TABLE I

| Dose | No. rats in group | Days lived. Average | Polyneuritis[1] developed on day. Average | Dermatitis developed on day. Average | Average gain 8 weeks |
|---|---|---|---|---|---|
| | | | | | gms |
| Neg. controls | 5 | 23 | 13.4 | None | −12.4 |
| 3 cc fresh juice | 7 | 46 | 28.8 | None | − 9.86 |
| 3 cc canned " [3] | 7 | 45.8 | 27.1 | None | −11.0 |
| 4 cc fresh " | 7 | 50.28 | 44.1 | 43.57 | −11.0 |
| 4 cc canned " | 7 | 54.9 | 51.85 | 43.4 | − 4.14 |
| 5 cc fresh " | 7 | 56+[2] | 51.1 | 43.1 | − 1.8 |
| 5 cc canned " | 7 | 56+ | 53.16 | 45.16 | +12.7 |
| 6 cc fresh " | 7 | 56+ | 55.0 | 44.1 | + 1.3 |
| 6 cc canned " | 7 | 56+ | 56+ | 44.7 | +11.0 |
| 7 cc fresh " | 7 | 56+ | 56+ | 43.5 | + 5.1 |
| 7 cc canned " | 7 | 56+ | 56+ | 43.0 | +10.3 |
| | | | Average | 43.8 | |

Autopsies in all cases confirmed the symptoms shown.

[1] Severe type.

[2] 56+ indicates animals still alive at termination of experiment.

[3] Beechnut Brand.

these rats showed no dermatitis. This shows the absence of vitamin G from the tomato juice.

On the smaller quantities of juice, the rats showed a loss of weight and on the larger doses a gain. It is shown that this gain can not be correlated with any presence of vitamin G and probably is not related to the presence of vitamin B ($B_1$) since Reader[4] and Williams and Lewis[6] have shown the absence of growth when rats were fed an abundance of this vitamin. This growth factor, therefore, probably is Reader's $B_4$ or the vitamin F, of which Sure, Smith and Kik[7] speak.

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## ARE LEAF LIPIDES RESPONSIVE TO SOLAR RADIATION?[1]

EXPERIENCE reported elsewhere[2] led to the present inquiry. The earlier work had shown a consistent increase of lipide content in various plant species reared under Vita glass in comparison with common glass. Vita glass is one of the several products which transmits greater proportions of both ultra-violet and infrared radiations than does common glass. Additional evidence of favorable rôles of this glass has been obtained which can not be presented in detail here. Livingston Globe tomato plants transplanted to the field from beneath Vita glass have yielded an earlier and larger crop than plants simultaneously transferred from common glass; and Early Fortune cucumber plants have developed more rapidly under Vita glass than under common glass in the early spring, ultimately producing larger fruits in the greenhouse. In these cases the air temperature was maintained essentially equal under the two forms of glass by use of a fan. Inasmuch as the tomato (*Lycopersicum esculentum*) had responded prominently in the manner indicated above, it was subjected to special examination of the lipide fraction.

A large quantity of leaf tissue was taken from potted plants of the Bonnie Best variety late in February. The height under common glass at this time was about 30 cm, while development had recently been noticeably more rapid under Vita glass.

Hot alcoholic extraction of 740 gm leaf tissue, as free from petioles as feasible, yielded about 12 gm of crude lipides. Determinations on separate samples of leaf blade tissue[3] indicated the presence of 1.76 per cent. chlorophylls (as potassium chlorophyllins) 0.007 per cent. carotin, and 0.053 per cent. xanthophylls in the dry tissue beneath common glass; with 1.50, 0.017 and 0.068 as the corresponding percentages under Vita glass. From the partially purified lipides precipitation of the sterols was effected as digitonides after saponification. In this form they amounted to 0.81 per cent. of the dry tissue under common glass and 0.87 under Vita glass. It is probable that alcohols of high molecular weight other than sterols and fatty acids associated with both in waxes were present, but these possibilities have not yet been investigated.

While the values here found for leaf pigments may be considered abnormal it must be recognized that the conditions of illumination, in relation to the requirements of this species, were also abnormal at the date of sampling, and had been more so during midwinter. It appears that the plane of carotinoids, and to a less extent that of sterols, has been favored by the increased radiation under Vita glass, with a corresponding decline in the content of chlorophylls. To be sure, the percentage fluctuations in lipide components here observed are of small magnitude. Their possible import would become more apparent were they converted to actual weights of constituents in equal numbers of plants under the two forms of glass. No record of plant yields were taken in this instance, but our earlier records, already mentioned, show

[6] Williams and Lewis, *J. Biol. Chem.*, 89: 275, 1930.

[7] Sure, Smith and Kik, SCIENCE, 73: 242, 1931.

[1] Published with the approval of the director of the Wisconsin Agricultural Experiment Station.

[2] W. E. Tottingham and J. G. Moore, "Some Phases of Plant Development under Vita Glass," *Jour. Agric. Research*, 43: 133–163, 1931.

[3] With the aid of E. R. Tobey, graduate student.

marked increase in tissue production by the tomato under Vita glass. In view of the rôle of lipides, and particularly their fatty acid and sterol components, as carriers of energy, even small variations within this compositional fraction of plant tissue merit attention. Yet variation of its proportions in tissue might bear little relation to the potency of a growth promoting factor. One must admit that such a factor might either induce a growth rate parallel to its own accumulation or become activated to a special function without increase in amount. In the former case there would be no difference in percentage of the compound concerned as radiation treatment varied, while in the latter case it would decline in proportion as the tissue developed. In the present instance the increased content of carotinoids and sterols is merely suggestive of a causal relation of these lipides to increased vegetative development.

The observations here briefly presented increase the desirability of further investigation of the influences of solar radiation in plant growth. As suggested in our earlier paper, it will be desirable to isolate the effects of ultra-violet from those of infra-red radiations, as may be accomplished by the use of a water cell to absorb the latter spectral region.

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## EFFECT OF DISSOLVED $CO_2$ ON THE pH OF WATER

THE recent letter in SCIENCE by Mr. Emil Truog concerning the hydrogen-ion concentration of water in which carbon dioxide is dissolved, prompts me to present the following calculations which were made several years ago in connection with some calculations on the lead carbonate equilibrium, and which, I think, have not appeared elsewhere.

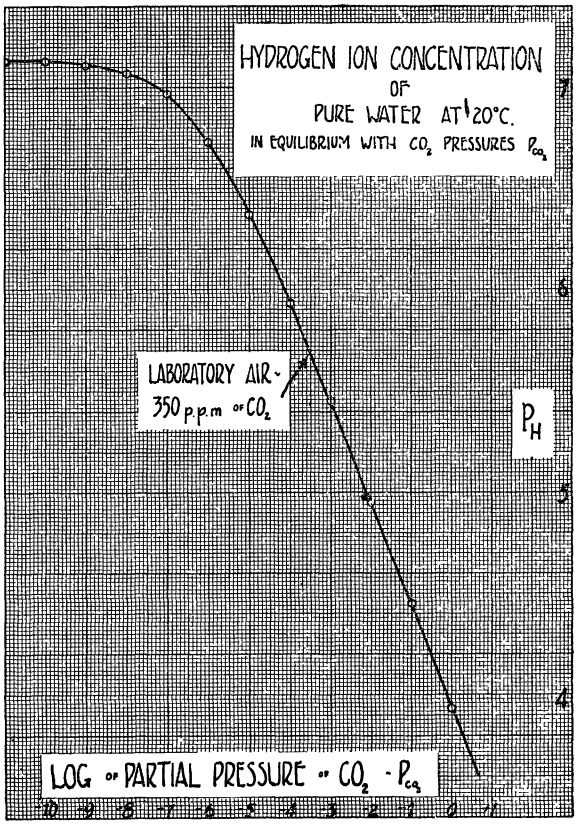
Setting up the familiar equations of carbonate equilibria with values of the constants indicated,

(1) $[H^+]\ [OH'] = K_w = 0.54 \times 10^{-14}$ (20° C.)
(2) $[H^+]\ [HCO_3']/[H_2CO_3] = k_1 = 3.18 \times 10^{-7}$ (20°)
(3) $[H^+]\ [CO_3'']/[HCO_3'] = k_2 = 3.54 \times 10^{-11}$ (20°)
(4) $[H_2CO_3] = ncP$ $nc = .0393$ (20°)
(4) $[H_2CO_3] = ncP$ $nc = .0393$ (20°)
(5) $[H^+] = 2\,[CO_3''] + [HCO_3'] + [OH']$

we arrive at the following equation containing only constants and the two unknowns, $[H^+]$ and P

$$(6)\quad [H^+] = \frac{2k_1 k_2 ncP}{[H^+]^2} + \frac{k_1 ncP}{[H^+]} + \frac{K_w}{[H^+]}$$

This equation (6) is solved for $[H^+]$ by substituting values of P, the partial pressure of $CO_2$ with which the pure water is in equilibrium.




The curve of pH plotted against log of the partial pressure of $CO_2$ is practically linear from one atmosphere of $CO_2$ to about $10^{-6}$ atmospheres (which includes the range usually encountered) and for a pressure of $CO_2$, corresponding to 350 parts per million in air—an average value—gives a calculated pH of 5.68 which agrees well with the value given by Truog. From $10^{-6}$ of an atmosphere of $CO_2$ to zero pressure of $CO_2$, the curve rapidly approaches the dissociation constant of pure water as asymptote. The curve shows these results graphically.

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