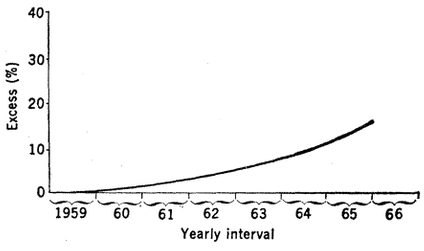

Fig. 2. Radiocarbon in ocean at 50°N.

In that only limited localities have been studied no very general conclusions can be drawn. However, the results suggest that (i) the quality may be due to an enzyme, like carbonic anhydrase, which might well be isolatable and may be derived from sea life known to produce it (*5*); (ii) there may be extensive areas of the sea that are devoid of the quality imparted by carbonic anhydrase and therefore slow to dissolve CO_2; (iii) that this quality may not long survive contact with air.

The rates measured here for Santa Monica beach surface waters agree well enough with the work of others (*3*), for the seas as a whole; therefore, we can have some confidence in the tentative conclusions. However, additional work is necessary to isolate and identify the enzyme and to measure its oxidative stability and to assay the waters of the seas for it.

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9. Supported in part by NSF, G-628. We thank Captains V. H. L. Duckett and W. A. White, officers, and men of U.S.S. *Baya* and G. Plain, for assistance; and E. D. Goldberg, L. Provasoli, R. Revelle, and J. D. Strickland, for advice and comments. This is publication 730 of the Institute of Geophysics, University of California.

14 January 1969

Peanuts: Gibberellin Antagonists and Genetically Controlled Differences in Growth Habit

Abstract. *Treatment of peanuts with gibberellin changed the orientation of lateral branches of runners to that of erect ones, and two growth retardants changed those of the erect type to a more horizontal orientation. Little or no difference was found in amounts of endogenous gibberellin in the two types of plants, but amount of native gibberellic acid antagonists was higher in runner plants. Furthermore, runner plants contained a particular gibberellic acid inhibitor not found in erect plants. Applications of various auxins, antiauxins, and a cytokinin had no effect on tropistic growth of the side branches.*

Commercial varieties of peanuts differ in their diatropic growth habit. Some are erect (bunch) whereas others are runner (trailing). Both types have an erect main stem, usually short in the runner type, which gives rise to lateral branches. In erect plants, the side branches are also erect or ascending in a 50° to 60° angle to the soil surface. In runner plants the cotyledonary and secondary lateral branches grow horizontally at an angle of 0° to 25°.

Growth habit is controlled by at least two kinds of cytoplasm, or plasmons, designated "V4" and "Others," and nuclear genes at two loci, Hb_1 and Hb_2 (*1*). In the "Others" plasmon Hb_1-$Hb_1Hb_2Hb_2$, $Hb_1Hb_1Hb_2hb_2$, and Hb_1-$hb_1Hb_2Hb_2$ are runners, and all other genotypes yield bunch plants. In the "V4" plasmon the above genotypes and also $Hb_1hb_1Hb_2hb_2$ give runner plants; all other genotypes produce bunch ones. Runner plants and erect plants of both plasmon types were used in this study (*2*).

Geotropic growth is usually considered to be controlled by amount and distribution of auxins (*3*). External applications of auxins, antiauxins, and phthalamic acid derivatives have been effective in modifying the geotropic response of various plants (*3*). Gibberellic acid (GA) also induces erect growth in diageotropic or plagiotropic branches of various species (*4*). Conversely, growth retardants which interfere with gibberellin biosynthesis (*5*) decrease the negative geotropic growth of shoots (*6*). In none of these reports was endogenous gibberellin concentration determined, although in several it was suggested that gibberellin may be involved in geotropic movement of shoots.

In our study of the physiology of differences in the growth habit of peanut plants, we used true-breeding bunch and runner F_4 and F_5 lines derived from reciprocal crosses of V4 with N.C.2, and V4 with VSM. Initial attempts to modify the geotropic position of the shoots by external application of auxins, antiauxins, and cytokinins (*7*) failed in both erect and runner plants.

Treatments with gibberellic acid (1 to 100 ppm) and growth retardants, 2-chloroethyltrimethylammonium chloride (CCC, 20 to 2000 ppm) and *N*-dimethylaminosuccinamic acid [Alar (B 9), 100 to 10,000 ppm], modified the position of side branches of the plants (Table 1) (*8*). Treatment with GA changed the diageotropic growth of the runner type to an erect position; the growth retardants changed the negative geotropic growth of the erect type to a plagiotropic position. In other experiments the branch angle of the GA-treated runner type was even greater than that of the erect untreated controls, and erect plants treated with Alar were as prostrate as runner plants.

Thus, we assumed that the difference in growth habit of peanut plants re-

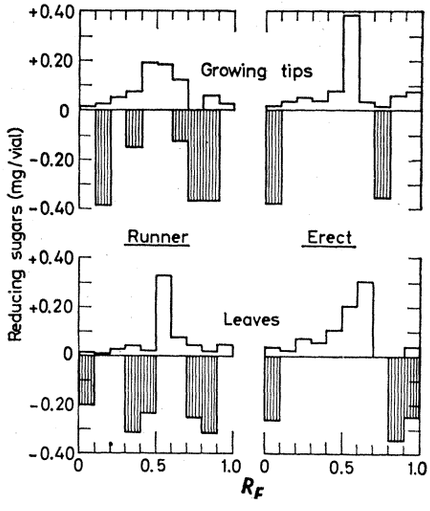

Fig. 1. Histograms showing promotion or inhibition of α-amylase activity by eluates from chromatogram strips developed with a mixture of isopropanol, ammonia, and water (10:1:1) when tested by the barley endosperm bioassay for gibberellins. Each chromatogram represents 250 mg dry weight. Ordinate represents increase in reducing sugars over 10^{-7} gram of GA per liter (0.38 mg/vial). (Native reducing sugars of each R_F fraction, tested without barley seed, were considered as controls.) Data obtained from one experiment; five other experiments yielded similar results.

Table 1. Mean angle of the cotyledonary branches to a horizontal axis, in erect and runner peanut plants as affected by foliar sprays with GA and seed treatments with the growth retardants CCC and Alar.

Treatment	Angle of cotyledonary branches in:	
	Erect plants	Runner plants
Control	51 a*	16 d
GA (10 ppm)	52 a	58 c
Alar (0.1%)	30 b	21 d
CCC (0.02%)	33 b	21 d

* Within each column, values followed by the same letter do not differ significantly from each other; those followed by different letters differ significantly at $P < 0.01$.

sults from heritable difference in amounts of endogenous gibberellin. This hypothesis was tested in growing tips and leaves from side branches of mature plants. Freeze-dried plant material was extracted, partitioned, and assayed with the barley endosperm bioassay (*9*).

Figure 1 presents data for runner and erect derivatives from the cross of VSM♀ × V4♂. Similar findings were obtained from runners having either plasmon and from bunch plants with either plasmon. One gibberellin detected in the growing tips and leaves of both types had an R_F of 0.5 to 0.6 corresponding to GA_3. Only slight and not significant differences were found in the amounts of gibberellin present in the two types of plants (Fig. 1).

We used a modification of the barley endosperm bioassay (*9*) to investigate possible differences in endogenous gibberellin antagonists (Fig. 1). Two significant differences were found between gibberellin inhibitors of plants having different growth habits. The same differences were found in reciprocal F_1 hybrids of V4 × Shulamit which differed in their plasmon but were all $Hb_1hb_1Hb_2hb_2$. The differences were: (i) three gibberellin inhibitors were found in both the growing tips and leaves of runner plants, whereas only two inhibitors were found in the erect ones; (ii) the amount of the inhibitor at R_F 7 to 10 was much higher in the growing tips of the runner type. The R_F of this inhibitor corresponded to that of abscisic acid in the solvent system used in the present experiment as well as in two other solvent systems—diethyl ether, methanol, acetic acid (50 : 50 : 1) and methanol, butanol, water, acetic acid (50 : 20 : 30 : 0.1).

Abscisic acid, identified in many plants (*10*), reportedly antagonizes several gibberellin-stimulated processes, including biosynthesis of amylase in barley endosperm (*11*). Endogenous inhibitors of gibberellin have been found recently in several plants (*12*). However, to the best of our knowledge the existence and endogenous level of gibberellin antagonists has not been correlated previously with a distinct morphogenetic character of a plant organ, nor have genetic differences in growth habit been correlated with levels of endogenous gibberellin antagonists, one of which may be a compound similar to abscisic acid. The effect of this acid on a physiological characteristic, bud dormancy, is well known. The possibility that native gibberellin antagonists function in geotropic growth of shoots regulated by genes and plasmatic factors is supported by the fact that the geotropic growth habit was modified by external application of synthetic gibberellin antagonists.

It is generally accepted that genetic differences between tall and dwarf varieties may be associated with ability to synthesize gibberellins (*13*). This concept is not always supported by endogenous amounts of gibberellin. For example, in tall and dwarf peas (*14*), only small and inconsistent differences in gibberellin content occur, which cannot account for the difference in growth habit. Our results suggest that in cases where there is a lack of correspondence between the responses to external application of gibberellin and the amount of endogenous gibberellin, one should examine gibberellin antagonists, including abscisic acid. These may prove to have a more important function in the regulation of plant growth than has been anticipated.

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8. Gibberellin (10 ppm) applied as a foliar spray twice weekly from 1 week after emergence. Growth retardants CCC and Alar were applied to seeds. Six weeks after emergence the angle of the side branches to a horizontal axis was measured in each plant.
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19 February 1969; revised 1 April 1969

Reticulocytosis in Response to Dietary Antioxidants

Abstract. *Alpha-tocopheryl acetate, 1,2,dihydro-6-ethoxy-2,2,4-trimethylquinoline, and butylated hydroxytoluene increased the number of circulating reticulocytes when added to the diet of chickens. Hematocrit values were not reduced and erythrocyte life-spans were not shortened by the antioxidants. The reticulocytosis is attributed to delayed loss of reticular material from the maturing erythrocytes.*

Reticulocytosis has been reported to occur in response to vitamin E and to coenzyme Q_4 chromanol treatment of vitamin E–deficient monkeys, human infants, and children (*1*). The experiments described here demonstrate that antioxidants, when fed to chicks kept under normal dietary conditions, retard the maturation of reticulocytes.

In two experiments chicks were fed balanced diets based on natural ingredients and supplemented with antioxidants as indicated in Table 1. Retic-