academy were arranged by Russell L. Poor, chairman of the Geology Department, Birmingham-Southern College, for Saturday. Much of interest was revealed in the Red Mountain and Shades Mountain regions, in the blast furnaces and coke ovens, as well as in the beautiful residential areas of Mountain Brook and the Country Club.

Reports of special interest at the business session were made by John Xan, Howard College, Birmingham, treasurer; J. H. Coulliette, Birmingham-Southern College, councilor of the American Association for the Advancement of Science, and E. V. Jones, Birmingham-Southern College, editor of the journal. Three new committees functioned for the first time. These were: (1) Committee on Promoting Membership and Activities, Walter B. Jones, *chairman;* the Committee on Research, S. J. Lloyd, *chairman;* and (3) the Committee on Publication, under the chairmanship of E. B. Carmichael, of the Medical School, University, with the editor serving as *ex-officio* member.

The American Association for the Advancement of Science grant-in-aid of research was renewed for another year to J. Allen Tower, Birmingham-Southern College, for continuation of his work on the "Preparation of an Atlas and a Geography of Alabama." The committee was composed of the president-elect, C. M. Farmer, chairman, and the four vice-presidents. Two honorary members were elected, namely, Wright A. Gardner, Auburn, founder of the academy, and John Y. Graham, for forty-two years chairman of the department of zoology at the university, who retired last year, now emeritus professor of zoology. The members voted to establish an academy statistician, a permanent director of exhibits and demonstrations and to expand the sections to seven, including Physics and Mathematics in a separate section from Chemistry, and adding one on Geography, Conservation and Allied Subjects and one on the Teaching of Science. James L. Kassner was retained for one more year as acting permanent counselor of the Junior Academy, to be assisted by two academy members. Sustaining memberships were acted upon favorably, as was a suggestion by the president that steps be taken at the next annual meeting to organize a Southeastern Scientific Society. The academy received an invitation to meet with Howard College in 1942 in connection with the Centennial Celebration of that school. The 1941 meeting will be held at Spring Hill College, Mobile. Following the report of the various committees and the expression of appreciation to the officers and the host college upon the completion of business, the meeting adjourned.

New officers for 1940–1941 were elected as follows: *President,* C. M. Farmer, State Teachers College, Troy; *President-Elect,* Paul D. Bales, Howard College; *Vice-Presidents* and *Section Chairmen,* H. D. Jones, Biology and Medical Science, Alabama Polytechnic Institute, Auburn; Lindsey M. Hobbs, Chemistry, University; David L. DeJarnette, Geology, Anthropology and Archeology, Alabama Museum of Natural History, University; J. Allen Tower, Geography, Conservation and Allied Subjects, Birmingham-Southern College; W. A. Moore, Physics and Mathematics, Birmingham-Southern College, and Claustie E. McTyeire, The Teaching of Science, Hueytown High School, Bessemer. The chairman of Industry and Economics is to be appointed. Miss Winnie McGlamery, Geological Survey, University, was selected as secretary to succeed the present secretary, who has served for five years. J. H. Coulliette, Birmingham-Southern College, councilor of the American Association for the Advancement of Science, was reelected. The terms of office of the treasurer, John Xan, Howard College, and of the editor, E. V. Jones, Birmingham-Southern College, continue for one and two more years, respectively.

SEPTIMA C. SMITH,
Secretary

SPECIAL ARTICLES

TIME COURSE OF PHOTOSYNTHESIS AND FLUORESCENCE

WHEN a plant is exposed to light after a dark period, photosynthesis (as measured by uptake of CO_2) gradually comes to its full rate during a short interval called the induction period. Changes in intensity of the fluorescence of chlorophyll of the plant during this time have been interpreted[1] in terms of photochemical processes. Experiments are in progress in the Division of Radiation and Organisms of the Smithsonian Institution for the simultaneous measurement of the rate of uptake of CO_2 and intensity of fluorescence during the induction period.[2] These measurements confirm the usefulness of fluorescence observations as a tool in the study of photosynthesis.

The rapid spectrographic method of CO_2 measurement previously used[3] has been adapted to a constant-flow technique with a rapid time response. The Mazda illumination was limited by filters to < 6400 Å (in-

[1] J. Franck and R. W. Wood, *Jour. Chem. Phys.*, 4: 551, 1936; H. Kautsky and R. Hormuth, *Biochem. Zeits.*, 291: 285, 1937; E. C. Wassink and E. Katz, *Enzymol.*, 5: 145, 1939.

[2] E. D. McAlister and Jack Myers, *Smithson. Misc. Coll.*, 99: (6), 1, 1940.

[3] E. D. McAlister, *Smithson. Misc. Coll.*, 95: (24), 1, 1937; *Jour. Gen. Physiol.*, 22: 613, 1939.

tensity: 60×10^4 ergs/cm.^{2}/sec.). Intensity of fluorescence was measured with a filter-photocell combination responding only to radiation > 6500 Å. (Fluorescence of chlorophyll *in vivo* falls in the region between 6500 and 8200 Å.)

Solid lines on the curves are tracings of original records (upper: intensity of fluorescence; lower: rate of CO_2-uptake. The dot-dash lines (—.—.—) represent the probable course of CO_2-uptake in the plant during the first seconds of illumination, obtained by correcting the recorded curve for the time lag of response of our instruments (6 seconds [wheat] to 15 seconds [*Chlorella*]).

When wheat is suddenly exposed to high light the burst of fluorescence consists of an abrupt initial rise, a slower secondary rise and a decay toward the steady-state, as was previously shown by Franck and Wood.[1] The simultaneously observed rate of CO_2-uptake follows a course inversely related to fluorescence. In low O_2 (Fig. 1) these curves are almost exact mirror

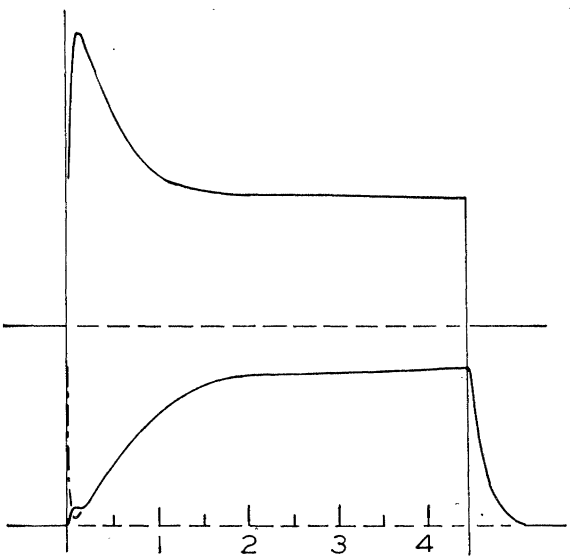

FIG. 1. Induction behavior of wheat in .03 per cent. CO_2 in N_2. (Ordinates: rate of CO_2-uptake [lower] and intensity of fluorescence [upper] in relative units; abscissas: time of illumination in minutes).

images as to time. In normal air (Fig. 2) the decay in fluorescence is more rapid, but the induction in CO_2-uptake is prolonged. For comparison the low O_2 curves of Fig. 1 have been superimposed as broken lines (- - -). Apparently the induction in normal air is caused by two processes, one of which involves an inverse, the other a direct relation between rate of CO_2-uptake and intensity of fluorescence. Assuming arbitrarily that the second process does not occur at all in low O_2, its magnitude in normal air is indicated by the hatched areas. The dependence of the direct relationship on O_2 and the observation of a greater

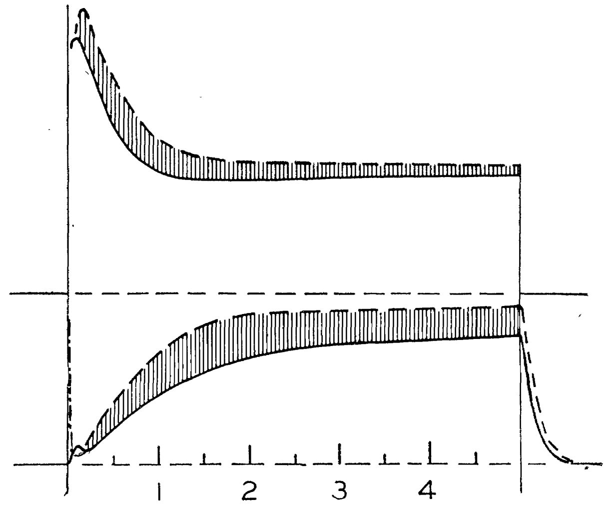

FIG. 2. Induction behavior of wheat in air (solid lines). Curves of Fig. 1 are superimposed as broken lines.

rate of CO_2-uptake in low O_2 suggests that this process involves a photoxidation.

Under CO_2 concentrations greater than that of normal air the induction in wheat (Fig. 3) is complicated

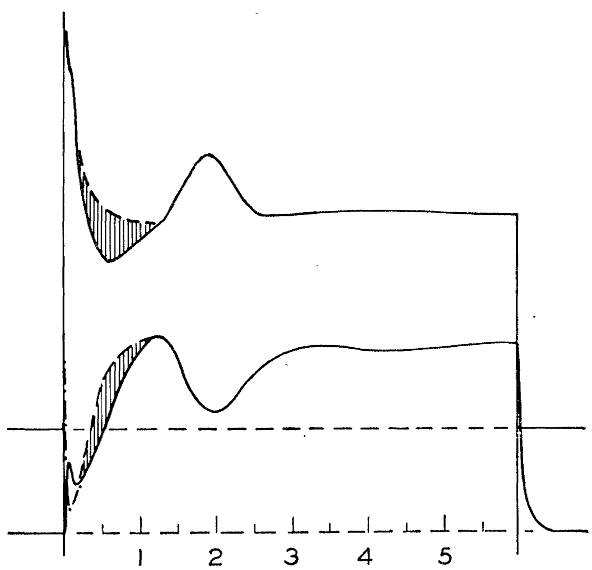

FIG. 3. Induction behavior of wheat in .24 per cent. CO_2 (solid lines). Ordinates for rate of CO_2-uptake $\frac{1}{2}$ scale of Figs. 1 and 2. Hatched areas represent the minimum extent of a direct fluorescence-CO_2 relation.

by a second maximum in fluorescence. The simultaneous minimum in rate of CO_2-uptake is clearly inversely related. The broken lines, here arbitrarily drawn in, merely show the possible course in the absence of the second process.

In *Chlorella pyrenoidosa* the induction behavior is greatly influenced by the previous conditions of culture. Cells grown in 4 per cent. CO_2 show a behavior quite comparable to that of wheat. In the induction shown by cells acclimated to .03 per cent. CO_2 the photoxidation type of reaction predominates to such an extent that minima are produced in both the fluorescence and CO_2-uptake curves (Fig. 4). The

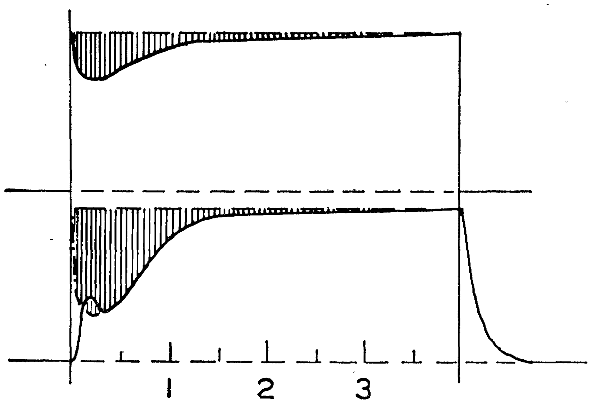

FIG. 4. Induction behavior of *Chlorella* cultured in air. The upper boundaries (broken lines) of the hatched areas are arbitrarily drawn.

arbitrarily drawn broken lines enclose hatched areas representing (as in Fig. 3) what may be considered the minimum extent of the second type of reaction.

The behavior observed in several hundred induction curves, obtained over a wide range of conditions, may be described in terms of two processes. One of these involves an inverse relation between rate of CO_2-uptake and intensity of fluorescence, the other a direct relation. Further and more quantitative work is being undertaken in order to learn more of the nature of these two processes.

E. D. MCALISTER
JACK MYERS[4]

SMITHSONIAN INSTITUTION

ETHYLENE INJURY TO CUT FLOWERS IN COLD STORAGE ROOMS

IT has been known for some time that even traces of illuminating gas leaking into a greenhouse are detrimental to flowers and plants.[1,2] Little consideration has been given, however, to the possible presence of gases toxic to cut flowers where they are kept in refrigerators to prolong their period of salability.

Investigations have recently been started at the United States Horticultural Station, Beltsville, Maryland, into the problem of increasing the keeping quality of cut flowers. The flowers so far included in these investigations are carnations, roses, snapdragons, stocks and narcissus. They were all, with the exception of the narcissus, grown in the Department greenhouses at Beltsville. The latter were grown in outdoor beds. Ample supplies were available in all instances.

Among the factors studied, that of temperature was given considerable attention in an attempt to find optimum conditions when refrigeration alone was considered.

Early in the course of these experiments it was found that ethylene, which is known to be given off by apples and other ripening fruit,[3,4,5] caused identical injury to cut flowers when they were placed either in sealed containers with ethylene or in storage room with apples or even in rooms close by.

Check lots of flowers at 70°, 50° and 36° F. remained in good condition longer than corresponding lots stored in the presence of fruit or ethylene at the same temperature, and with fruit or ethylene, the higher the temperature, the more pronounced was the effect of the gas.

Carnations, roses, snapdragons, narcissus and stocks under these conditions were all adversely affected. The damage to carnations in full bloom was indicated by an incurving of the edges of the petals and they also became discolored and lost their turgor. This effect was typical of the deterioration of carnations commonly known to flower growers as "sleepiness," which may occur both before and after the flowers are cut, and is believed to result from unfavorable environmental conditions. The symptoms of injury observed on cut roses and snapdragons consisted of a discoloration and early dropping of the petals and flowers. Narcissus and stocks reacted by a deterioration of color and shriveling of the flowers.

In general, florists are of the opinion that carnations keep best at a temperature close to 50° F. However, Neff[6] and the writers have found temperatures between 33° and 36° to be best. The accepted opinion in favor of 50°, rather than the lower temperatures, may have been arrived at as a result of frequent damage to carnations stored in room with ripening apples. Most large cold storage buildings have large quantities of ripening fruit in storage rooms where cut carnations would be stored by florists anticipating peak demands just prior to holidays. Neff reported that his best results were obtained in sealed containers, while the writers used rooms free from the influence of ethylene. Hence in both of these cases the flowers were not damaged by this gas. Most fruits are not generally stored at 50° F. and therefore carnations

[4] National research fellow.

[1] W. Crocker, *Flor. Exc.*, 70: 15 and 54, March 30, 1929.

[2] P. W. Zimmerman, W. Crocker and A. E. Hitchcock, *Proc. Amer. Soc. Hort. Sci.*, 27: 53–56, 1931.

[3] R. Gane, *Great Britain Dept. Sci. and Ind. Res. Food Invest. Bd.*, 1934: 122–123, 1935.

[4] E. Hansen and H. Hartman, *Plant Physiol.*, 12: 441–454, 1936.

[5] J. A. Milbrath, E. Hansen and H. Hartman, SCIENCE, 91: 100, 1940.

[6] M. S. Neff, *Plant Physiol.*, 14: 271–284, 1939.