we were cordially welcomed by Prof. G. Tiercy, dean of the Faculté des Sciences, and by Prof. F. Chodat, acting for the president of the Société de Physique et d'Histoire Naturelle. The receptions were much enjoyed, and offered a precious opportunity of personal contacts and exchange of opinions and criticisms in private. When we were driven into the Jura and, having turned a corner, saw the Lake of Geneva far below the road, and in front of us, behind the Lake, the glittering tops of the Alps, the exclamations of delight were mixed with unfinished sentences concerning point sets, measure, Bayes, etc. The cordiality of the hosts, among whom were Profs. H. Fehr, D. Mirimanoff, G. de Rham, and R. Wavre, culminated at the closing dinner on Friday night, after which the guests departed, carrying with them happy memories of the Conference and a feeling of gratitude to the hosts and hopes of future similar occasions.

It was announced that another conference on the theory of probability will be held soon in Geneva, and will deal more especially with problems of various applications.

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The Birch 'Forests' of Greenland

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DURING the past summer of general botanical work in the Julianehaab district—climatically the most favourable part of Greenland—special attention has been paid to the history and present-day ecology of the oft-mentioned but little known Greenland 'tree' birch (*Betula pubescens* sens. lat.).

In 1933 I was able to show[1] that in Lapland the roots of the nearly related (perhaps conspecific) *B. odorata* Bechst. are able to conduct water actively through at least half a metre of hard-frozen soil, and moreover that where the roots are unable to extend below the frozen surface layer, this generally dominant plant is absent or at least fails to attain proper 'tree' form[2]. Much the same seems to be true of the Greenland *B. pubescens* which, however, scarcely attains the form or proportions of a real tree. Its 'forests', which are generally confined to the most sheltered fjord-head regions, consist for the most part of straggly bushes 2–4 metres in height. Moreover this scrub, at least in the district visited, appears almost always to be interrupted at more or less frequent intervals by patches of lower Salices or dry lichen or herb associations—most often due to biotic disturbance but sometimes, it seems, to natural edaphic or other environmental conditions. Occasionally an individual birch will be found reaching a height of 5½ metres or a little more, while the maximum stem diameter observed was 25 centimetres. These larger trunks and indeed almost all the 'trees' are gnarled and prostrate or obliquely ascending near the butts[3], being often twice as long as they are high and generally growing several from a stool and away from the direction of the worst "foehns".

These peculiar winds, descending with gale force from the lofty ice-cap, may be so warm and lasting as to melt all the snow even in the dead of winter and kill whole patches of the shallow-rooted *Empetrum* and other 'heaths' by desiccation when the soil is frozen near the surface and water cannot be absorbed to make good that which is lost by transpiration from the aerial parts. The result is that the ground vegetation in many places consists largely of cryptogams which are temporarily able to withstand almost complete desiccation. But the dominant birches—and probably also the Salices—have roots going down far below the deepest level (60 cm.) to which, so far as I have been able to determine by digging in early summer and questioning the natives, the soil is liable to be frozen in the areas of the largest birches in winter. (During the first week of August I was unable to find any ground-ice or temperatures below 2–3° C. even down to depths of nearly 2 metres in the bogs in Tunugdliarfik Fjord.)

There can be no reasonable doubt that the 'trees' are, as in northern Lapland[4], limited to areas where the soil is only frozen superficially in winter, and that they can withstand the extremely inimical springtime foehns—which may cause the buds to swell and sometimes burst into leaf, yet even small twigs are rarely killed—only by absorbing water from lower levels and conducting it up through the frozen layers; for rootlets are to be found almost everywhere extending to 1–2 metres, at which depth sandy soil is in summer almost as warm as near the surface. Such regions, with relatively warm or at least unfrozen conditions of subsoil throughout the year and supporting tree or tall bush growth over considerable areas, are by the biologist to be classed as Subarctic rather than truly Arctic in type; for in the Arctic the soil is permanently frozen to a great depth, only the surface layer thawing out in summer.

The presence or absence of a permanently frozen subsoil, which itself depends upon local physiographic as well as general climatic conditions, may largely determine the northern limit of tree growth in the world, at least in regions of relatively oceanic climate; it may perhaps also afford a convenient standard for distinguishing between the Arctic and Subarctic where latitude and other criteria fail.

The theory propounded by Ostenfeld[5] but already strongly refuted by Porsild[6] that the 'tree' birch was introduced to Greenland from Iceland by the Nordic colonists of the tenth century is quite untenable on geobotanical, sub-fossil[7] and even written historical grounds. The Greenland 'forests', the dominants of which often approach 100 years in age and harbour junipers 200–300 or even more years old[8], appear instead to be relics of a more genial postglacial warm period that probably lasted until about 2,000 years ago, according to verbal information from Prof. Knud Jessen and Dr. J. Iversen of Copenhagen, who have each carried out independent investigations on the sub-fossil strata of different parts of south-west Greenland. These authorities and Dr. M. P. Porsild, who has spent most of the last thirty-one years in Greenland as director of the Danish Arctic Research

Station on Disco Island, moreover agree with me that there is no real evidence, either archæological or otherwise, for the popularly supposed serious deterioration of climate since the time of the Nordic colonization.

What was probably the strongest suggestion of such a change resulted from the discovery of the coffins of some buried Norsemen permeated by roots of plants but all frozen in summer[9]; but that was only in one place far out on the exposed ocean coast and in a bad year and other quite unusual circumstances, as the late Fridtjof Nansen quickly pointed out in objecting to this suggestion; moreover, the presence or absence of frozen soil conditions depends on a number of factors of which aerial temperature is only one[10]. That the climate may have become somewhat drier and a very little cooler since the advent of the Norsemen seems quite possible, and indeed just around Eric the Red's estate at Qagssiarssuk where the birch 'trees' were extensively cleared by the Norsemen they have failed to reappear even in the 400–500 years since the dying out of the colony. But there is no evidence of a change great enough to have been, at the very most, more than one factor contributing in some degree to the downfall of their once flourishing civilization.

Thus the peat deposits show no signs of any important change in the summer temperature since long before the advent of the Norsemen[11], while even if the climate has become drier the conditions are still damp enough to support over large areas in this district luxuriant grassy herb communities that afford some of the best summer pasturage I have ever seen! Moreover the outlawed Eric, in what has wittily been termed 'the first real-estate venture', called the country *Groenaland* 'the green land' merely in order that he might the more easily attract colonists from Iceland[12]—which suggests that the notoriously inhospitable aspect of the coast is no mere present-day phenomenon. Finally, and perhaps most significantly of all, the tree and bush communities in some places show to this day what is with little doubt the same delimitation as they were given by cutting by the Norsemen and grazing by their domestic animals. It is inconceivable that the extremely fine equilibrium existing between these 'higher' communities on one hand and the *luxuriant* alternating patches of grass and herbs on the other could have been maintained in the face of any appreciable climatic vagaries, much less a profound change; while even if this remarkable community delimitation can only with fair certainty be stated to date from the final disappearance of the Norsemen, it seems highly probable that it is the result of long lasting biotic impress and hence dates from well before that time. Even the temperature of the earlier warm period, which presumably corresponded to the sub-boreal of Europe, may have been only slightly above that of the present day, for no evidence has yet been found of the occurrence in Greenland in post-glacial times of any plant formation or species which does not live there now.

Since the above was written Prof. Jessen has informed me (1) that he has found plentiful fruits of *Betula publescens* s.l. in peat layers from south-west Greenland that were laid down long before the advent of the Norsemen, which finally proves that the plant is indigenous; and (2) that from the experience of many deep borings which he made in the summer of 1926 in the Julianehaab district it was obvious that ice was quite absent from the ground.

[1] NATURE, **132**, 313 (1933).
[2] Oxford Univ. D.Phil. Dissert. 1935 (Abstract published at the Clarendon Press).
[3] cf. Rosenvinge, *Medd. om Grønl.*, **15**, 135 (1896).
[4] Polunin, *J. Ecol.*, **24**, 2 (1936).
[5] *Kgl. Danske Vidensk. Selsk. Biol. Medd.*, **6**, (3), 17 (1926).
[6] *Medd. om Grønl.*, **92**, (1), 57 (1932).
[7] Trapnell, *J. Ecol.*, **21**, (2), 311 (1933).
[8] cf. Rosenvinge, *Medd. om Grønl.*, **15**, 135 (1896).
[9] Nørlund, *Medd. om Grønl.*, **67**, 237 (1924).
[10] cf. Nansen, *Avh. utgitt av Det Norske Vidensk.-Akad. i Oslo*, nr. 3 (1926).
[11] Iversen, *Medd. fra Dansk Geol. Forening*, **8**, 4 (1934).
[12] cf. Jónsson, "Greenland", **2**, 333 (1928).

The Cyclol Hypothesis and the 'Globular' Proteins

DR. D. M. WRINCH has extended the cyclol theory of protein structure to account for the existence of space-enclosing or 'globular' molecules (*Proc. Roy. Soc.*, A, **161**, 505; 1937).

The cyclol theory showed that a molecular fabric could be formed on the basis of the polypeptide theory by assuming that the peptides did not lie fully extended but underwent rotation at the bonds to form hexagonal structures. A series of these containing 2, 6, 18 . . . $18 + 24n$ residues can form closed systems of regular geometrical form with three-way symmetry. The second member of this series, called 'cyclol 6', forms the basis of the 'cyclol fabric'. Other members of the series could, if it were desired, be used as the basis of geometrically regular two-dimensional fabrics.

Any theory of the structure of three-dimensional molecules containing several thousand atoms must take into account the mathematical possibilities of distributing these in space in such a way that the resulting model will account for the known chemical and physical properties of the substance in question. The cyclol fabric can be folded along certain well-defined lines to form space-enclosing models of regular geometrical form, without violating any of the fundamental requirements of the cyclol fabric; for example, truncated tetrahedra can be formed by bending round the cyclol fabric without any distortion of the cyclol net. The truncated tetrahedra form a series which contain 72, 288 . . . $72n^2$ residues. These tetrahedral models, like the original 'cyclol 6', allow for polymerization, so that one, two or more of them can be brought together by apposition of their plane faces to form a series of polymers.

The model containing 288 residues is of great interest for it would have a molecular weight approximating to 35,000, which Svedberg has found as a basic number for the molecular weights of globular proteins. For example, insulin and egg albumin (which on the cyclol theory consist of 288 residues per molecule) have molecular weights of approximately 35,000, while various other proteins have molecular