ent fiscal year began with its reduced appropriations. The estimated expenditures for experiment and scientific research in the field of agriculture were $13,898,047 for the year which ended on June 30, 1933. This was a reduction of $2,434,930, or nearly 15 per cent. below the amount devoted to this work in the year previous. These figures were prepared by the U. S. Department of Agriculture at the request of the United States Senate, and are now given in the report just made public as a Senate Document. More than 70 per cent. of this "saving" was in compensation to the personnel working on scientific investigation. Altogether $1,741,552 was taken from the salary checks of workers on scientific projects—$1,188,856 being in the form of the general federal pay cut, and the remainder, about half a million dollars, representing amounts saved through administrative furloughs and dismissals. Altogether 567 workers on scientific projects were dismissed from the Department of Agriculture.

DISCUSSION

SOME ERRONEOUS AGE RECORDS OF PALEOZOIC PLANT GENERA

FIFTY years ago the statement that Welsh anthracite coal is characterized by its very low ash (3 per cent.) was still to be found in authoritative textbooks. This glaring misrepresentation, now only too obvious to most householders using anthracite from any source, has only in very recent years passed wholly out of common belief, but the erroneous theory, associated with and apparently founded, in part at least, on it, that anthracite was formed from vegetation different from that composing other coals, is still deep-rooted in many quarters. The ghost of a false record often haunts the literature for a generation or more after it has been exorcised by the specialists in the particular field to which it pertains. The purpose of this paper is to "lay" several ghosts of error relating to the geological range of certain genera of Paleozoic plants.

The genus *Taeniopteris* is nearly everywhere if not wholly confined to strata as young as Permian, of which it is characteristic, though it has a wide Mesozoic range. The plant described by me[1] as *T. missouriensis* is bipinnate and a *Desmopteris*. *Taeniopteris* is simply pinnate and petiolate. Zeiller's *T. jejunata*[2] goes out of the genus for the same reason. Lesquereux's *T. truncata*,[3] from the Allegheny, is a pinnule of *Neuropteris hirsuta* in every detail; the apex is folded backward incidental to burial. His *T. smithii*,[4] of unknown locality and stage, is probably a fragment of *Cannophyllites*, the geological level (upper Pottsville) of which was the source of most of the plants in Dr. E. A. Smith's collection.

Walchia antecedens Stur[5] from the Ostrau culm is a Lycopod, probably a *Lepidodendron*, lacking all diagnostic features of *Walchia*, which seems to have made its appearance in the latest Stephanian, notwithstanding Kidston's identification[6] of what is undoubtedly a leafy twig of *Lepidodendron*, from the Staffordian (Upper Westphalian) of Great Britain, as *W. imbricata*.

Most paleontologists know, though not all lay writers are informed, that the plant-bearing beds ("Fern Ledges," "Little River group," "Cordaites sandstones," etc.) in the vicinity of St. John and Lepreau, New Brunswick, from which C. F. Hartt, Sir William Dawson and G. F. Matthew described species of *Annularia, Asterophyllites, Palaeostachya, Sphenophyllum, Calamites, Callipteris, Neuropteris, Odontopteris, Cardiopteris, Aneimites, Megalopteris, Alethopteris, Pecopteris, Cordaites, Antholithus, Whittleseya* and *Trigonocarpum*, together with Matthew's genera *Ginkgophyton, Johannophyton, Lepidocalamus, Pseudobaiera* and *Ramicalamus* as Devonian, even Middle Devonian when not Silurian, are now unshakably proved Pottsville (Westphalian) in age. Similarly, the flora, once supposed Mississippian, from Rushville, Ohio, embracing *Alethopteris, Megalopteris* (name antedated by *Cannophyllites* Ad. Brongn.), and *Orthogoniopteris*, as described by Andrews, is of upper Pottsville age. Of these genera from New Brunswick and Rushville all except *Cardiopteris, Aneimites, Neuropteris, Calamites, Cordaites, Antholithus, Trigonocarpum* and *Sphenophyllum* are unknown below the Pennsylvanian. *Aneimites* is present in basal Mississippian. *Cardiopteris eriana* Dawson probably represents interpinnate rachial pinnules of a plant belonging to the *Neuropteris gigantea* stock. *Cardiopteris* proper is a Mississippian genus characteristic of the Chester. *Callipteris pilosa* Dawson is a *Sphenopteris*, as was noted by Stopes; *Callipteris* proper is the most wide-spread and characteristic genus of the Permian.

On the other hand, the plant from Rushville described by Andrews as *Archæopteris stricta*, which so far as found is a strictly upper Pottsville species,

[1] D. White, *Bull. Geol. Soc. Amer.*, 4: 119, pl. 1, 1893.
[2] C. Grand 'Eury, "Fl. carb. Loire," p. 121, 1877; R. Zeiller, "Fl. foss. bassin Commentry," Pt. 2, p. 280, pl. 22, figs. 7–9, 1888.
[3] L. Lesquereux, "Coal Flora," Vol. 3, p. 743, pl. 94, fig. 8, 1884.
[4] L. Lesquereux, *op. cit.*, Vol. 1, p. 153, pl. 15, fig. 7, 1880.
[5] D. Stur, "Culm Flora," p. 80, pl. 17, fig. 7, 1875.
[6] R. Kidston, *Trans. Roy. Soc. Edinb.*, Vol. 35, p. 324, pl. 35, fig. 9, 1888; *Proc. Geol. Polytechn. Soc. Yorksh.*, Vol. 14, p. 368, pl. 63, fig. 1, 1902.

has not yet revealed the frond structure characteristic of *Archæopteris,* which is typically upper Devonian the world over. Dawson's *Psilophyton* (?) *glabrum,* from the "Fern Ledges" at St. John, has after examination been referred by Stopes to *Dicranophyllum. Psilophyton* seems to have a rather extended vertical range in the Devonian.

The trunks from the Hamilton, at Gilboa, New York, described by Dawson as *Caulopteris* and *Psaronius,* lack the distinctive features of those genera, which, furthermore, seem to have borne Pecopterid fronds and to be confined to formations of Pennsylvanian and Permian age. The Gilboa trunks are, on the contrary, associated with, and, if I am not mistaken, belong to the trees described by Goldring as *Eospermatopteris.*

Sphenophyllum, the name of another genus unknown in rocks earlier than Carboniferous, was without warrant applied by Lesquereux[7] to a minute fragment, apparently algal, from the Silurian at Covington, Ky. The pre-Carboniferous record should be deleted.

The genus *Idiophyllum* (monospecific; *I. rotundifolium*) was founded by Lesquereux[8] on a single specimen of *Neuropteris,* probably *N. rarinervis* Bunbury, in circinate vernation. On the basis of the misleading figure in the "Coal Flora," in which the ultimate divisions of the rachis are drawn as lateral nerves, the name *Idiophyllum* was penciled by Schenk, in some at least of the copies of his Chinese flora distributed by him, in place of the printed *Megalopteris* Schenk (preoccupied by *Megalopteris* Hartt). Later he substituted a second name, *Gigantopteris,* by which the plant from the lower Permian is still known.

The generic correlation of the wide-spread Gondwanaland plant *Dancæopsis hughesi,* present also in the Permian of the Far East, with Lesquereux's *Protoblechnum,* which it resembles, is evidently untenable, the Asiatic frond being dichotomous in structure, while *Protoblechnum* has a straight, undivided and broad petiolate frond. The American genus is probably confined wholly to the Pottsville, though it is apparently closely related to Sellards' *Glenopteris*[9] from the Permian of Kansas.

Callipteridium sullivantii Lesquereux, from the Appalachian Allegheny, is Alethopteroid in general features, including its architectural plan. In America the genus *Callipteridium* as now defined is very rare and has not been found in beds older than Conemaugh. In fact, most of the Dunkard plants referred to it are unquestionably Pecopterids; some may be *Cladophlebis.*

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[7] L. Lesquereux, *Proc. Am. Phil. Soc.,* Vol. 17, p. 167, pl. 1, figs. 3–5, 1877.

[8] L. Lesquereux, *op. cit.,* Vol. 1, p. 160, pl. 13, fig. 11, 1880.

[9] E. H. Sellards, *Kans. Univ. Quart.,* Vol. 9, ser. A, p. 180, 1900.

A STARCHLESS POTATO INDUCED BY THE INTRODUCTION OF FOREIGN ENZYMES

Following on a series of recent researches carried out in the laboratory of one of us (H. H.) relating to the synthesis and structure of polysaccharides from common sugars by bacterial action, such as levan obtained by the action of *B. subtilis* and *B. mesentericus,* dextran by the aid of *Leuconostoc dextranicus* and *mesenterioides* and cellulose by the use of *Acetobacter xylinus,* the possibility suggested itself of bringing about a change in physiological characteristics through the introduction into the growing plant of foreign bacteria or their corresponding enzymes with a resulting change in the nature of the polysaccharide formation. Previous investigations have established the structure of levan as a polymerized 2, 6-fructofuranose anhydride, so that a very close relationship exists between this polysaccharide and that formed in the Jerusalem artichoke, namely, inulin, which is known to be a polymerized 1, 2-fructofuranose anhydride.

In view of the similarity in structure of the artichoke and the common potato plant, the idea was conceived of introducing into the latter during growth, through the main stem, the levan enzyme, or its corresponding bacterial culture, with a view to bringing about the replacement of the starch in the potato tuber by another polysaccharide.

Young potato plants about 5 to 6 weeks old (10 to 12 inches high) were taken for this purpose. The tip of the main stem was removed and the bacterial culture (*B. subtilis*) was introduced by means of an attached tube. The treatment was repeated at intervals of several days for two and one half months.

From four plants out of about 30 investigated there was obtained a new type of potato, namely, one practically free from starch as indicated by the entire absence of any color on placing a section in iodine solution, except for a peripheral ring of tissue about one eighth of an inch wide.

These results would seem to establish the possibility of bringing about a change in the physiological characteristics by the external introduction of a foreign enzyme or bacterial culture into the growing plant.

The experiments are being continued with a view to ascertaining the reproducibility of such, and the effect of introducing a variety of other bacterial cultures into the potato and other plants is being investigated.