Origins and Distribution of Peat-Types in the Bogs of Ireland[1]

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ABSTRACT

Two bog types (raised-type and blanket-bog) and one sub-type (high-level blanket bog) are distinguished. Their geographical distribution in Ireland is outlined on a map in relation to rainfall and relief.

A summary of the distribution-in-depth of the main genetic peat types is given, three in blanket bog and five in raised-type bog, and the story of peat and bog formation since the retreat of the ice is told in eight illustrations.

A NOTE ON THE NATURE OF PEATLANDS IN IRELAND

Although peri-glacial and possibly pre-glacial peats occur in Ireland, in this paper we shall be concerned only with post-glacial peats. These are derived from the remains of hydroseres, fresh water plant-communities, marsh and fen; and, usually via a forest stage, from the xeroseres, heath, moor and possibly sub-alpine pasture. Accordingly, all the peat lands of present-day Ireland can be grouped simply as follows:

Callows & Fens	Former Tundra, Heath, Forest Former Swamp, Fen, Carr	→ Bog	Moor.

Callows, peat-alluvial water-meadows lying between the greater rivers of Ireland and the adjoining raised-type and blanket bogs, and moor, of shallow acid peat, heath-covered, will not be further described here. The two lines of succession that lead to bog are described in this paper and illustrated by Figs. 3, 4 and 5. The development of two main types of bog, thereafter, is shown on Figs. 6 and 7.

THE DISTRIBUTION OF BOG-TYPES IN IRELAND.

The bogs of Ireland to-day, in terms of significant human usage, are either uncut (grazed or ungrazed), in course of hand-winning for

1. Paper given at a Symposium on Peat as a Medium for Horticultural Crop Production, Kinsealy, Co. Dublin, June 1968, (Proceedings now in Press). Published by permission of An Foras Taluntais (The Agricultural Institute).

2. Bord na Mona, Experimental Station, Droichead Nua, Co. Kildare.

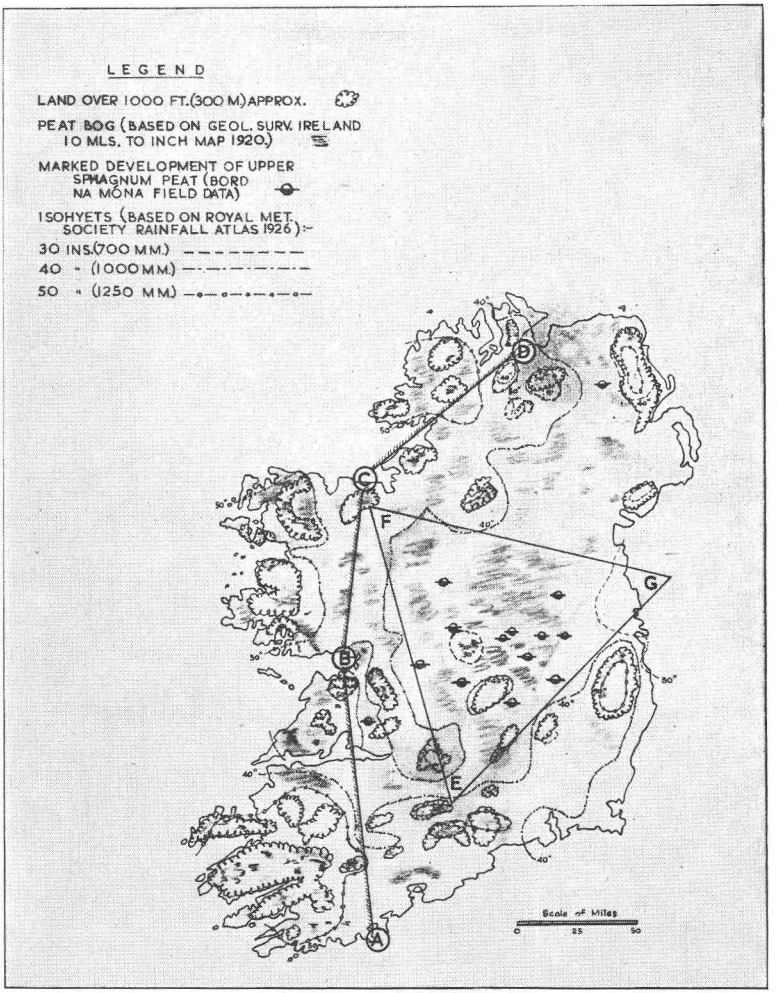

Fig. 1

Distribution of the main bog types in Ireland in relation to rainfall and relief. West of A B C D is the region of blanket bog par excellence. Within the triangle E F G are the main aggregates of raised-type bog (Hochmoore). On high ground everywhere is the sub-type high level blanket bog (Reprinted by courtesy of Bord na Mona, from Barry, 1954).

fuel, in course of machine-development for sod-peat and milled-peat fuel and for moss-peat production or to some degree reclaimed for

agriculture and forestry, usually from the cut-over stage following hand winning of fuel peat.

The distribution of the most common, widespread and important peat-types within Ireland's bogs is best described in relation to their genesis, that is, according to the ways and in the order in which they have been formed. Describing them in this way enables one to indicate most conveniently not only the variations encountered from place to place horizontally but those that are found vertically at any one point in a bog. Knowledge of this kind, particularly of the vertical arrangement of peat-types within them, is fundamental to our understanding of the problems that are likely to arise in the development of peat-lands and of peatland products for man's use.

Every bog in Ireland is a multi-storeyed structure, as we shall see.

Distribution within the island of Ireland of the main bog-types was first outlined cartographically by Barry (1954), and their relationship to rainfall and relief was set out on a map now reproduced with this paper. Fig. 1 (The terms "blanket bog" "raised type bog" and "high level blanket bog" will be explained further on).

Since then the suggested outline-distribution has stood the test of many field checks and has been, in effect, confirmed by other workers, e.g. Moore (1960, 1962, 1964) and O'Sullivan (1968).[1]

THE ORIGINS AND DISTRIBUTION OF PEAT-TYPES WITHIN OUR BOGS.

So far we have been speaking in terms of bog types only. Let us now look at the stages of development whereby successive peat layers have been built up to form the bogs as we know them today. These stages of development are presented in this paper schematically (*Figs.* 2-9). While much of the background information on which the diagrams are based comes from the work of the great names in twentieth-century Quaternary peat-investigation, of Von Post (1937), Osvald (1923) and Jessen (1949), of Scandinavia; of Britain's Godwin (1956), Pearsall (1938) and Tansley (1939) and of Ireland's Lloyd Praeger (1901) and Mitchell (1951), recent peat surveys also (Bord na Mona, 1946-1968) have contributed much to these pictures of peat formation. In so far as the peat-stratigraphy of the bogs of Ireland is concerned, they may be said to rest on a basis of fact. Necessarily telescoped here, however, both in the figures and in the account that follows.

The chronology adopted is that which is most widely accepted. Whatever degree of authenticity it possesses as used here derives from its origins and development in the classics of peat literature such as Godwin's (1956) and Mitchell's (1951) works.

1. This is a very recent account of admirable work in West Mayo which sets a headline for the way in which floristic and pedological data may be collated with a view to presenting a scientific picture of complex peatlands.

Its hazards, as now applied, are obvious and inherent, in that peat formation may well have begun at quite different points in time within any one bog of uneven bog-floor topography, at places no more than a couple of hundred yards apart. It was in order to illustrate this very point, in fact, that the present series of drawings was produced in the first place. See and compare the very different histories of peat formation over the convexity on left and over the concavity right, in Figs. 3, 4 and 5.

The last or Weichsel Glaciation (Fig. 2)

The Glacial Ages in these latitudes are said to have begun about one million years ago. Successive glaciations covered Ireland, to a depth of 1,000 feet or more of ice field. Generally, the story of the most recent glaciation is one of soil-material creation, of rock being ground down to "rock flour"; of abrasion, transportation and deposition extending, from say 100,000 B.C. to 12,000 B.C. — a span of 88,000 years.

Development of Post-Glacial Vegetation, Stage 1 (*Fig.* 3)

LATE-GLACIAL (Lower Dryas, Allerod, Upper Dryas) and PRE-BOREAL— about 12,000 B.C. to 7,000 B.C., — a period of 5,000 years.

By about 10,000 years ago the ice fields had retreated northward leaving behind them drift, till, and scratched and polished rock-surfaces; the hollows being fielled with glacial melt-waters. Boulder-clay, gravels and sands although sometimes of remote origin were more often locally-derived and therefore resembled the rock type of the general area e.g. siliceous drift among the quartzites and mica-shists of the West; calcareous drift in the carboniferous central plain. Gradually lichens colonised the rocks, and sub alpine plants, Arctic willow and birch followed in succession to form tundra and later heath-land vegetation. This colonisation may well have been assisted by seeds from plant refuges on the mountains and, in the final phase, from the South West.

Development of Post-Glacial Vegetation, Stage II (*Fig.* 4)

BOREAL 7,000 B.C. to 5,000 B.C., a span of 2,000 years.

After the lapse of some thousands of years mixed forests of pine, oak, and yew, or of pine only, depending on the nature of the drift,[1] covered all the "middle ground" (that is, above flood level, beneath the hills) while lakes and ponds were being encroached upon by *Phragmites* reedbeds. The remains of these and other aquatics went to form the first peat-type, reedswamp peat, resting on silt, clay or shellmarl, or on other detritus or algal mud.

1. R. F. Hammond's recent work (1963-67) is likely to throw much new light on the processes of soil formation prior to the onset of bog.

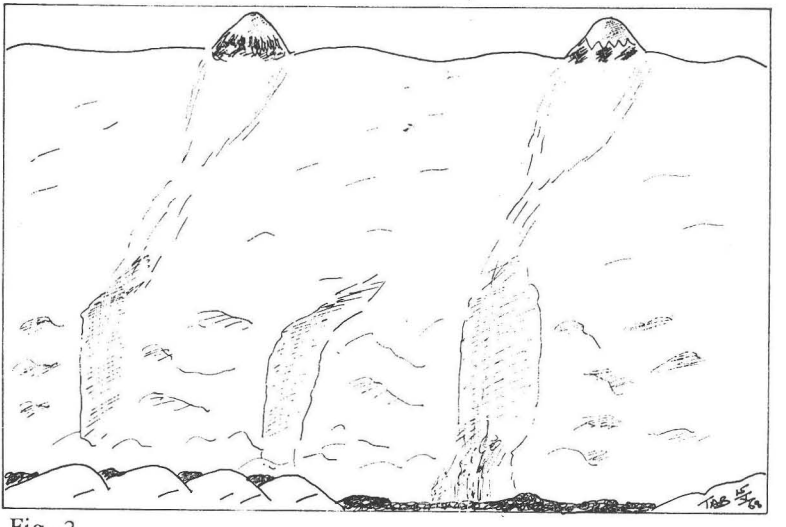

Fig. 2
The last (?) glaciation. Climate: Arctic. At the culmination of each glaciation, only the higher mountains protruded from the ice, except at the final glaciation when Ireland, south of the line River Slaney—Baltinglass—Newcastle West—S. W. Clare, was apparently clear of the main ice field.

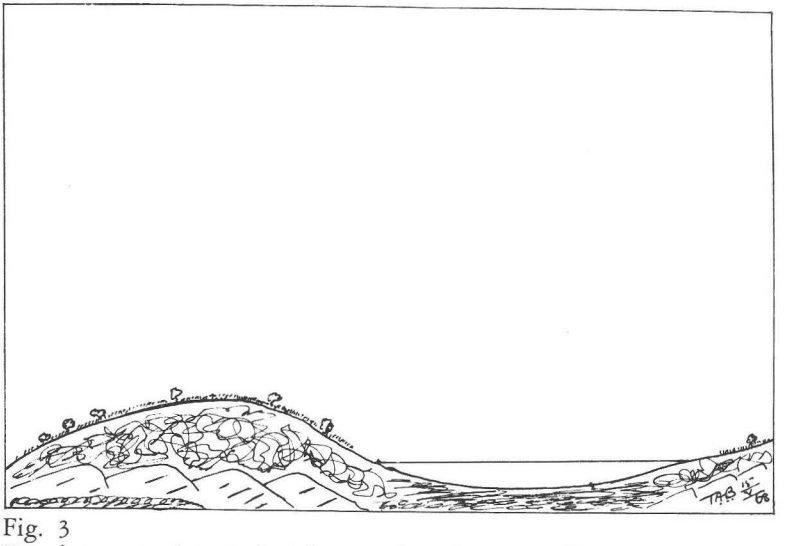

Fig. 3
Development of post-glacial vegetation. Stage 1. Climate: sub-Arctic. Tundra conditions prevail at the beginning. Vegetation colonises the higher drier ground, at first intermittently, then progressively.

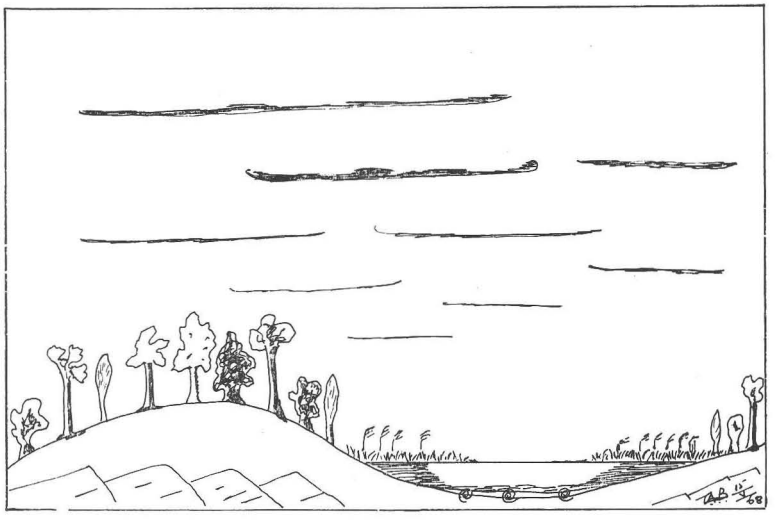

Fig. 4
Development of post-glacial vegetation. Stage II. Climate probably warm and dry. Forests of oak, pine and yew. Lakes and ponds infilling.

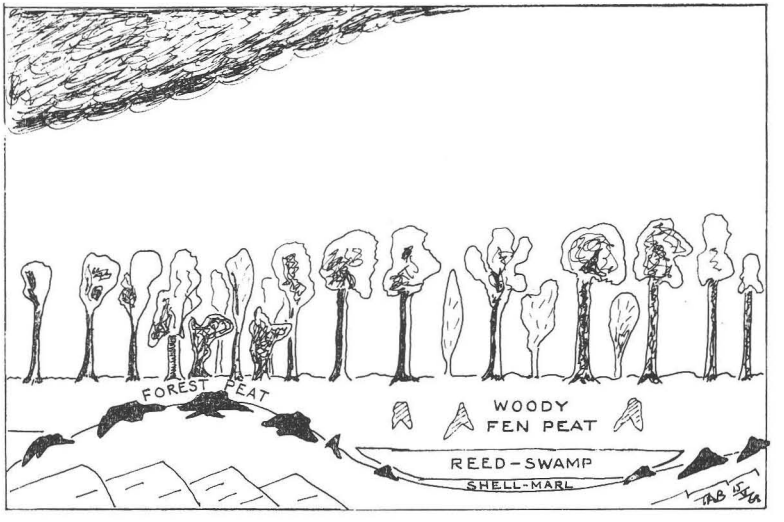

Fig. 5
Development of post-glacial vegetation. Stage III. Climate moist and warmer than today. In the central plain of Ireland, pine forests extend over the woody fen-peat and reedswamp.

Development of Post-Glacial Vegetation, Stag III (*Fig.* 5)
ATLANTIC and SUB-BOREAL. 5,000 B.C. to 500 B.C. or later.
A span of 4,500 years at least.

For as long as the post-glacial amelioration of climate continued, forests persisted on the middle ground and extended widely, pine succeeding birch, out over the "woody-fen" (*Eng.* carr. from a Swedish phytogeographical term), which had by this time developed over the reedswamp. The woody-fen peat is composed of mosses, mainly non-sphagnum, and very mixed eutrophic or meso-trophic vegetation remains, occasionally including birch, sometimes with *Phragmites* intrusions. Rapid and numerous. fluctuations in botanical composition and in humification, indicating changes in flood-level, are not rare.

It must be emphasised that the diagram is entirely schematic. In reality, as Bord na Mona stratigraphical records, 1953 to date, show quite clearly, in the Central Plain of Ireland a convexity of the bog-floor, as shown in Fig. 5 could cover anything from a hundred square yards to hundreds of acres. It could be in the form of a ridge, or a plateau. Similarly the concave reedswamp, which looks like a pond in Fig. 5 could cover several hundred acres, could extend along a mile of section, or could be interrupted several times in the course of that mile by abrupt or gradual uplifts of the floor.

Development of Raised-type bog (*Fig.* 6)
SUB-ATLANTIC and RECENT. 500 B.C. or later, up to now,
a period of 2,500 years at most.

In the Central Plain of Ireland, when the forests shown in Fig. 4 had decayed, from whatever cause, most probably a relatively drastic deterioration of climate, true acid bog peat, of the *Sphagnum-Carex* association rich in *Eriophorum,* began to grow over their remains. This series of layers of well humified older – *Sphagnum* and *Eriophorum* peat, is distinguished from all of the foregoing peat types by a total absence of arboreal woody remains. This was the beginning of true bog and it was succeeded, (sometimes by sharp alteration at a particular level, sometimes by a gradual change upward) by younger-sphagnum peat composed mainly of sphagnum mosses, relatively un-humified, which does not in surface configuration reflect the contours of the bog floor. On the contrary the more concave the ffoor, the more likely it is that the surface of this type of bog will be distinctly convex.

Development of Blanket bog (*Fig.* 7)
SUBATLANTIC and RECENT. 500 B.C. or later, up to now. A
period of 2,500 years at most.

While the eents outlined in the preciding paragraph were taking shape in the Central Plain, in the Western maritime countries and on high ground everywhere, the pine forests, at the lower levels, and the birch woods on the hill slopes and hill tops were dying out leaving an amorphous peat containing stumps of pine and birch and were being replaced by true blanket-bog peat in which sphagnum mosses

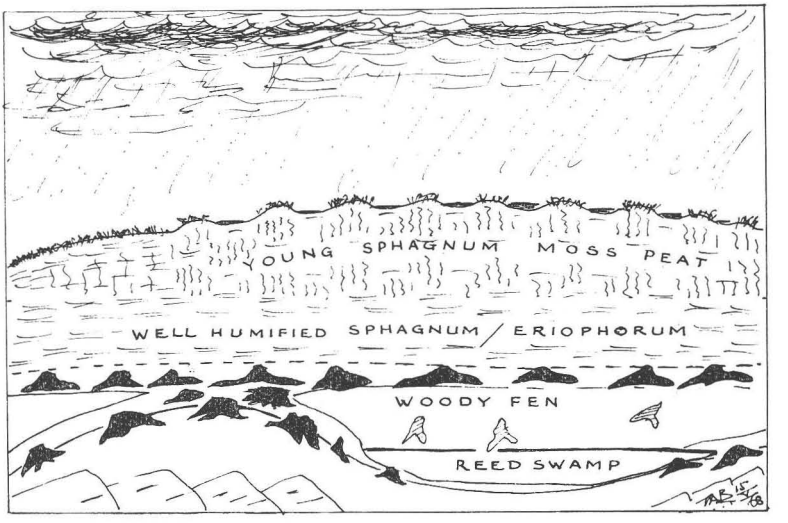

Fig. 6
Development of post-glacial raised-type bog. Climate: oceanic, North temperate. In the central plain, this type of bog developed over the decayed pine forests, in two stages, as shown.

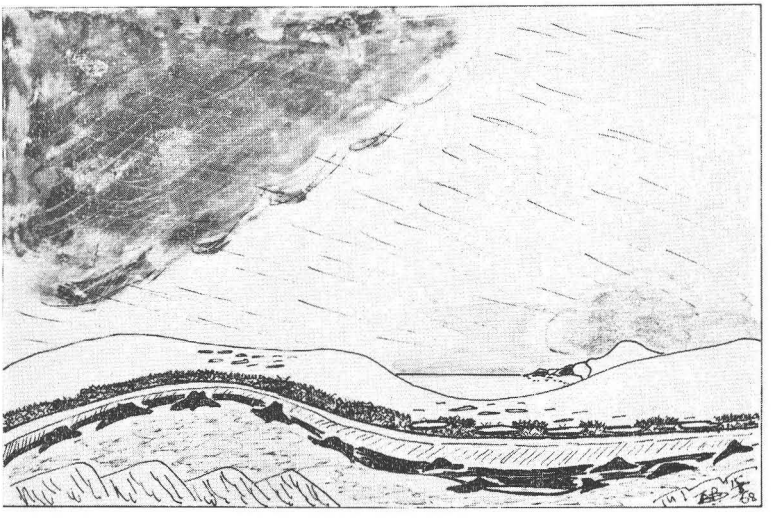

Fig. 7
Development of post-glacial blanket bog. Climate: extreme oceanic. In western Ireland this type of bog developed over the decayed pine-forests, as sedge peat, rather than as moss peat, in two distinct layers.

rarely if ever played a principal part. This layer of mixed composition, *Cyperaceae - Gramineae - Ericaceae,* is usually very well humified (H8—9 on the Von Post scale). Above it there is a sharp change to a blanket peat of approximately similar composition but noticeably less humified, which condition continues to the present surface.

The obvious reason for this radical difference between the true bog peats of the West of Ireland and of high ground as compared to those of the Central Plain is a difference of climate going back a couple of thousand years or more. The Western counties are subject also, by reason of their maritime situation, to more base-rich air and rain than is the Central Plain. Further, the ruggedness of the terrain affords better opportunities for the formation of soligenous peats—those enriched by ground waters flowing on to them from higher levels, now or in the past, so that it is not surprising to find that Western blanket-bog profiles often include quite large depths of *Phragmites* peat at base, on long slopes and in declivities.

As will be seen in Fig. 7, the blanket bog, in contrast to the raised-type bog, does reflect in surface configuration, more or less faithfully, the contours of the underlying mineral soil.

High-level blanket bogs occur commonly above the 1,000 ft. contour or so and resemble the Western low-level blanket bogs in growth-form but are of more montane and ericaceous composition.

The Regeneration-Complex of Younger-Sphagnum Peat (*Fig.* 8)

To revert to the regeneration-complex, of the raised-type bog in Ireland and West Europe, a feature that is of special importance as it gives rise to the industrial product moss peat. This was first worked out in detail by Osvald in 1923. In Tansley (1939) two of Osvald's profiles from his examination of raised-bogs in Ireland are given. One south-west of Athlone shows seven complete or incomplete cycles of regeneration going to a depth of 15 ft., the other, south of Edenderry, shows six or seven cycles to a depth of 10 ft. Such successions have been found repeatedly since then in surveys of other undrained raised-bogs in the Central Plain.

The figure (Fig. 8) shows schematically only one such complete cycle, the one nearest the surface, in a bog of classical moss-peat composition. Such a bog, in Ireland, could be comprised mainly of younger-sphagnum peat in the top one, two or three metres. The explanation of the sequence of growth in the part shown in Fig. 8 is as follows: on right and left former hummocks have gone through a pool stage and then a stage of pronounced upward growth of *Sphagnum* to become a pair of present-day bare-topped hummocks, which will form the floors of the next pair of pools if growth continues. At centre a similar succession at a different level has led to a present-day pool.

The sphagnum mosses are remarkable for the specialised cellular structure of their stems and leaves, so much so that one early worker

wanted them classified as sponges, not mosses. Their structure is a microcosm of the regeneration-complex to which they give rise and this complex in turn foreshadows, as it were, within each sphagnum cushion of vertical aggregates, the upward growth and domed form of the bog that will result.[1]

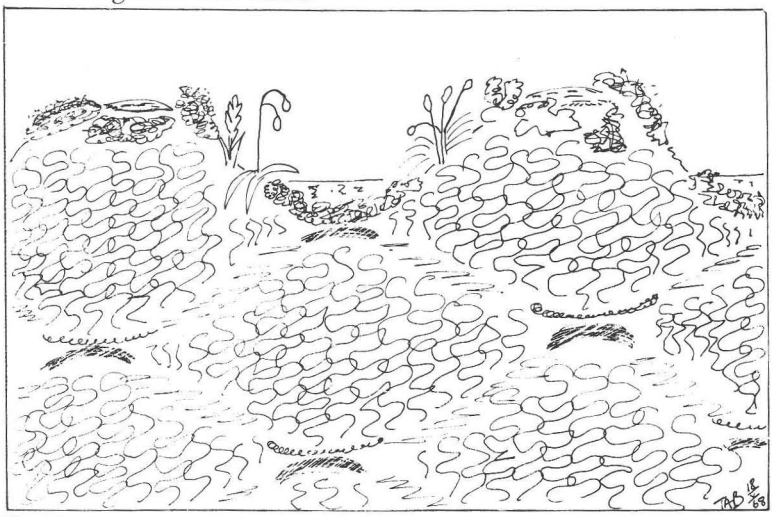

Fig. 8.
Regeneration complex of younger sphagnum peat in raised-type bog of the central plain, Ireland. (One cycle—schematic).

From a review made in 1963 of all the literature containing vegetational records for Ireland, e.g. Tansley (1939) Osvald (1949) Mitchell (in Jessen 1949) and Walker & Walker (1961); from personal observation of bog cuttings and profiles, and from subsequent discussion, it appears clear that the sphagnum species most commonly found in our younger moss peats of the East Central Plain are

Sphagnum papillosum
" *imbricatum*
" *magellanicum* (*S. medium*)
" *rubellum*
" *plumulosum*

1. Recently in a stimulating paper Walker and Walker (1961) have cast some doubt on the reality of the regeneration-complex concept. The meticulous observations made were all at the vertical faces of peat left by turf-cutters. "A very large number of cut faces were examined", they write, "and the examples recorded are thought to be fairly representative of these." Since, however, four of the eight places plotted on their map and reported on in their paper are well outside our E. Central Plain region of best younger sphagnum peat regeneration-complex (one was in Tipperary, one in E. Galway—West bank of Lough Derg —and two in Co. Derry) it may be that the authors themselves have not lent their theories the support they perhaps deserve.

It would appear (J. J. Moore, S.J., Personal communication, 1963) that of these, *Sphagnum papillosum* and *Sphagnum imbricatum* together make up on average the main bulk of our first-quality moss peat. An interesting point is that both of those species (and *S. magellanicum*) belong to the *Cymbifolia* or coarse-leaved group of sphagnum mosses. Dittrich (1954) quoting Overbeck in support, claims that *Cymbifolia* moss-peats have a higher rate of absorption and in their dehydrated state, better aeration than *Acutifolia* moss peats of small-leaved sphagnum species. "Cymbifolia peat is loose and bulky, Acutifolia peat is dense."

D. M. Synnott, Natural History Division, National Museum of Ireland, while concurring in the views expressed regarding the former most common sphagnum species, states that *S. imbricatum* is now quite rare on growing bog surfaces (Personal communication 1868).

Blanket-bog and Raised-type Bog profiles compared. (Fig. 9)

In this figure fairly typical profiles of raised-type and blanket bog in Ireland may be compared and contrasted in respect of plant suc-

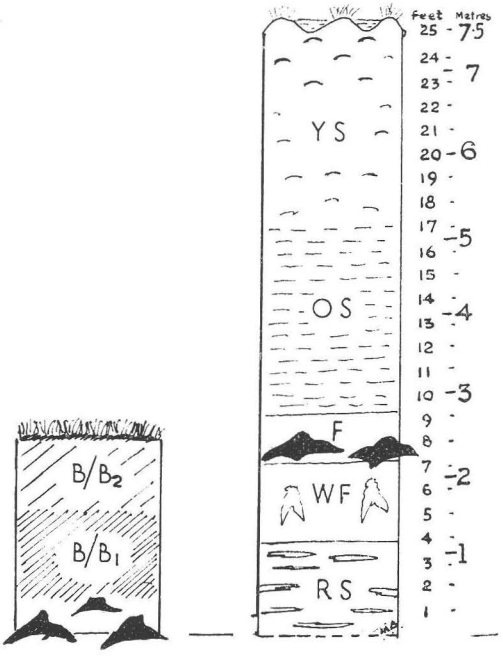

Fig. 9
Blanket bog and raised-type bog. Normal profiles in Ireland compared. For explanation of symbols see Appendix.

cession, peat-types, and depth. Each is of average depth, undrained —raised type bog 25 feet blanket bog 8 feet deep. As the schematic sections in Figs. 6 and 7 will have shown, it would be easy to discover profiles quite different from these in either bog-type.

ACKNOWLEDGEMENT

Thanks are due to Bord-no-Mona for permission to make use in this paper of information gained in the course of duties for them.

APPENDIX

Key to the peat-type abbreviations used in Fig. 9 follow:

Blanket Bog Profile

B/B_2 = Upper stratum of blanket bog peat, moderately or poorly humidified

B/B_1 = Lower stratum of blanket bog peat, well humidfied.

F = Forest peat (usually amorphous), with pine stumps common.

(See *Fig.* 7 also)

Raised-Type Bog Profile

YS = Younger-sphagnum regeneration-complex.

OS = Older-sphagnum and eriophorum peat.

F = Forest peat, with pine remains most common, except over convexities of the floor, in the Central Plain, where oak and yew occur, with or without the pine.

WF = Woody-fen (carr) peat.

RS = Reedswamp.

(See *Fig.* 6 also)

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