than the body of the cigarette). If the cigarette is shaken up and down, the tip will appear to separate itself from the body and dance up and down separately, being 180° out of phase at certain frequencies. Shaking the cigarette longitudinally will cause an apparent periodic change in length. The existence of the effect apparently indicates a threshold in the visual process that is more quickly reached by a large amplitude transient than by a small one.

Thus, to introduce an apparent retinal disparity in a movie of a rotating object, a person need only cover one eye with a neutral filter. Translation will also bring objects out from the background and shift one's angle of view to give depth. Owing to the color-sensitive transient build-up of retinal response, it might be possible to equalize approximately intensities with different colored filters before the two eyes and still have the effect (cf. Fechner Colors, for example, the Benham Top) while viewing monochrome movies. A red filter might be considered to dark adapt one eye (*4, 5*) alone. If the wrong eye is covered, for the existing direction of motion, an unfamiliar scene can appear turned inside out (pseudoscopy). In terms of the filter density, one can calculate the proper angular velocity that the body must have in order to give a normal effective interocular separation (realistic depth). For example, if the difference in time delay from the two eyes is 0.025 sec and the object is 12 ft away from the camera, it should be turned at about 1 rev in 8 sec. Objects in the scene that are turning faster will have their structure magnified in deepness, and vice versa. Circling by the camera can also augment or produce this effect. Apparent depth is inversely proportional to camera distance if the latter is not constant. A darker filter would be appropriate with slower turning, or with slow-motion projection.

It might be noted that the time difference over a given scene is probably not exactly constant, because of a lack of linearity in the dependence of time delay on apparent brightness, but this does not noticeably distort depth. In fact, if the ambient illumination in the swinging-pendulum experiment is altered, the path seems relatively unchanged, thus indicating a reasonable degree of linearity over the range. The fact that the system works indicates that this dependence applies "point by point" within one field of view. Probably these time delays are too short to be effective for movies in general, but in experimental situations the method is convenient. To transmit a 3D television image by this means, it might be better to follow the receiver by a separate cathode-ray tube for each eye and have one tube receive its signal via a delay line. Unlike other systems, band width need not be doubled (just as the previous did not require twice as much film).

A variable density goggle would allow the performance of inexpensive experiments in continuously variable effective ocular separation. It can be observed that whenever a person places a filter before one eye while watching a rotating real object directly, he varies his effective interocular distance. An easy way to demonstrate the movie effect is to watch, with one eye filtered, a ground-glass camera image of an object on a low-speed phonograph turntable. Three-dimensional or depthy shadows can be cast on a flat wall by rotating an object before a point source of light and viewing the shadow in this manner. (In the case of the aforementioned pendulum, it is obvious that the shadow will jump through and off the wall—that is, travel along the path that the pendulum itself would appear to follow). An interchange of filter position will alter the apparent sense of rotation. Without a filter (the density range 0.3 to 1.0 is suitable), a rotating shadow is completely ambiguous. The foregoing method not only is a way to put true binocular "3D" into many single movies (colored or monochrome) by a simple subsequent process, but it exemplifies quite a general method for coding and decoding two channels of certain types of information into one by a form of repetitious time-modulation.

References

1. G. L. Walls, *J. Opt. Soc. Amer.* **32**, 693 (Nov. 1942).
2. University of Rochester Staff, *J. Am. Med. Assoc.* **135**, adv. p. 27 (Oct. 27, 1953).
3. C. Pulfrich, *Naturwiss.* **10**, 553, 569, 596, 714, 735, 751 (1922).
4. A. L. Sweet, *Am. Psychologist* **4**, 230 (1949).
5. M. L. Rock and B. H. Fox, *Am. J. Psychol.* **62**, 279 (1949).

February 17, 1954.

Incorporation of C^{14} into Various Carbohydrates of Tobacco Leaves after Different Periods of Photosynthesis in $C^{14}O_2$*

P. V. Vittorio, G. Krotkov, and G. B. Reed

Departments of Biology and *Bacteriology, Queen's University, Kingston, Ontario*

In the numerous recent studies on the path of carbon during photosynthesis, attention has been paid mainly to various soluble compounds, while the role of starch has been neglected. Moreover, in an attempt to find the first compound into which carbon is incorporated, the tendency has been to cut down the time of photosynthesis to as short a period as possible. It appeared desirable, therefore, to follow incorporation of carbon from CO_2 in a starch-producing plant and to extend the observed duration of photosynthesis to several hours. The present experiments were performed with this object in mind.

Nicotiana tabacum plants (variety Connecticut seed leaf) were placed in darkness for 8 hr to deplete their starch content. Then after 2 hr of illumination a large number of 1-in. leaf disks were punched and strung on 10 nylon strings, 10 disks per string. The disks were placed on wet blotting paper at the botton of an 8-liter desiccator, where according to preliminary tests each disk received a constant supply of water.

* This study was made with financial assistance from the National Research Council of Canada and the Charles F. Kettering Foundation.

Table 1. Total activities of starch and sugars isolated from tobacco leaves after different periods of photosynthesis in $C^{14}O_2$.

Feeding time* (min)	Total activity (10^3 counts/min)	
	Sucrose, glucose, and fructose	Starch
20	0	0
1	0	3.48
2½	0	40.5
5	176	306
10	633	642
15	1,730	Sample lost
30	4,290	2,140
60	8,410	4,680
180	15,500	30,000
360	51,900	165,000

* The 20-min feeding period took place in the dark; all other feeding periods were in light.

After 15 min in darkness the desiccator was filled with 5-percent $C^{14}O_2$ and the dark period was continued for another 20 min.

At the end of this time a sample, consisting of one string of 10 leaf disks, was removed and killed in boiling 80-percent ethanol. The photosynthetic chamber was then illuminated, and successive samples were taken at the time intervals noted in Table 1.

The glucose, fructose, and sucrose from the ethanol extracts were isolated by paper partition chromatography, and after radioautography their total and specific activities were determined as described elsewhere (*1*).

The starch in the ethanol insoluble residue was extracted with perchloric acid, precipitated with iodine, and purified, and its total and specific activities were determined (*1*). Two experiments were carried out with 1 and 3 millicuries of C^{14}, respectively. Since the results of both were essentially the same, only those for the 3-millicurie feeding are given.

Table 1 shows that activity appeared in the "starch" fraction before it did in sugars. Since the technique used did not separate starch from the dextrins, which might be present, the activity observed in this fraction could really be in dextrins. Gibbs observed that in illuminated sunflower leaves uniformly labeled glucose appeared in dextrins before it did in sucrose (*2*). However, whether this activity is in dextrins or in starch, C^{14} appears in a polysaccharide before it does in sucrose, glucose, or fructose.

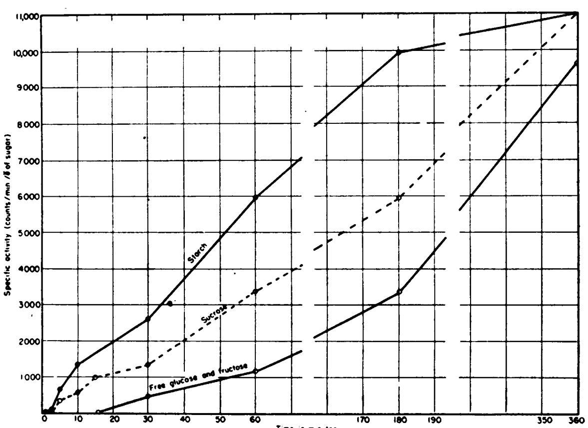

Fig. 1. Specific activities (counts/min) of starch (top curve), sucrose (middle curve), free glucose and fructose (bottom curve) isolated from tobacco leaves after different periods (min) of photosynthesis of $C^{14}O_2$.

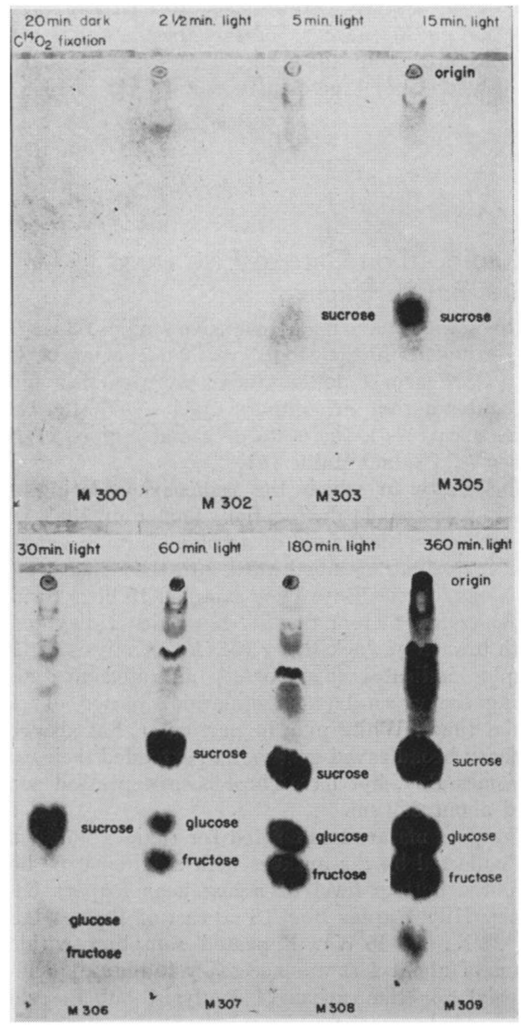

Fig. 2. Incorporation of C^{14} into sugars after different periods (min) of photosynthesis in $C^{14}O_2$.

If the total activity in the "starch" fraction is compared with that of the sucrose, glucose, and fructose, one can see that at first it is higher in the starch. After 30 min more, activity is higher in the sugar fraction; but after 3 hr of photosynthesis the starch fraction is again higher.

Figure 1 shows that up to 3 hr of photosynthesis the specific activity of the starch is consistently higher than that of sugars, while at the end of 6 hr all the specific activities are about equal. At this point the specific activities of the carbon in the starch and sugars are approximately equal to that of the carbon fed.

Figure 2 shows the radioautographs obtained from the ethanol extracts. The activity first appeared in sucrose and only later in fructose and glucose. This is in agreement with the results obtained by Calvin and Benson (*3*). The fructose and glucose are in approximately equal amounts and contain about the same total activity. Hydrolysis of sucrose revealed that the specific activity of the glucose and fructose moieties are about the same. This suggests that the free glucose and fructose are formed by sucrose hydrolysis. It is interesting to note that in every case the fructose was as abundant as the glucose.

From the results obtained, it is evident that in tobacco leaves during photosynthesis, carbon from CO_2 appears in the "starch" fraction before it does in sugars. This observation brings back to us an old idea of Sachs, that starch is the first visible product of photosynthesis.

References

1. P. V. Vittorio, G. Krotkov, and G. B. Reed, *Can. J. Botany* **32**, 369 (1954).
2. M. Gibbs, *Plant Physiol.* **26**, 549 (1951).
3. A. A. Benson and M. Calvin, *Ann. Rev. Plant Physiol.* **1**, 25 (1950).

January 25, 1954.

Communications

A Radiocarbon Date of Peat from James Bay in Quebec

The authors have made extensive studies of bog and lake sediments in the Mont Tremblant region of Quebec (*1*). Previous pollen studies were carried out by the senior author in southern Quebec (*2*), the Great Lakes area (*3–5*), the eastern coastal regions of New Jersey (*6, 7*), and Maine (*8*).

The study to which the radiocarbon-dating contributed was made during the summer of 1953 when the authors, with the aid of airplane service, extended their investigations northward into the wilderness regions near James Bay. They sampled 19 bogs forming a line transect from the St. Lawrence valley to the north branch of Jack River (52°N). Analysis of these samples indicates that forests migrated northward during the warm-dry (xerothermic) period of postglacial times. White pine in particular, but also some southern broadleaved genera, had extended their range to James Bay, but have since been depressed southward about 350 mi.

The peat material submitted for radiocarbon dating was collected by the authors with a Hiller-type borer from the bottom level of a bog near Rupert River, Smoky Hills Rapids Bog, 18 mi east of Rupert House (51°28′N; 78°45′W). Repeated sampling within a radius of about 4 ft was necessary to obtain sufficient material for the carbon-14 analysis, but the sharp contrast between the earliest organic deposits and the rock flour bottom sediments facilitated the securing of these multiple samples at a uniform level.

The samples thus obtained were submitted to the Lamont Geological Observatory for carbon-14 determination. Dr. J. Laurence Kulp reported an age determination of 2350 (±200) yr as marking the beginning of deposition of organic matter and doubtless of upland occupation by forests (*9*). During this 2350-yr period the shallow lake (10 ft) has filled in completely. Also, during this period the climate has cooled and become more humid. The change in climate very likely contributed to the establishment of the muskeg condition which favors a forest composed chiefly of black spruce (*Picea mariana*). At the present time the forest distribution is black spruce on muskegs and Jack pine in dry-rocky habitats. Observations from the plane show that much of that vast wilderness region is still in the formative period of forest development, with black spruce barely invading the muskegs.

J. E. Potzger
Albert Courtemanche
Department of Botany, Butler University
Indianapolis, Indiana
Service de Biogéographie
Université de Montréal, Canada

References and Notes

1. J. E. Potzger and A. Courtemanche, *Can. J. Botany*, in press.
2. ———, *Can. J. Botany* **31**, 383 (1953).
3. ———, *Butler Univ. Botan. Studies* **8**, 161 (1948).
4. ———, *J. Forestry* **51**, 560 (1953).
5. I. T. Wilson and J. E. Potzger, *Ecology*, **24**, 382 (1943).
6. J. E. Potzger and J. H. Otto, *Am. J. Botany* **30**, 83 (1943).
7. J. E. Potzger, *Bartonia* **26**, 20 (1952).
8. ——— and R. C. Friesner, *Butler Univ. Botan. Studies* **8**, 178 (1948).
9. Recording number of the dating of the peat sample is Lamont No. 219.

April 22, 1954.

An Ethical Problem for Scientists in a Divided World

It is a sad fact that quacks and impostors arise from time to time to prey upon science. Sometimes they are merely a nuisance, but occasionally they become dangerous. The Lysenko scandal in the U.S.S.R. is the most shocking recent instance which has secured international notoriety. It belongs to the dangerous variety, and it would seem that exposing its true nature is a manifest responsibility of scientists competent to do so.

Responsibilities and ethics have, however, become blurred in our divided world. Several colleagues, both biologists and nonbiologists, have argued, in conversations, that nothing should be done that might weaken the domination of the biological sciences in the U.S.S.R. by Lysenko and his followers. Some have