been the compilation of data on Alberta coal. The sampling and analysis of the coals of Alberta in co-operation with the Provincial Mines Branch was continued actively in 1943 and a new programme was to start in 1944. Results of an investigation on alternative fuels for motor vehicles have been published and it is proposed to ascertain commercial possibilities of Alberta coals in this connexion. A co-operative investigation with the National Research Council of Canada has been planned and initiated, involving the low-temperature carbonization of the coals to give a reactive producer gas fuel. A study of the suitability of typical Alberta coals for use in automatic domestic stokers was commenced, and a special investigation carried out on possible effects of the addition of purple dye on the storage and use of gasoline and other motor fuels. A report on the geology of coal areas of Alberta, with coal areas map, has been delivered to the Department of Lands and Mines, and a preliminary investigation made of the coal deposits in the Grand Prairie district. Assistance was given to the Petroleum and Natural Gas Conservation Board in Calgary in connexion with geological work concerned with the preservation and examination of rock core samples from various oil wells in Alberta, and brief reports on silica deposits in Alberta and clays and shales in Alberta have been prepared for the Post-War Reconstruction Committee. A report on farm electrification is in preparation, and a list of publications of the Research Council is included in the report.

Further reference to work on bituminous sand is made in Contributions 4 and 5 of the Research Council of Alberta, covering the calendar year 1944. The separation of the oil from bituminous sand by washing with hot water has again advanced, mainly in the study of factors affecting separation through recognition of the fact that time is important in displacing oil from the sand grains by the hot water, bituminous sands differing in the time required.

With regard to natural resources and research data, the main work was the preparation, publication and distribution of reports on Alberta coals, as well as an abstract of all available publications on bituminous sands. Installation of equipment for testing coals in automatic domestic stockers was completed early in the year and tests made through the remainder of the year except during the warm months. A satisfactory coal should be low in ash to avoid too frequent clearing of the fire ; a dust-free (oiled) coal is preferable and it should have a uniform size suited to the individual stokers. Another major project was the low-temperature carbonization of low-grade coals, and the carbonizer has been designed, constructed and operated to make a char, the heat value of the clean, smokeless fuel obtained being increased sometimes as much as 55 per cent. The char was primarily intended for tests by the National Research Council for portable gas-producers attached to a motor vehicle. A survey of the motor gasolines on sale at the filling stations of the Province was commenced and an electronic knock meter for use on the octane engine was devised, constructed and tested.

A brief account is given of the geological field investigation in the Grand Prairie district to study the coal occurrence and to determine a possible coal supply for that part of Alberta somewhat removed from the developed coal fields ; a report is in preparation. The structure and rock formation of the Rocky Mountains in the vicinity of North Saskatchewan between Nordegg and Horse Pass has been investigated during the past four seasons, and an important discovery of a bed of rock salt was made in October in a search for petroleum. Research on the vis-breaking of Alberta bitumen was completed in September and showed that a practical process was possible without excessive formation of coke or gas, the bitumen being converted from a highly viscous material, difficult to handle except when hot, to a material of viscosity sufficiently low to permit handling in the usual manner for liquids. Research on the Fischer–Tropsch synthesis of liquid fuels was commenced in the summer. Another investigation was concerned with the purification of silica sand for the manufacture of glass.

LIFE-HISTORIES IN THE NEMALIONALES

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THE arrival of reprints relating to researches by Swedish algologists during the war years has been welcome. Some of these have a bearing on life-histories in the Nemalionales, and in particular reference should be made to the work of Svedelius on *Galaxaura*. On the basis of morphological knowledge the existence of different types of life-history in this order seems obvious. So far, however, those which have been investigated cytologically have all conformed to one type : in this type reduction division occurs immediately after fertilization, the two dissimilar haploid phases (the gametophyte and carposporophyte) being separated by a diploid phase of the shortest possible duration.

Species of *Galaxaura* were studied by Howe[1] in their natural habitat in the West Indies and he was able to show that at least some species have three somatic phases. This is an exceptional state in the Nemalionales although it is usual in the other Floridean orders. He also demonstrated that Kjellmann's[2] earlier classification of the genus was an artificial one as the 'species' of one of Kjellmann's sections were found to be the tetrasporophytes of the 'species' of another section, the anatomical differences between the two having led Kjellmann to consider them separate species. Børgesen[3] later confirmed Howe's findings. Such a situation plainly called for a cytological investigation.

It was at this point that Svedelius[4] took up the investigation in detail of the four South African species, *G. Diesingiana* Zanard., *G. tenera* Kjellm., *G. corymbifera* Kjellm., and *G. magna* Kjellm. The results are embodied in the work under review. He has shown that reduction division in two of these species takes place in the tetrasporangium. These species are thus somatically and cytologically unlike other Nemalionales of which the cytology is known. It may be commented in passing that a term is required to distinguish the balance of cytological phases as seen in *Nemalion*, *Galaxaura* and possibly *Liagora* when the relevant data are available. In some species regeneration of the tetrasporangium with repeated reduction division has been observed. The post-fertilization developments and the structure of the cystocarp show some new features, and morphological differences between the gametophyte and tetrasporophyte are described. In an additional publication[5] critical notes on species from Ceylon

are given but, it should be noted, these species are entirely sexual or tetrasporic. Two valuable accounts[6,7] of the main conclusions are available in the English language. The work is profusely illustrated by both photographs and drawings. There is considerable variation in the magnification used and the photographs only reproduce the grosser features. This is to be regretted as the time has surely come when at least some of the cytological evidence should be presented photographically.

The salient points that emerge from the work are as follows. First, while the sunken growing region, consisting of a number of filaments, is identical in both sexual and tetrasporic plants, the appearance of the mature plants is different. This is due to the fact that in addition to the normal method of branching by dichotomy (brought about by the loss of activity of the primary growing region and the subsequent initiation of two lateral ones) the sexual plants show a rich development of proliferations induced by the shedding of the sexually fertile shoots after maturity, the reproductive organs having brought about considerable disintegration of their tissue. The anatomical dimorphism observed by Howe is shown to depend on very early differentiation just below the growing region, resulting in the production of an extra layer of cells in the cortex of the tetrasporic plants. Secondly, with regard to the reproductive organs, the spermatangia are exceptional in that they are produced in cavities but the three-celled carpogonial branch is normal. Thirdly, the carposporophyte shows various features worthy of note in that it has no pericarp and no paraphyses, and to quote Svedelius: "After fertilization, the diploid nucleus either enters directly into the hypogynous cell (*G. corymbifera*) or first divides in the carpogone itself, after which the daughter nuclei migrate into the different inferior cells (*G. Diesingiana*). In the emigration of the fertilized nucleus from the carpogone, *Galaxaura* corresponds with *Scinaia* and *Chætangium*, but differs from these genera in an important respect: no immediate reduction division occurs in *Galaxaura*." After entering the lower cells, the diploid nuclei divide rapidly and enter all cells of the branchlets of the carpogonial branch. Gonimoblast filaments arise from any cell containing diploid nuclei, some being stoloniferous in nature and giving rise to secondary centres of gonimoblast development. Fourthly, reduction division is shown to occur in the tetrasporangia of *G. Diesingiana* and *G. tenera* and a new classification of the genus into three sections, based on the position of the tetrasporangium, is suggested.

The main interest of the work under review lies in the fact that the earlier contention of Svedelius[8] that the *Polysiphonia*-type must have originated from the *Nemalion*-type by a postponement of reduction division is now borne out by the data submitted for these species of *Galaxaura*. A second conclusion is that, as he rightly insists, the "haplobiontic organization" must not be considered a fundamental character of the Nemalionales as it has been in the past, nor made the fundamental basis for the distinction of main groups. Thus, on a basis of a reclassification of the Chætangiaceæ according to the structure and development of the cystocarp, he is able to conclude that the "diplobiontic organization" has arisen on different occasions in this family, just as heterospory is known to have originated along different lines of descent in the Pteridophyta.

Svedelius states that the whole carpogonial branch of *Galaxaura* "can be comprehended as a compound auxiliary system", and the argument regarding the application of the term 'auxiliary cell' (originally defined by Schmitz on limited knowledge) is revived. Svedelius maintains that the term even as redefined by Kylin on various occasions is applicable to certain Nemalionales and that the restriction of the term 'typical auxiliary cell' to four orders is arbitrary and obscures the evolutionary relationships between the different types. In reply, Kylin[9] while ceding that Wilke and Ziegenspeck's[10] term 'Karpogonauxiliaren' is applicable to certain of the Nemalionales, will not admit any evolutionary connexion between such a structure and his "typische Auxiliarzelle", which can never occur in a carpogonial branch as it is dependent on the establishment of contact with a fresh food channel. It is clear that whatever the terminology used, there is considerable variety in the earliest post-fertilization nuclear changes in the Nemalionales. However, since the auxiliary cell is one of the most fundamental characteristics of the Florideæ, it is desirable that the terminology used should be generally accepted. With this in view, it would seem best to keep the term 'auxiliary cell' for general use to cover all cells which directly or indirectly receive the fusion nucleus or its derivative, either haploid or diploid, from the carpogonium and is also the starting place for gonimoblast development. Each type might then receive a qualifying prefix, although 'typical' seems unsuitable in this connexion. At present it includes four types, which are as different from one another as any of these are from the carpogonial auxiliary cell.

The Nemalionales is clearly not the uniform order it was once thought to be and further investigations are greatly to be desired. In this connexion, brief reference should be made to a note by Kylin[11] describing the rearing of young plants of *Bonnemaisonia asparagoides* from carpospores, which on germination give rise to a branched protonema. This stage was previously identified by J. and G. Feldmann[12] as *Hymenoclonium serpens* (Crouan) Batters and it was stated to bear tetrasporangia. While agreeing that the first assumption may be correct, Kylin maintains that the tetrasporangia are in reality only end cells which have started to divide by oblique walls typical of the adult axis. Thus in Kylin's opinion, there are only two somatic phases in the life-history, the gametophyte and the carposporophyte. However, in the parallel case of *Asparagopsis armata*, the evidence presented by the Feldmanns[13] favours the view of three independent somatic phases, the *Falkenbergia rufolanosa* being the tetrasporophyte. Conclusive evidence in the form of cytological and further cultural investigations is awaited.

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