has been experimented with for tanning leather instead of oak-bark. Different sorts of peat were tried, but found unsuccessful. From the appearance of the soft animal substances found in peat strata, it is probable that the peat matter did once act as a tanning agent. The peat that is entirely formed from oak is quite destitute of the quality which is found in the fresh bark and wood of that tree, and of striking a black colour with the sulphate of iron. This quality belongs to all vegetable astringents, but is lost by putrefaction. When oak loses its styptic quality it becomes no longer a tanning agent, hence it is probable that the tanning property is restricted to the vegetable astringent principle in the fresh bark.

Peat Alcohol.—By converting the cellulose into sugar, alcohol can be, and has been, made from peat. In some of the experiments the peat was heated to from 115° to 120° C., with diluted sulphuric acid, for four or five hours to convert the cellulose into sugar. After this treatment the mass was pressed and the liquid fermented with yeast and afterwards distilled. It was proved by these experiments that peat yielded nearly as much alcohol as potatoes; 1000 kilos. of dry peat produced sixty-two to sixty-three litres of absolute alcohol, whereas 500 kilos. of potatoes, containing 20 per cent. of starch, yielded sixty to sixty-one litres of alcohol of the same strength.

Peat Manure.—Peat is a superior manure for grass and straw, and, if moderately used, for potatoes and grain.

Peat-mull and waste peat fuel have been used in the form of ash.

As compared with straw it has been found to be much more valuable for potatoes, but for barley the peat and straw were of the same value.

A most excellent peat-manure has been made from the peat waste mixed with the concentrated liquor from Strontium sugar factory. According to Märcker, this manure contained 2·5 to 3·3 per cent. of nitrogen, of which only 0·15 to 0·20 per cent. was derived from the peat; the rest came from the roots in the form of nitrates, ammoniacal compounds, amides, and amido-acids. The potash amounted to 11·5 to 14 per cent.

For some sorts of plants, such as ferns, palms, and the like, powdered peat, or peat-mull, is most excellent, because the peat holds the water, therefore the soil does not become dry so quickly.

The Lennox Peat Fuel Co. have made peat manure a special study, and manufacture manures for different purposes, of which the following is a summary:—

Peat dust and blood mixed and dried.

Peat dust and slag mixed.

Peat dust and fish-offal mixed and dried.

Peat dust and coal sludge.

Peat Building.—To illustrate the possibilities of peat, there was, at the Vienna Exposition in the year 1899, a building all the contents of which were manufactured from peat. The carpets, the curtains at the windows, and the paper on the walls, were all produced from the same material.

Peat Foundations.—Peat appears to be very durable for foundations. This is proved by the ancient monastery at Crowland, near Peterborough, which was founded by King Ethelwald in the year 716. This foundation is now (1907) giving way on account of vaults in the church.

Pavements.—Peat has been tried for paving stones and found admirably adapted, giving a nice springy road for horses' hoofs, and deadening the sound of the wheels and the stamping of the horses. These sets, or slabs, consist simply of well-dried peat subjected to an extra heavy pressure under a moderate heat.

At Jever, in Oldenburg, paving bricks are manufactured from a material consisting of one part of peat and ten parts of coal. The bricks are hard and brown, instead of a light red as formerly.

Peat as a Clarifying Agent.—A great difficulty has existed in the use of vegetable substances for clarifying liquids on account of the development of a growth in the sediment. This objection has been removed by Herr Rienisch, who first boils or steams the peat to ensure the destruction of all the bacterial germs. The material is then added, whilst still moist, to the liquid to be clarified, and in settling down carries with it the impurities in suspension, as well as such that have been rendered insoluble by the aid of chemical precipitants.

Ammonia from Peat.—Professor George Lunge, Ph.D., Federal Polytechnic of Zurich, in his book on *Coal Tar and Ammonia*, states that the nitrogen found in peat in the form of ammonium salts in many cases amounts to 4 per cent., and by dry distillation 8 per cent. of ammonium sulphate is yielded.

The "Grouven" process for recovering the ammonia consists in mixing the damp peat with chalk and heating the mixture in vertical cylinders and passing the gaseous products of this distillation through peat, chalk, and clay in equal proportions moulded in the shape of drain tiles. In this way the nitrogen, under the influence of incandescent aqueous vapour, hydrocarbons, and hydrogen, is to a great extent converted into ammonium carbonate, which is condensed by the calcium sulphate and thus converted into ammonium sulphate; strontium sulphate may be used in place of calcium sulphate.

Professor Camille Vincent, in his book entitled *Ammonia and its Compounds*, makes the following statement:—

"Air-dried peat containing 20 per cent. of moisture contains the following percentage of nitrogen:—

"Peat from	Mennecy	2·4
,,	Vulcaire, near Abbeville	2·09
,,	Terrire (Finisterre)	1·7
,,	Saumur	0·65
,,	Montoire, Loire Inférieure	0·55."

APPENDIX.

"PEAT IN THE FALKLAND ISLANDS AND ITS SUITABILITY FOR BRIQUETTING PURPOSES.

"The Board of Trade have received, through the Colonial Office, copy of a despatch from the Governor of the Falkland Islands, forwarding the following summary of a report by the Director of the Imperial Institute on samples of peat obtained in that colony:—

"In February 1905 the Governor of the Falkland Islands drew the attention of the Secretary of State for the Colonies to the extensive peat deposits in the colony, and suggested that it might be possible to develop these resources with the view of supplying the demand for fuel in the southern portion of the mainland of South America.

"As a result of this communication three representative samples of Falklands peat were forwarded to the Imperial Institute, in order that their composition and calorific value could be determined and their suitability for technical use ascertained.

"The samples were taken from depths between one and nine feet. On examination by the Scientific and Technical Department of the Imperial Institute they yielded the following results:—

"Sample No. 1, about 10 lbs. of 'brown mossy peat, the first sod obtained after removing the top sod.'

"The material consisted of the dried and partially decayed remains of the moss from which the peat is formed. It was very loosely compacted and could be readily disintegrated.

The peat was of a kind chiefly utilised as litter for stable use in place of straw. In Europe there has been a constantly increasing demand for this material, which on account of its absorbent and antiseptic properties forms a cleaner litter, and, when spent, is a more valuable manure than straw litter.

"Sample No. 2, about half a hundredweight of 'black peat one or two years old obtained at a depth of from two to four feet.'

"The material consisted of blocks of peat which were black and dull, and contained little plant remains still showing structure. It contained a quantity of the soil in which the moss had grown, as was shown by the higher percentage of ash, and would be described as 'mud peat.'

"Sample No. 3, about 20 lbs. of 'black peat obtained at a depth of nine feet.'

"This peat contained more plant remains still showing signs of structure than sample No. 2, indicating possibly its derivation from a drier locality in which decay had not been so rapid.

CHEMICAL RESULTS.

	I.	II.	III.
	Per cent.	Per cent.	Per cent.
Ash	2·71	6·52	2·72
Moisture (at 100·6)	11·13	31·29	37·23
Volatile matter	57·26	35·39	39·17
Fixed carbon	28·90	26·80	20·88
	100·00	100·00	100·00
	Calories.	Calories.	Calories.
Calorific value	4,728	4,241	4,033

"(1 calorie is the amount of heat required to raise 1 gram of water from 0° to 1° C.)

"The ash was analysed, but the percentages of potash, lime, and phosphoric acid were too low to make the ash of value as a fertiliser.

"The conclusion arrived at in the report was that, compared with peat from other sources, No. 3 sample might be said to be of the best quality, whilst No. 2 was of average quality. It was added that the calorific value of samples Nos. 2 and 3, which were suitable for fuel, would be increased by briquetting, and that, from the results obtained, it seemed likely that Falkland Island peat would prove to be quite satisfactory for carrying out the process.

"The Government of the Falkland Islands will be willing to consider applications for a peat monopoly for a term of years, for the purpose of converting the Government reserves of peat into briquettes or other patent fuel.

"An account of the methods of utilising peat for fuel purposes, which could be referred to in connection with the proposal to work the deposits in the Falkland Islands, will be found in the *Bulletin of the Imperial Institute*, vol. iii., 1905, p. 166."—*Board of Trade Journal*, vol. liv. p. 263, 1906.

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LIST OF PATENTS RELATING TO PEAT FROM 1900 TO THE PRESENT TIME.

[There are many of an earlier date, the first taken out belonging to 1620 ; but these are not specified here.]

Year.	Patent No.	Name.	Address.	Subject of Patent.
1900	3,036	Springborn, E. .	Ilford . . .	Peat for sewage purposes.
	11,464	Jones, G. B. . .	Toronto, Canada .	Drying peat.
	14,627	Hasselmann, F. .	Munich . .	Peat fuel.
	14,661	M'Namee, F. .	Umeras, Monasterevan	,,
	14,937	Socé Paté Buike et Cie.	Paris . . .	Preparation of peat.
	15,092	Ziegler, M. . .	Schoneberg . .	Carbonising peat.
	15,476	Dörr, C. . .	Cologne . .	Peat fuel.
	15,700	Macalpine, T. .	Chiswick . .	,,
	18,680	Zohrab, G. T. .	Glasgow . .	Pulping, mashing, and moulding peat.
	19,087	Humy, P. R. de F.	Liverpool . .	Peat fuel.
	19,571	Spooner, H. J. .	London . . .	,,
	20,166	Whittaker, C., & Co. (1900), Ltd., and Whittaker, L.	Accrington, Lancs.	Expressing liquid from peat.
	21,431	Zohrab, G. T. .	Glasgow, . .	Drying peat.
	21,641	Custodis, A. . .	Dusseldorf . .	Coking peat.
	23,236	Sims, W. J. R., and Davis, A. L. .	Kirkfield, Peterborough, Ontario	Separating roots and foreign matter from peat.
	23,237	,, ,,	,, ,,	Process for drying and otherwise treating peat.
1901	2,859	Kinloch, H. H. .	London . . .	Disintegrating, pulping, and moulding peat or turf.
	3,215	Heine, G. . .	Norway . .	Peat briquettes.
	3,548	Kerr, J. . .	Ruthwell, N.B. .	Peat as a deodorant.

Year.	Patent No.	Name.	Address.	Subject of Patent.
1901	4,410	Galecki, G. . .	Warsaw . .	Cutting or digging peat from the bog and mixing it.
	6,260	Hartmann, G. .	Munich . .	Drying and moulding peat.
	13,136	Helbing, E. . .	Wandsbeck, Germany	Peat wood.
	23,260	Schild, H. . .	Rendsburg . .	Peat briquettes.
	24,491	Dobson, A. . .	Beaverton, Canada	Cutting and drying peat.
	24,492	,,	,, ,,	Cutting peat.
	25,392	Schlickeysen, C. F.	Steglitz, Germany .	Digging and conveying peat.
	26,271	Milne, W. A. .	Brown's Corner, Ontario	Peat blocks for fuel.
1902	747	Griffin, W. T. .	New Jersey . .	Excavating peat from the bog and preparing it for use.
	2,306	Vulitch, D. de .	Paris . . .	Peat briquettes.
	2,307	,, ,, .	,, . . .	Peat opener.
	6,153	Carmichael, E. K., and Sahlström, C. A.	Edinburgh . .	Treatment of peat.
	6.844	Hulsberg & Co. .	Charlottenburg .	Peat wood.
	11,703	Green, J. O., and Martin, H.	Whitewater, Wisconsin, U.S.A.	Drying peat for fuel.
	14,080	Fleck, R. . .	Glasgow . .	Peat opener and cutter for moss-litter.
	17,299	Classon, A. . .	Aix-la-Chapelle .	Peat wood.
	18,282	Musgrove, H. .	Croydon .	Peat firelighters.
	18,658	Milne, W. A. .	Brown's Corner, Ontario	Peat briquettes.
	19,719	Bessey, J. B. .	London . . .	Treating peat electrically and mechanically to produce artificial fuel and charcoal.
	20,839	Schlickeysen, C. F.	Steglitz, Germany.	Drying peat.
	22,016	Reif, N., and Reibnitz, E. von	Wunstorf, Germany	Manufacture of plastic objects from peat.
	22,524	Duclos, A. . .	Montreal, Canada .	Peat briquettes.
	690,363	Esser, Christian .	Wiener - Neustadt, Austria	Stamping peat turf
	701,311	Dobson, Alex. .	Beaverton, Canada	Peat press.
1903	4,978	Peters, G. . .	Langenberg . .	Peat blocks.
	7,632	Glover, A. W. .	Leeds, . . .	Peat firelighters.
	10,276	Galecki, L. . .	Warsaw. . .	Disintegrating peat
	12,528	Milne, W. A. .	Brown's Corner, Ontario	Treatment of peat.
	12,529	,, ,,	,, ,,	,, ,,

Year.	Patent No.	Name.	Address.	Subject of Patent.
1903	12,653	Kellond, R. A., and Morrison, J. C.	Chicago. . .	Peat briquettes.
	13,494	Dobson, Alex. .	Beaverton, Canada.	Peat harvesting machinery.
	17,096	Carmichael, E. R. .	Edinburgh . .	Treatment of peat.
	17,514	White, F., and Griffin, G. A.	Toronto, Canada Guelph, Ontario, Canada	Peat fuel blocks.
	20,420	Ekenberg, M. .	Stockholm . .	Artificial wood.
	21,968	Haring, P., and Mjöen, J. A.	Berlin, . . . Christiania	Coking peat.
	22,902	Schlickeysen, C. F.	Steglitz, Germany .	Peat diggers.
	26,892	Milne, W. A. .	Brown's Corner, Ontario	Moulding peat.
	26,893	,, ,,	,, ,,	Peat collectors.
	701,858	Dickson, A. A. .	Toronto, Canada .	Peat compressing machine.
1904	700	Roman, R. I. R. .	Dublin . . .	Peat briquettes.
	1,628	Zohrab, G. T. .	Glasgow . .	Peat blocks and peat charcoal.
	2,268	MacGregor, J., and Pearson, G. C.	Old Charlton, Kent	Peat fuel.
	2,616	Schlickeysen, C. F.	Steglitz, Germany .	Compressing peat.
	4,401	MacGregor, J., and Pearson, G. C.	Old Charlton, Kent	Preparing and storing peat.
	4,995	Schlickeysen, C. F.	Steglitz, Germany .	Peat fuel.
	6,308	Kennedy, A. C. .	Cambridge . .	Drying peat.
	6,314	Green, J. O., and Martin, H.	Whitewater, Wisconsin, U.S.A.	Consolidation of peat.
	12,231	M'Lean, A. . . Paterson, W. . .	Turnham Green . Broomlands, N.B. .	Treatment of peat for fuel.
	13,822	Whittaker, L., and Whittaker, C. & Co. (1900), Ltd.	Accrington, Lancs.	Peat fuel.
	17,497	Bessey, J. B. . .	London . . .	Electrical treatment of peat.
	24,336	Carpenter, C. H. . Davis, S. L. . .	South Bend . . Indiana, U.S.A.	Peat fuel.
	25,896	Strenge, O. . . Strenge, W. K. Strenge, J. W. Strenge, G.	Elizabethfen, Oldenburg	Cutting and raising peat.
	27,397	Central Torfkohlen Gesellschaft	Berlin . . .	Peat fuel.
1905	1,947	Strenge, O. . . Strenge, W. K. Strenge, J. W. Strenge, G.	Elizabethfen, Oldenburg	Peat briquettes.
	4,291	Knops, J. . .	Aix-la-Chapelle .	Peat fuel.

Year.	Patent No.	Name.	Address.	Subject of Patent.
1905	4,426	Mundy, H. L. M., and Broadley, T. R.	Leeds . . .	Extracting moisture from peat.
	15,149	Leavitt, T. H. .	Boston . . .	Machinery for treating peat.
	24,619	Fulton, J. S. S. .	New York . .	Furnace for burning peat.
	355,928	Forgeot, M. . .	Paris . . .	Treatment of peat fibre.
1906	1,510	Crawford, Victor Middleton	London . . .	Improvements pertaining to the treatment of peat.
	3,998	Prout, Harry St Clair	London . .	Improvements in and relating to the manufacture of peat fuel.
	7,237	Joly, Céleste . .	London . . .	Improvements in and connected with peat and other fibrous materials.
	7,299	Szek, Joseph Theodor	London . . .	Improvements in and connected with peat.
	7,732	Simpson, William Speirs	London . . .	Improved method of and apparatus for the purification and calcination of peat, brown coal, or lignite and like substances.
	8,617	Anrep, Aleph .	Markaryd, Sweden.	Driving device for cars for transporting peat from a peat-working machine to the drying field.
	18,333	Warburton, Frederick Tynte	London . . .	Peat harrow cutter.
	20,936	West, James Holcombe	London . . .	Manufacture of alcohol from peat.
	21,151	Aktieselskabet Thunes Mekaniska Vaerksted	Sköien, near Christiania	Peat, sawdust, or coal feeding arrangement for furnaces.
	21,321	Fritz, Ferdinand .	London . . .	Method for reducing the consumption of power at alternately repeated creations of vacuums specially for the production of peat fuel.
	25,943	British Moss Litter Co., and Smith, W. S. . .	London . . . Goole, Yorks.	Disintegrating peat.
	American 836,069	Esser, Christian .	Wiener - Neustadt, Austria	Half-stuff from peat turf for paper-making.

APPLICATIONS FOR PATENTS.

Year.	No. of Application.	Name.	Address.	Subject.
1907 Feb. 6	2,226	Verey, Joseph Crossby, and Downes, Lacey	London . . .	Improvements in or relating to the manufacture of peat blocks or peat fuel, and to apparatus therefor.
Feb. 18	4,030	Clement, Henry Milward, and National Peat Industries, Ltd.	London . . .	Improvements in and relating to method and apparatus for recovering peat fibre from raw peat.
Mar. 2	5,128	Pradel, Georges Jean Leopold	France . . .	Improvements in and relating to treatment of peat.
Mar. 19	6,620	Booth, Alfred Thomas	London . . .	Improved method of means of extracting moisture from peat.

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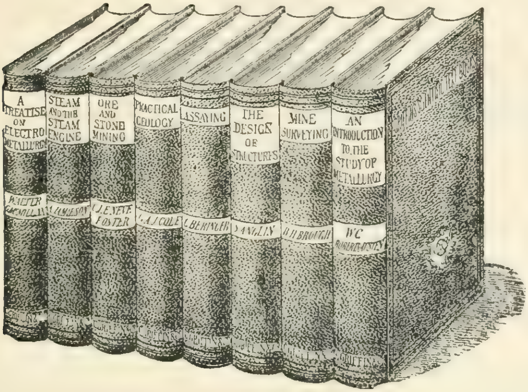

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