Petromyzon appear to have no homology with these larval ganglion cells.* The proof of this statement is impossible without figures. I hope to show, in a fuller paper on the early development of the central nervous system, that in *Scyllium* giant ganglion cells are developed in deeper portions of the spinal cord, and that these cells have exactly the situation and characters of the well-known giant ganglion cells of *Amphioxus*.†

In the same sections of *Scyllium* embryos the two sorts of cells can be seen; the one deeply situated in the cord, and with well developed processes, the other outside the nervous system, and greatly degenerated.

I will here only remark that I cannot support Mayer's conclusions‡ as to the fate of these giant ganglion cells, and defer a discussion of his views until I have followed the history of these cells in *Petromyzon*.

I may here point out, however, that Kleinenberg§ appears to me to have been quite right when he suspected that the cells described by Mayer might be analogous to certain sub-umbrellar ganglion cells in the larva of *Lopadorhynchus*, which "introduce" the development of the ventral cord: and that, just as in the Annelid, the development of the vertebrate central nervous system would appear to have been initiated by a larval nervous apparatus outside the same. I propose to discuss this question in a future paper.

V. "The Assimilation of Carbon by Green Plants from certain Organic Compounds." By E. HAMILTON ACTON, M.A., Fellow of St. John's College, Cambridge. Communicated by W. T. THISELTON DYER, C.M.G., F.R.S. Received April 20, 1889.

(Abstract.)

The recent synthesis of a true glucose ("Acrose")|| by Fischer and Tafel, and additions to our knowledge of the structure of dextrose and lævulose by Kiliani,¶ &c., seem to render desirable fresh experiments on the synthetical production of carbohydrate in green plants from sources other than CO_2 (*i.e.*, from organic compounds in which C is already combined with H and O).

* The homology of the giant ganglion cells described by Fritsch in *Lophius* is doubtful.

† *Vide* the excellent figure (fig. 143) in Hatschek's 'Lehrbuch der Zoologie,' p. 138. Probably *Amphioxus* possesses a transient or larval nervous apparatus.

‡ *Op. cit.*, p. 229.

§ N. Kleinenberg: "Die Entstehung des Annelids aus der Larve von Lopadorhynchus." 'Zeitschr. Wiss. Zool.,' vol. 44, pp. 220–221.

|| 'Deutsch. Chem. Ges. Berichte,' vol. 20, pp. 1088, 2566, 3384.

¶ *Ibid.*, vol. 19, p. 221.

Papers have been published by A. Meyer and E. Laurent* dealing with this question.

A. Meyer has shown that the leaves of green plants can form starch when supplied with solutions of glucose, saccharon, mannite, inulin, glycerin. E. Laurent has confirmed this observation for glycerin.

A. Meyer has shown that starch is not formed from solutions of raffinose,† inosite, erythrite, dulcite, trioxymethylene, aldehyde (acetic); and Wehmer‡ that starch is not produced from formic aldehyde or formose.§

The method used by these observers|| is placing leaves which have been deprived of starch by keeping in the dark in solutions of the substances, and testing for starch after a certain interval of exposure to daylight.

I have used "culture" experiments, and in most cases removed the starch at first present in tissues, not by keeping in the dark, but by placing in a receiver, the air of which is completely deprived of CO_2 by KOH and soda-lime.

Sachs's method of testing for starch was generally used, but in most cases also supplemented by direct microchemical observations.

The experiments fall mostly under three headings—

1. Experiments with shoots.
2. Experiments with entire plants, the carbon compounds being supplied to the roots.
3. Experiments with shoots of "water-plants."

In all cases the plants or shoots were placed in a "culture liquid" whilst being completely deprived of starch, and then transferred to another portion of the same culture solution to which the carbon compound had been added in known quantity. The "culture liquid" used was composed as follows:—

Distilled water	100 grams.	KNO_3	0·15 gram.
$MgCl_2$........	0·10 ,,	$Ca_3(PO_4)_2$	0·05 ,,
$FeSO_4$	0·025 ,,	$CaSO_4$	0·05 ,,

* Both in 'Botan. Zeitung,' 1886. Meyer's paper gives an account of previous work on this subject.

† Details as to constitution of these compounds and their relations to glucoses are given by Tollens, 'Handbuch der Kohlenhydrate,' Breslau, 1886.

‡ 'Deutsch. Chem. Ges. Berichte,' vol. 20, p. 2614.

§ Quite recently Fischer and Loew have independently shown that formose is a complex mixture, but that it contains a small quantity of a true glucose—probably "acrose." Loew states that this polymerisation only occurs with dilute solutions of the aldehyde ('Deutsch. Chem. Ges. Berichte,' vol. 22, 1889, Nos. 3, 4). Compare also on this point Tollens, *loc. cit.*, p. 250—252.

|| *Vide* 'Botan. Zeitung,' *loc. cit.*

The shoots or plants in this liquid were placed under a bell-jar, so arranged as to exclude all possibility of entry of CO_2 from surrounding air during the experiments, but to allow a free circulation between the air in bell-jar and external atmosphere: this is effected by tubes introduced through the india-rubber stopper of bell-jar communicating with the outside through soda-lime U-tubes. Several capsules of soda-lime and cylinders of strong KOH solution were placed under the bell-jar to absorb any CO_2 given off by respiration.

In No. 2, special precautions were taken to prevent any CO_2 evolved from roots finding its way to the leaves.

In No. 3, the same result was obtained by the addition of barium acetate to the solution in which the plants were immersed. The apparatus was less complex in this case.

In all the experiments, provision was made that the air in confined spaces might be in free communication with external atmosphere (to admit free supply of oxygen), but always by passage through soda-lime U-tubes.

The plants used were not selected for any particular reasons beyond the fact that a good supply of them was conveniently at hand during the progress of these experiments. They were for No. 1, shoots (cut branches)—

Acer pseudo-platanus, L.
Ranunculus acris, L.
Tilia Europæa, L.
Alisma plantago, L.
Phaseolus vulgaris, L.
Cheiranthus cheiri, L.
Scrophularia aquatica, L.

For (No. 2) whole plants, seedling plants of—

Acer pseudo-platanus, L.
Phaseolus multiflorus, L.
Quercus robur, L.
Euphorbia helioscopia, L.
Phaseolus vulgaris, L.
Cheiranthus cheiri, L.
Campanula glomerata, L.
Epilobium hirsutum, L.

For (No. 3) water-plants, shoots of—

Anacharis alsinastrum, Bab.
Sparganium natans, Bab.
Chara vulgaris, L.
Callitriche aquatica, Sm.
Fontinalis antipyretica, L.

The substances (carbon compounds) used in all cases (1) and (2) in some cases also (3) were acroleïn, acroleïn-ammonia, acroleïn compound with acid sodium sulphite ($NaHSO_3.C_3H_4O$), allyl alcohol, glucose (partly quantitative), acetic aldehyde, aldehyde (acetic) ammonia, glycerin, lævulinic acid, calcium lævulinate, saccharon (cane-sugar, partly quantitative), inulin,* dextrins, soluble starch, glycogen,

* The inulin was free from glucoses, but it is doubtful whether it was really pure.

"extract of natural humus," the "humus-like" product obtained by the action of alkalis on saccharon. The results of these experiments may be tabulated as follows :—

Starch is formed when the compound is supplied either directly to the shoots or through the medium of the roots, with glucose, saccharon, glycerin,* inulin.† (A. Meyer's observation for "supplied to shoots.")

Starch formed when compound is supplied directly to the leaves, but *not* when supplied to the roots, with "soluble starch."

Starch formed when compound is supplied to the roots, but not when directly supplied to the leaves, with "extract of natural humus."

Starch not formed at all from acroleïn, acroleïn-ammonia, compound of acroleïn with $NaHSO_3$, allyl alcohol, aldehyde, aldehyde-ammonia, dextrin, glycogen, lævulinic acid, calcium lævulinate, "artificial humus substance."

That glucose is more readily taken up by the roots of plants from 0·5 per cent. solution than saccharon.

That the roots of plants can withdraw all the glucose from a 1 per cent. solution if they be left in the solution for a sufficient length of time, and the plants remain healthy.

The conclusions I should draw from these experiments are: That green plants cannot normally obtain carbon for assimilation from organic substances except carbohydrates or closely related bodies, not from aldehydes or their derivatives, and not even from all carbohydrates.

That a compound may be a source of carbon when supplied to the leaves but not when supplied to the roots, and *vice versâ.*

That green plants, owing to the normal process of obtaining carbon being from CO_2, have, to a large extent, lost the power of using organic compounds as a source of carbon. (Parasitic and saprophytic plants, especially fungi, undoubtedly do always obtain their carbon from complex organic compounds.)

That many (? all) green plants behave in the same manner towards the substances enumerated as regards formation or non-formation of starch. (Contrast in this respect with fungi, which are often characterised by decomposing special substances.)

That if a single substance of an aldehydic or ketonic nature is formed by plants as an intermediate product between CO_2 and H_2O and glucose (or starch), it can only be polymerised by the plant under special conditions, probably at the moment of formation.

* When glycerin was supplied to the roots in solutions stronger than 10 per cent. starch was not found.

† *Vide* note above.