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THE

GEOLOGICAL

AND

NATURAL HISTORY SURVEY

OF

MINNESOTA.

Peat for Domestic Fuel.

EDITED BY

S. F. PECKHAM,

STATE CHEMIST.

SUBMITTED TO THE PRESIDENT OF THE UNIVERSITY JULY 8TH, 1874.

PRINTED FOR GENERAL DISTRIBUTION.

COPIES MAY BE OBTAINED OF

N. H. WINCHELL, State Geologist. W. W. FOLWELL, President of the University.
J. S. PILLSBURY, President Board of Regents.

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To Prof. N. H. Winchell, St. Anthony Falls, Minn.:

DEAR SIR:—In accordance with your request made just prior to your departure, that I should prepare a paper for general distribution throughout the State, upon "Peat for Domestic Fuel," I have the pleasure of submitting the following pages, which I trust will be found available for the purpose above specified. Very truly yours,

S. F. PECKHAM,
State Chemist.

PEAT FOR DOMESTIC FUEL.

The elaborate article upon Peat, contained in the report of the State Geologist for the year 1873, will give the reader a very comprehensive statement of the Peat question in general, and especially of that question as related to the interests of the citizens of Minnesota. Therein may be found abundant proof that good Peat—yes, very good Peat—has been found in this State, and while there is no doubt very much more that is worth very little or nothing, there is enough that is good to warrant the supposition that many more localities than have been brought to the notice of the Geological Survey, are likely to yield peats that may prove more or less valuable as they are more or less remote from forests or means of communication with deposits of coal.

For this reason the object of the following pages will be to convey information.

Firstly—Regarding the appearance and properties of the different kinds of peat, in order that those interested in the subject may be able to distinguish the valuable from the worthless varieties without unnecessary expense.

Secondly—Regarding such methods of preparing peat for domestic purposes as require but little capital and are of most general application.

Thirdly—Regarding any peculiar conditions attending the combustion of peat that may be necessary to render its introduction successful.

Firstly: *What is Peat?*

The partially decomposed remains of vegetation that accumulate in localities that are at all times wet or damp, have been called Peat. Those deposits that under this general term have attracted attention and have served to some extent as fuel in this State may be classified as follows:

1. Slough Peat.
2. Side Hill Peat.
3. Turf Peat.
4. Turf.

The first two only are properly termed peats, yet among many people they are all frequently embraced under that term.

1. *Slough Peat,* is that which is found in low grounds, oc-

cupying the lowest spots in old drainage courses which are now either entirely destitute of currents of running water, or are only filled in the wet seasons of the year, or occurring in the depressions among the drift hills or knolls, the slow drainage from which prevents the accumulating water from standing for too great a length of time above the usual level. In southwestern Minnesota such peat must be so situated also that the slough which holds it never becomes dry, else the prairie fires will certainly consume it. Hence, the necessity of constant springs of water to supply the slough in the dry months of the year. This again implies that the surface of the country must be rolling, at least that some bluffs of drift gravel must lie adjacent to the slough to give origin to springs of water. These springs are very often invisible. Their existence may be known, however, by the standing of the water of the slough at the same level, even in the dryest seasons. In case such peat lies in an old drainage course which shows no gteat flow of water in the dry season, the low spots containing it are still supplied with water enough to preserve the peat, by the slow, invisible, underground drainage pertaining to the valley. These correspond to the German *Weisenmoore*.

The primary and essential ingredient that goes to form this kind of peat is a fine moss that grows over the surface of the bog, among the coarse stalks of other vegetation, such as grasses or rnshes, making a handsome green surface. At a distance this moss cannot generally be seen. It is hid by the coarser vegetation. Besides this moss, the roots and decaying stems of the grasses and other acquatic plants that may grow in the slough, also aid in the peaty accumulation.

The aquatic plants that accompany and hide the peat are bnllrush, scouring rush, a short "blue-joint" grass, and occasionally the cat-tail and some others.

There is, besides the typical moss peat of the sloughs, a pulpy deposit in the bottoms of many small lakes and ponds derived from the coarse grasses and sedges that grow about their margins, which consists principally of vegetable matter, and if treated properly will make a useful fuel. It is in the form of a fine silt, and is usually too limited in quantity, and too impure in quality to be very valuable. It is apt to be most abundant on the leeward side of the lake, where the prevailing winds have driven it, and the waves have beaten and broken it.

2. *Side-hill Peat.*—This is formed on the side of a gentle declivity where springs of water furnish the necessary constant moisture. It is apt to accompany those springs that lie in belts, marking the outcropping upper edges of shale beds or

other impervious rock. It is composed of the same materials as slough peat, but is more liable to be impure, from the sand and dust that are carried upon it by the high winds of the plains. Such peat may accumulate to the depth of six or eight feet. It is far less common in southwestern Minnesota than slough peat. It requires also a rolling surface that may give rise to unfailing springs. Many springy side hills that in a moister climate would become peat-bearing, dry up in summer to such an extent, in southwestern Minnesota, that no aquatic plant can survive, and no peat can be formed on them.

3. *Turf-Peat.*—This is formed of the roots and fallen stalks and blades of the rank grasses and sedges that grow in the shallow sloughs, or about their margins, in situations moist enough to resist the prairie fires. It is found sometimes on a side hill or in a narrow ravine or inclined slough through which there is a slow seepage of water. It is always more impure than the foregoing varieties, and becomes mixed with sand and black mud below the depth of 12 or 18 inches, so as to render it unfit for use. It is always fibrous and conveniently handled. Owing to its being so hard as to support the weight of a man, or often of a team, in the dry months of the year, its accessibility and the ease of taking it out by simple means, it is probably the most useful variety of peat to the farmers of southwestern Minnesota. It is also the most common. In very dry seasons the fires get into this turf-peat and consume vast quantities, burning for several weeks, or even till mid-winter. It is invariably found about the margins of the little depressions in the general prairie which contain water in the spring of the year, but become nearly or quite dry in the summer. The peat itself is annually submerged for several weeks in the spring. It lies on a hard and impervious drift clay, which is generally very fine, and blackened to the depth of a foot or more by the charred vegetation of many generations.

4. *Turf.*—This is the common sod of the prairie. It passes into the last. It is made of the prairie grass roots, and other vegetation that may grow there. In dry sloughs, that furnish a fine growth of hay annually, it is sometimes fit for fuel, but it rarely becomes thick enough to make it of much use for that purpose. It always contains considerable sand and clay.

There is nothing in Minnesota, so far as yet discovered, that answers to the extensive *moors* or *heathers* of the moist climate of Ireland, Holland, and North Germany. They occur on the northeast coast of North America, in Labrador,

Newfoundland, and Anticosti, where the summers are not so excessively warm, and where frequent fogs give the atmosphere that state of moisture which the peat mosses require. Along the low lands on the south coast of Anticosti "a continuous plain covered with peat extends for upwards of eighty miles with an average breadth of two miles; thus giving a superficies of more than a hundred and sixty square miles."* It has a thickness of three to ten feet. In the wooded portions of the State the peat deposits are likely to be made up of more or less coarse vegetation, such as deciduous leaves, and the stems and roots of various ericaceous plants. In the extensive peat deposits of the old world the vegetable fibre is entirely destroyed below a depth of ten or fifteen feet, and the peat has a compact, earthy texture, and a black or brown color. The peat deposits of Minnesota are, so far as known, too shallow to exhibit this perfect decomposition, and hence they are generally distinctly fibrous from top to bottom. In the lower portions of the deep peat bogs of Ireland the per cent. of ash is much greater than near the surface, reaching sometimes as high as nineteen per cent., those portions near the surface, which contain the vegetable matter but little altered, affording but one and a half per cent. Thus, while the density of peat, and hence its usefulness for domestic fuel, are enhanced by the greater depth, its combustibility and its purity are diminished. The superficial layers have nearly the same composition as wood. The foreign substances, that constitute the ash of the lower portions, are lime, silica, iron and clay.

A great diversity exists in the qualities of the samples of peat found in Minnesota, but they compare favorably with peats analyzed from Iowa, Connecticut, or even the famous Irish peat.

The method adopted for testing for peat is very simple. A common augur, of about one and a half inch bore, is supplied with a jointed rod eight or ten feet in length. The handle and all of the joints are removable, and can be transported in one package. The thread of the augur will bring out the material passed through, from any desired depth, the sample being preserved if necessary. This will answer for most cases. If the peat prove too pulpy or too wet to be brought out on the thread of the augur, other means must be adopted. When it is too fibrous and loose to be penetrated by the augur, the desired sample can be taken out by the hand, as the loose and fibrous parts are always near the surface. The best way to

*Geology of Canada, 1863.

illustrate the contents of a peat marsh, is to take out and dry a full section from the surface to the bottom, cutting the fibre with the slane or spade, and exposing the variations in composition and color without disarranging their superposition.

When apparently dry the pieces may be burned, care being taken to break them as little as possible, and also that the draft, in case a stove is used, is not too strong. If the ashes amounts to more than twenty-five per cent. the peat is only of *fair* quality; if they amount to more than forty per cent., the peat is worth very little.

The quantity of water retained by air-dried peat appears to be the same as exists in air-dried wood, viz.: about 20 *per cent.* The proportion will vary however according to the time of seasoning. In thoroughly seasoned wood or peat, it may be but 15 *per cent.*; while in the poorly dried material it may amount to 25 or more *per cent.* When *hot-dried*, the proporportion of water may be reduced to 10 *per cent.*, or less.

When peat is still moist, it gathers water rapidly from damp air, and in this condition has been known to burst the sheds in which it was stored, but after becoming dry to the eye and feel, it is but little affected by dampness, no more so, it appears, than seasoned wood.

In estimating the value and cost of peat fuel, it must be remembered that peat shrinks greatly in drying, so that three to five cords of fresh peat yield but one cord of dry peat. When the fibre of the peat is broken by the hand, or by machinery, the shrinkage is often much greater, and may sometimes amount to seven-eighths of the original volume.

The difference in weight between fresh and dry peat is even greater. Fibrous peat, fresh from the bog, may contain 90 *per cent.* of water, of which 70 *per cent* must evaporate before it can be called dry. The proportion of water in earthy or pitchy peat is indeed less; but the quantity is always large, so that from five to nine hundred weight of fresh peat must be lifted in order to make one hundred weight of dry fuel.

Peat which is intended to be used after simply drying, must be excavated so early in the season that it shall become dry before frosty weather arrives; because, if frozen when wet, its coherence is destroyed, and on thawing it falls to a powder useless for fuel.

Peat must be dried with great precautions. If a block of fresh peat be exposed to hot sunshine, it dries and shrinks on the surface much more rapidly than within: as a consequence it cracks, loses its coherence, and the block is easily broken, or of itself falls to pieces. In Europe, it is indeed customary to dry peat without shelter, the loss by too rapid drying not

being greater than the expense of building and maintaining drying sheds. There however, the sun is not as intense, nor the air nearly so dry, as it is here. Even there, the occurrence of an unusually hot summer, causes great loss. In our climate, some cover would be commonly essential unless the peat be dug early in the spring, so as to lose the larger share of its water before the hot weather; or, as would be best of all, in the autumn late enough to escape the heat, but early enough to ensure such dryness as would prevent damage by frost. The peculiarities of climate must decide the time of excavating and the question of shelter.

The point in drying peat is to make it lose its water gradually and regularly, so that the inside of each block shall dry nearly as fast as the outside.

Summer or fall digging would be always advantageous on account of the swamps being then most free from water. In Bavaria, peat is dug mostly in July and the first half of August.

Experience in the different localities in which peat is found in this State, can alone *demonstrate* the best time for cutting. But I hazzard the opinion that the best time will be found to be as soon as the frost is out; giving from four to six weeks of admirable drying weather before the June season of rains set in.

2.—How is Peat Prepared?

It is intended in this connection to describe only those processes of cutting and preparing peat that may be carried on without machinery, and by hand tools such as almost every owner of land has already on hand or can easily procure. In case the tools hereafter described are not procurable, a common spade, well ground to a *thin* sharp edge will be found to answer very well, especially if the handle is long and nearly straight.

When it is intended to raise peat *in the form of blocks*, the bog should be drained no more rapidly than it is excavated. Peat which is to be worth cutting in the spring, must be covered with water during the winter, else it is pulverized by the frost. So, too, it must be protected against drying away and losing its coherency in summer, by being kept sufficiently impregnated with water.

In case an extensive bog is to be drained to facilitate the cutting out of the peat for use as fuel, the canals that carry off the water from the parts which are excavating, should be so constructed, that on the approach of cold weather, the remaining peat may be flooded again to the usual height.

In most of the smaller swamps, systematic draining is un-

necessary; the water drying away in summer enough to admit of easy working.

In some methods of preparing or condensing peat by machinery, it is best or even needful to drain and air-dry the peat, preliminary to working. By draining, the peat settles, especially on the borders of the ditches, several inches, or even feet, according to its nature and depth. It thus becomes capable of bearing teams and machinery, and its density is very considerably augmented,

In preparing to raise peat fuel from the bog, the surface material which, from the action of frost and sun, has been pulverized to "muck," or which otherwise is full of roots and undecomposed matter, must be removed usually to the depth of 12 or 18 inches. It is only those portions of the peat which have never frozen nor become dry, and are free from coarse fibers of recent vegetation, that can be cut for fuel.

Peat fuel must be brought into the form of blocks or masses of such size and shape as to adapt them to use in our common stoves and furnaces. Commonly, the peat is of such consistence in its native bed, that it may be cut out with a spade or appropriate tool into blocks having more or less coherence. Sometimes it is needful to take away the surplus water from the bog, and alow the peat to settle and drain awhile before it can be cut to advantage.

When a bog is to be opened, a deep ditch is run from an outlet or lowest point a short distance into the peat bed, and the working goes on from the banks of this ditch. It is important that system be followed in raising the peat, or there will be great waste of fuel and of labor.

If, as often happens, the peat is so soft in the wet season as to break on the vertical walls of a ditch and fill it, at the same time dislocating the mass and spoiling it for cutting, it is best to carry down the ditch in terraces, making it wide above and narrow at the bottom.

The simplest mode of procedure, consists in laying off a "field" or plot of, say 20 feet square, and making vertical cuts with a sharp spade three or four inches deep from end to end in parallel lines, as far apart as it is proposed to make the breadth of the peat or sods, usually four to five inches, Then, the field is cut in a similar manner in lines at right angles to the first, and at a distance that shall be the length of the peats, say 18 to 20 inches. Finally, the workman lifts the peats by horizontal thrusts of his spade, made at a depth of three inches. The sods as lifted, are placed on a light barrow or upon a board or rack, and are carried off to a drying ground, near at hand, where they are laid down flatwise to drain and

dry. In Ireland, it is the custom, after the peats have lain thus for a fortnight or so, to "foot" them, i. e. to place them on end close together; after further drying the "footing" is succeded by "clamping," which is building the sods up into stacks of about twelve or fifteen feet long, four feet wide at bottom, narrowing to one foot at top, with a height of four to five feet. The outer turfs are inclined so as to shed the rain. The peat often remains in these clamps on the bog until wanted for use, though in rainy seasons the loss by crumbling is considerable.

Other modes of lifting peat, require tools of particular construction. In Germany it is common to excavate by *vertical* thrusts of the tool. This tool is pressed down into the peat to a depth corresponding to the thickness of the required block; its three edges cut as many sides of the block, and the bottom is then broken or torn out by a prying motion.

In other cases, this or a similar tool is forced down by help of the foot, as deeply into the peat as possible, by a workman standing above, while a second man stands in the ditch, cuts out the blocks of proper thickness by means of a sharp spade thrust horizontally. When the peats are taken out to the depth of the first vertical cutting, the knife is used again from above, and the process is thus continued as before, until the bottom of the peat or the desired depth is reached.

In Ireland, is employed the "slane," a long, narrow and sharp spade, 20 inches by six, with a wing at right angles to the blade.

The peats are cut by one thrust of this instrument which is worked by the arms alone. After a vertical cut is made by a spade, in a line at right angles to a bank of peat, the slane cuts the bottom and other side of the block; while at the end the latter is simply lifted or broken away.

Peat is most easily cut in a vertical direction, but when, as often happens, it is made of layers, the sods are likely to break apart where these join. Horizontal cutting is therefore best for stratified peat.

System employed in East Friesland.—In raising peat, great waste both of labor and of fuel may easily occur as the result of random and unsystematic methods of working. For this reason, the mode of cutting peat, followed in the extensive moors in East Friesland, is worthy of particular description. There, the business is pursued systematically on a plan, which it is claimed, long experience has developed to such perfection that the utmost economy of time and labor is attained. The cost of producing marketable peat in East Friesland in 1860, was one silver groschen—about 1½ cents per hundred weight;

while at the same time, in Bavaria, the hundred weight cost three times as much when fit for market; and this notwithstanding living and labor are much cheaper in the latter country.

The method to be described, presupposes that the workmen are not hindered by water, which, in most cases, can be easily removed from the high-moors of the region. The peat is worked in long stretches of 10 feet in with, and 100 to 1000 paces in length; each stretch or plot is excavated at once to a considerable depth and to its full width. Each successive year the excavation is widened by 10 feet, its length remaining the same. Sometimes, unusual demand leads to more rapid working; but the width of 10 feet is adhered to for each cutting, and, on account of the labor of carrying the peats, it is preferred to extend the length rather than the width.

Assuming that the peat bed has been opened by a previous cutting, to the depth of 5½ feet, and the surface muck and light peat, 1½ feet thick, have been thrown in the excavation of the year before—a new plot is worked by five men as follows.

One man, the "Bunker," removes from the surface, about two inches of peat, disintegrated by the winter's frost, throwing it into last year's ditch.

Following him, come two "Diggers," of whom one stands on the surface of the peat, and with a heavy, long handled tool, cuts out the sides and end of the blocks, which are about seventeen by five inches; while the other stands in the ditch, and by horizontal thrusts of a light sharp spade, removes the sods, each of five and a half inches thickness, and places them on a small board near by. Each block of peat has the dimensions of one fourth of a cubic foot, and weighs about 13 pounds. Two good workmen will raise 25 such peats, or 6¼ cubic feet, per minute.

A fourth man, the "Loader," puts the sods upon a wheelbarrow, always two rows of six each, one upon the other, and—

A fifth, the "Wheeler," removes the load to the drying ground, and with some help from the Bunker, disposes them flatwise is rows of 16 sods wide, which run at right angles to the ditch, and beginning at a little more than 10 feet from the latter, extend 50 feet.

The space of 10 feet between the plot that is excavating, and the drying ground, is, at the same time, cleared of the useless surface muck by the Bunker, in preparation for the next year's work.

With moderate activity, the five men will lift and lay out 12,000 sods (3,000 cubic feet,) daily, and it is not uncommon that five first-rate hands get out 16,800 peats (4,200 cubic feet,) in this time.

A gang of five men, working as described, suffices for cutting out a bed of four feet of solid peat. When the excavation is to be made deeper, a sixth man, the "Hanker," is needful for economical work; and with his help the cutting may be extended down to nine and a half feet; i. e., through eight feet of solid peat. The cutting is carried down at first, four feet as before, but the peats are carried 50 feet further, in order to leave room for those to be subsequently lifted. The Hanker aids here, with a second wheel-barrow. In taking out the lower peat the Hanker stands on the bottom of the first excavation, receives the blocks from the Diggers, on a broad wooden shovel, and hands them up to the Loader; while the Wheeler, having only the usual distance to carry them, lays them out in the drying rows without difficulty.

After a little drying in the rows, the peats are gradually built up into narrow piles, like a brick wall of one and a half bricks thickness. These piles are usually raised by women. They are made in the spaces between the rows, and are laid up one course at a time, so that each block may dry considerably, before it is covered by another. A woman can lay up 12,000 peats daily—the number lifted by 5 men—and as it requires about a month of good weather to give each course time (two days) to dry, she is able to pile for 30 gangs of workmen. If the weather be very favorable, the peats may be stacked or put into sheds, in a few days after the piling is finished. Stacking is usually practised. The stacks are carefully laid up in cylindrical form, and contains 200 to 500 cubic feet. When the stacks are properly built, the peat sufferes but little from the weather.

According to Schrœder, from whose account (Dingler's Polytechnishes Journal, Bd. 156, S. 128) the above statements are derived, the peats excavated under his direction, in drying thoroughly, shrank to about one-fourth of their original bulk, (became 12 inches+3 inches+3 inches,) and to one-seventh or one-eighth of their original weight.

When peat exists, not as a coherent more or less fibrous mass, but as a paste or mud, saturated with water, it cannot be raised and formed by the methods above described.

In such cases the peat is dredged from the bottom of the bog by means of an iron scoop, like a pail with sharp upper edges, which is fastened to a long handle. The bottom is made of coarse sacking, so that the water may run off. Some-

times, a stout ring of iron with a bag attached, is employed in the same way. The fine peat is emptied from the dredge upon the ground, where it remains, until the water has been absorbed or has evaporated, so far as to leave the mass somewhat firm and plastic. In the mean time, a drying bed is prepared by smoothing, and, if needful, stamping a sufficient space of ground, and enclosing it in boards 14 inches wide, set on edge. Into this bed the partially dried peat is thrown, and, as it cracks on the surface by drying, it is compressed by blows with a heavy mallet or flail, or by treading it with flat boards, attached to the feet, somewhat like snow shoes. By this treatment the mass is reduced to a continuous sheet of less than one-half its first thickness, and becomes so firm that a man's step gives little impression in it. The boards are now removed, and it is cut into blocks by means of a very thin, sharp spade. Every other block being lifted out and placed crosswise upon those remaining, air is admitted to the whole, and the drying goes on rapidly. This kind of peat is of excellent quality. In North Germany it is called "Baggertorf," i. e. mud-peat.

When black, earthy or pitchy peat cannot be cut, and is not so saturated with water as to make a mud; it is, after raking or picking out roots, etc., often worked into a paste by hands or feet, with addition of water, until it can be formed into blocks, which, by slow drying, acquire great firmness. In Ireland this product is termed "hand-peat." In Germany it is called "Formtorf," i. e. moulded peat, or "Backtorf," i. e. baked peat.

"The method of cutting peat in the Highlands of Scotland is very different from that adopted for cutting from bogs. After removing the surface-sod, the peat-cutter, with a peculiar shaped tool, digs out the peat in slices of about a foot square, and three or four inches thick. 'When mountain-peat is cut in slices, as I have described, and spread out on the ground during dry weather, the drying goes on rapidly; the surface of the pieces acquires a kind of skin, which is not wetted again by rain; and the peat in the course of a week is sufficiently hardened to be handled. The pieces are then set up on edge, so that the air may play on both sides; and, in the course of six weeks or two months, they are dry enough to be stacked or heaped up. In the Highlands of Scotland and the Hebrides, on the average, there is rain four days out of six; and it is only during the months of May, June and July that any continuance of weather favorable for drying peat can be expected. It is necessary, therefore, to obtain the utmost advantage of that period for drying: and to do so the peat

must all be cut before the end of May, at latest. On the other hand, if the peat is cut during frosty weather, and becomes frozen, it crumbles to powder when the thaw comes; and for this reason it is not safe to commence the cutting at all before April, or even May. As a rule, it may be said that the month of May is the only time available for cutting peat in the Highlands of Scotland, and more especially in the Hebrides, so as, on the one hand, to avoid the destruction of the peat by frost, and on the other hand, to insure the best possible chance of getting it dried.

"Two men working together, one cutting and one casting the peat, will, in good weather, get through what is equivalant to ten tons of dry peat; so that, if they were able to work every day during May, they would cut from two hondred to three hundred tons of peat; and, get ten thousand tons cut and spread, one hundred men would be required for the whole month."

3rd. *How* is Peat Used?

As with every other kind of fuel. The value of peat for service depends as much or more upon the *manner* in which it is used, and the methods and appliances for using it, as upon the peculiar qualities and characteristics of the peat itself.

It can be burned in open grates, close stoves, furnaces, ranges, and all the ordinary variety of heating apparatus in use in dwelling-houses. As regards open grates, ranges and furnaces, it will be found that the fire-pot, or receptacle for fuel, should be smaller in area and of less depth than are at present in use for coal. It requires to be renewed somewhat more frepuently than coal, and should be burned with very much less draft, indeed so soon as the fuel is once well ignited, it will generally be found desirable to close the draft almost entirely.

In the employment of peat fuel, regard must be had to its shape and bulk. Commonly, peat is cut or moulded into blocks or sods like bricks, which have a length of 8 to 18 inches; a breadth of 4 to 6 inches, and a thickness of 1½ to 3 inches. Machine peat is sometimes formed into circular disks of 2 to 3 inches diameter, and 1 to 2 inches thickness or thereabouts. It is made also in the shape of balls 2 or 3 inches in diameter. Another form is that of thick-walled pipes, 2 or 3 inches in diameter, a foot or more long, and with a bore of one-half inch.

Flat blocks are apt to lie closely together in the fire, and obstruct the draft. A fire-place, constructed properly for burning them, should be shallow, not admitting of more than

two or three layers being superposed. According to the bulkiness of the peat, the fire-place should be roomy, as regards length and breadth.

Fibrous and easily crumbling peat is usually burned upon a hearth, *i. e.* without a grate, either in stoves or open fireplaces. Dense peat burns best upon a grate, the bars of which should be thin and near together, so that the air have access to every part of the fuel. The denser and tougher the peat, and the more its shape corresponds with that usual to coal; the better is it adapted for use in our ordinary coal stoves and furnaces.

As a general thing peat-fuel should be burned in smaller area and bulk than coal, but renewed in small quantities somewhat more frequently, and *with very much less draft.* A common coal or wood stove, preferably the former, can be readily adapted to the use of peat by covering a *part* of the grate, and by constantly keeping a portion of the drafts closed. Stoves used for this purpose become foul with ashes somewhat sooner than when coal is used, and therefore need more frequent clearing out.

Stoves especially adapted to the combustion of peat have been manufactured in certain localities, but their introduction is not yet as general even as the use of peat. Such stoves can without doubt be procured through the dealers in any of our large cities. Soapstone stoves are very highly recommended by some persons for the combustion of peat.

In conclusion I would add,

1. There is not so much real peat in the State of Minnesota as has been supposed. There is a great abundance of turf, made of grass roots, containing a large per cent. of ash, not properly called peat, that will furnish, in any exigency, a fuel that will keep a family from suffering. This, however, is not thought the object of the survey to investigate, nor to locate, as it exists, as is often stated in the public press, on almost every square mile.

2. While a good fuel, almost equal to the Iowa coal, can be produced by the manufacture of peat by a process of condensaton and evaporation, it is far from certain that it will not cost as much, or more than wood or coal at the present prices.

3. If in any part of the Northwest peat can be made useful as fuel by manufacture, it is the woodless and coalless region of Southern and Western Minnesota.

4. Cautious experimentation should be carried on by those interested in the subject, with the view to protect the comparative cost of peat, wood and coal, at the prices current in different localities.

5. The farmers, and others who need fuel, but do not have means to produce a condensed peat, can take out in mid-summer a winter's supply, from the turf peat found on many farms in the prairie region, but they will generally not find it possible to utilize the real peat deposits without some method of manufacture. They will be too apt to crumble, and thus make a slow, smoldering fire.

It is, however, advised that each person who thinks he has found peat upon his premises should cut a few loads in square blocks and after drying it test its qualities as fuel under the conditions above specified. Those persons coming from North European countries, where peat has long been used and with which they have been familiar from infancy, need no advice upon the subject, but they can render good service and that of a most practical character by teaching their inexperienced neighbors who may need such instruction.

6. There is no known instance of the existence of peat in Minnesota along river valleys, on the bottom lands, where the surface is subject, at the present time, to inundation by spring freshets.

7. There are old river channels, or valleys of excavation, both in the drift and between rocky bluffs, that no longer exist as rivers, which contain considerable deposits of peat.

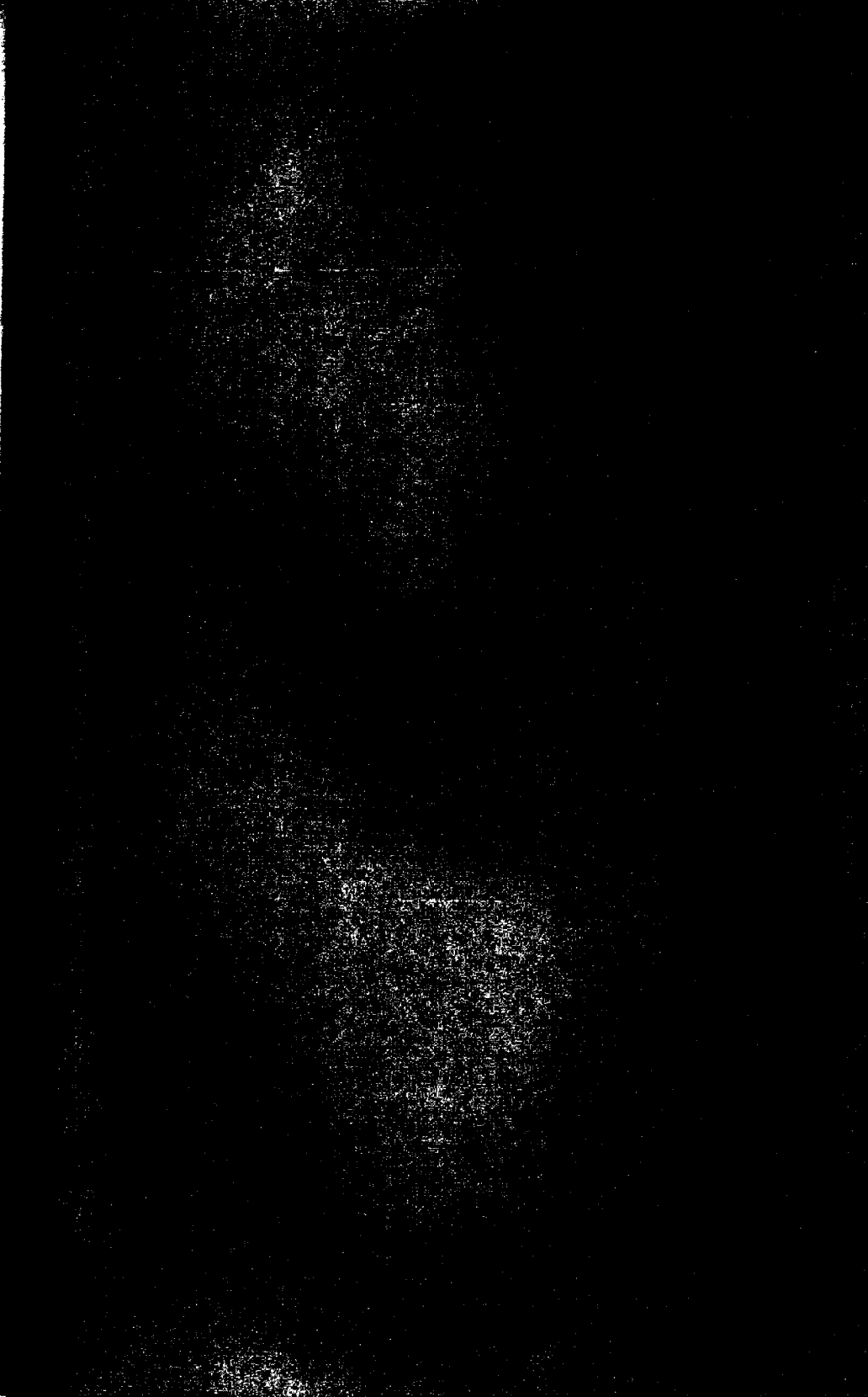
8. There are depressions in the rolling drift surface, in some localities, which, fed by invisible springs, maintain a nearly uniform stage of water throughout the year; and may hold peat of the best quality.

9. But a small portion of the State has been examined. In that a much smaller amount of peat was found than had been anticipated. Other portions, and especially the central southern counties, are believed to promise more peat than the counties examined. According to Dr. C. A. White, State Geologist of Iowa, a peat bearing belt enters Minnesota from the south, bounded, in general, by the Des Moines on the west, and the Cedar on the east.

10. Large quantities of peat are believed to exist in the northern part of the State, many of the cranberry marshes being peat bogs of great purity.

11. The facts mentioned in these pages have been derived from the most reliable sources, chiefly the report of Prof. Winchell, before mentioned, and a little book entitled "Peat and its Uses as Fertilizer and Fuel," by Prof. S. W. Johnson, of New Haven, a little book which every *farmer* at all interested in peat would do well to peruse.

S. F. PECKHAM,
State Chemist.



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SPECIAL NOTICE.

All specimens illustrating the Geology, Mineralogy, Botany or Zoology of the State, that may be sent to the State Geologist for the museum of the University, will be carefully preserved and credited to the donors, and any information regarding persons or localities that may lead to the acquisition of such specimens will receive prompt attention from the same.

N. H. WINCHELL,
State Geologist.