the infectivity of air samples collected from houses containing birds infected with this disease.

The air samples were collected from poultry houses located in an area where pneumoencephalitis vaccination trials had been conducted for several years. Each house contained one pen of nonvaccinated control birds and four pens of birds which had been vaccinated with formalized pneumoencephalitis vaccine. Air samples were taken from the control pens of houses #6 and #9. The control pen in house 6 contained 280 birds which had shown the first clinical evidence of pneumoencephalitis 7 days before the air was sampled; that in house 9 contained 335 birds which had shown the first evidence of infection 10 days prior to the time when the air was sampled. The houses were of shed-roof-type construction containing 5 pens 18′×32′. Each pen had four open windows across the front and two ventilators in the rear. The air in these pens contained a considerable amount of suspended dust, but the dust concentration probably was not different from that usually encountered in poultry houses where deep litter is used.

The air samples were drawn through allantoic fluids harvested from normal 10-day chick embryos by means of the sampling atomizers previously described by DeOme *et al.* (*2*). The air inlets of the atomizers were adjusted to the level of the birds' heads. The volumes of air sampled in houses 6 and 9 were 540 liters and 1,080 liters, respectively. The allantoic fluids from the atomizers were frozen in dry ice immediately after the air was drawn through them, returned to the laboratory, thawed, treated with 10,000 units of penicillin and 24,000 of streptomycin/ml of inoculum, and incubated for 4 hrs at 9° C.

Subsequent culture tests indicated that the treated fluids contained no viable bacteria. Thirteen of fifteen 11-day-old chick embryos injected with 0.2-ml portions of the sample obtained in house 6 died at a mean age of 6.5 days. In two subsequent embryo passages, one-half of generation 2 embryos died at a mean age of 3.6 days, and all of generation 3 embryos died at a mean age of 4 days. The sample from house 9, when inoculated into chick embryos, yielded similar results. The allantoic fluids collected from embryos of generation 3 agglutinated chicken red blood cells, whereas those of generations 1 and 2 failed to do so. Chickens inoculated with the allantoic fluids from embryos of generation 3 developed symptoms of pneumoencephalitis and, upon postmortem examination, presented marked lesions typical of those produced by cultured pneumoencephalitis virus.

These data show that air from an infected house, sampled in 540- or 1,080-liter quantities, contained virus in sufficient concentrations to infect chick embryos.

In an attempt to test the infectivity of such air for chickens, four normal chicks were exposed to the aerial environment of a house containing birds affected with pneumoencephalitis. The four chicks were confined in wire cages suspended 4½′ above the floor. Care was taken to prevent contact with contaminated material which was not air-borne. Respiratory symptoms were observed on the 6th day. On the 8th day the sera from three of the four birds were found to contain hemagglutination-inhibiting antibodies. On the 15th day the birds were returned to the laboratory and challenged with 2×10^5 chicken mid of pneumoencephalitis virus. All four birds were refractive.

No previous report of the isolation of virus from air contaminated as the result of natural infection has been found in the literature.

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High-Level Gravels of Western Grand Canyon

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Field studies[1] conducted during the summer of 1946 in the vicinity of Western Grand Canyon, Arizona, and the Hualpai Indian Reservation disclosed the presence of large areas of gravel composed of pebbles foreign to the region. Deposits are found at heights of 3,500–4,000′ above present river level. An occurrence of these gravels near Frazier Well, in the Hualpai Reservation, is mentioned by Darton (*1*) without discussion, and two small areas are indicated on the geological map of Arizona (*2*).

Detailed study of the gravel deposits showed that they were more extensive than had been indicated previously and that two types of gravel could be distinguished. The first is composed of poorly rounded and sorted pebbles of limestone, sandstone, and chert of local derivation and rests on steep bed-rock slopes. It is interpreted as a talus and alluvial cone deposit preserved in favorable locations during reduction of the cliffs at the bases of which it was deposited. The name 'Robbers Roost Gravel' is proposed for this group, because of its occurrence in good exposure near the mesa of the same name.

The second gravel, more extensively developed, consists of well-rounded pebbles and boulders of vein quartz, granite, gneiss, schist, red and white quartzite, and sandstone. These gravels are best exposed near Frazier Well and the name 'Frazier Well Gravel' is consequently proposed. The deposits vary in thickness from a thin veneer to more than 200′, the maximum thickness being found near Frazier Well. Present elevation of the deposits varies from 5,660′, 12 miles southwest of Frazier Well to 7,150′, 5 miles northwest of the Well. Though the southern end of the Toroweap Fault passes between these two localities, the total displacement is insufficient to account for the present difference in elevation, and it appears

[1] The field work was supported by a grant from the Kemp Memorial Fund of the Columbia University Geology Department.

that part, at least, of this difference is original, resulting from early deposition at the higher elevations, followed by later deposition at the lower elevations. Pebble counts show that at lower elevations granitic and gneissic pebbles comprise up to 50% of the total, while at the highest elevation quartzitic pebbles comprise up to 80% of the total and granitic pebbles are absent. Age of the deposits has not been determined, but weathering to depths of 15′, with partial decomposition of pebbles, has occurred and suggests that the deposits are pre-Pleistocene.

The nearest present outcrop of this assemblage of rock types is 50 miles southeast, in the Basin Ranges northwest of Prescott and Jerome, an area which is today drained by the southeast-flowing Chino Creek. It is suggested that the Frazier Well gravels were deposited by north-flowing streams tributary to the Colorado originating in the Prescott-Jerome area and that drainage reversal followed Basin-Range faulting. If the gravels were deposited during erosion of an uplift to the south, it is to be expected that the older and topographically higher deposits would consist of pebbles derived from the sedimentary cover and that the later deposits would contain a greater proportion of pebbles derived from the underlying crystalline basement. The history of this area may thus be divided into the following stages: first, uplift of the Prescott-Jerome area, accompanied by development of north-flowing tributaries to the Colorado River and deposition of gravels in the Frazier Well area; second, development of Basic-Range faulting; third, reversal of drainage along the margin of the plateau and abandonment of the north-flowing channels.

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The Path of Carbon in Photosynthesis[1]

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In a previous paper we described the effect of prior illumination on the dark reduction of carbon dioxide by green algae (*Chlorella*) (*4*). The essential experimental factor noted then was a large increase in the amount of carbon dioxide reduced in the dark by the algae which had been just previously illuminated in the absence of any carbon dioxide. Furthermore, some of this reduced radiocarbon was found in positions other than carboxyl groups or the number 3 and 4 carbon atoms of the hexose molecule. This evidence seemed to preclude the possibility that the dark reactions there observed could have been due only to the reversibility of the only two carboxylation reactions yet known to be reversible, namely, the beta carboxylation of pyruvic acid and the beta carboxylation of ketoglutaric acid (*13, 15, 18*). These observations were therefore taken to indicate the ability of the green algae to accumulate a certain amount of reducing power during illumination in the absence of carbon dioxide which could later be used for the reduction of carbon dioxide. The observation by McAlister and Myers (*12*) of a continued uptake of CO_2 after the cessation of illumination in cases of high light intensity and low CO_2 partial pressure might well be the direct manifestation of this situation. In the observations of Hill and Scarisbrick and others (*1, 9, 10, 16*) it was demonstrated that isolated green portions of the cell (chloroplasts and grana) can produce oxygen from water upon illumination in the presence of a suitable oxidizing agent other than carbon dioxide. It now appears clear that the path

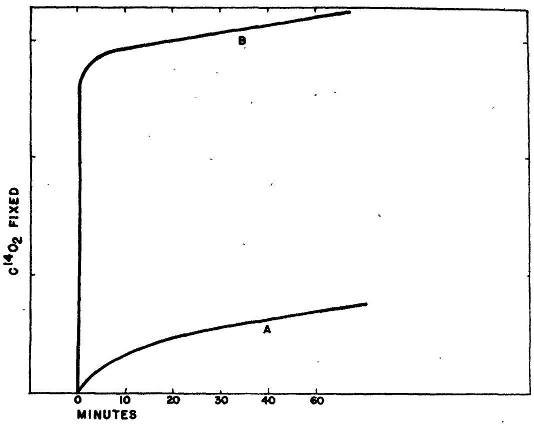

FIG. 1. Dark fixation rate of $C^{14}O_2$ by 2-day-old *Scenedesmus*. Curve A—cells kept in the dark for 1 hr in 4% CO_2–N_2 and then flushed with helium for 20 min; Curve B—same cells as for A following a 10-min exposure to light (2 × 17,000 lux), continuing the rapid flushing with helium. Both curves were obtained by taking aliquots from the main batch of cells and exposing them to $C^{14}O_2$ in the dark for the time period indicated. The concentration of cells in the large vessel was 1 cc of packed cells in 60 cc of nutrient solution, pH 6.2. The volume of the dark fixation vessels and the amount of $C^{14}O_2$ in them was such that the partial pressure of $C^{14}O_2$ was less than 0.2 mm Hg.

from carbon dioxide to reduced compounds, such as carbohydrates, fats, proteins, and amino acids, does not include the primary photochemical act itself.

The present paper presents a more extensive study of the factors influencing the dark reduction, including another organism (*Scenedesmus*), as well as the beginning of the next stage of this investigation, namely, the products formed during a very short period (30 sec) of photosynthesis. The dark uptake of C^*O_2 by *Chlorella* into nonvolatile products as a function of time was first investigated by Ruben and co-workers (*14*). These authors felt that the amount of carbon dioxide taken up reached a maximum after some 60–80 min of contact. More re-

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