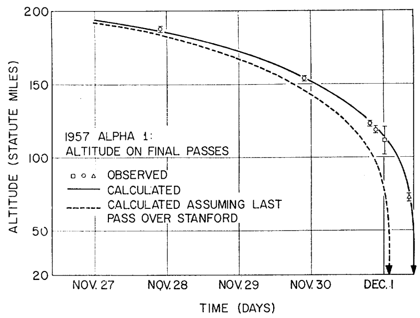

Fig. 2. Comparison of observed and calculated altitudes during the final days of satellite 1957 Alpha 1: ○, Lincoln Laboratory; □, Stanford Research Institute; △, Royal Radar Establishment (Malvern, England). The solid curve indicates the calculated altitudes. The dashed curve represents the calculated altitudes on the assumption that the satellite fell during its last pass over the United States.

to an uncertainty of ±15°, corresponding to an assumed variation in the drag coefficient by a factor of 2. The combined uncertainty is shown by the heavy line in Fig. 1, as mentioned above.

In the final phase of the reentry the rocket probably disintegrated into elements of differing drag coefficient, whose impacts would be strewn over an arc length of the satellite trajectory approximately equal to the uncertainty in impact shown in Fig. 1.

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References and Notes

1. See *Science* 126, 1334 (27 Dec. 1957).
2. G. H. Pettengill, private communication.
3. A. M. Peterson and W. E. Jaye, private communication.
4. J. S. Hey and V. A. Hughes, private communication.

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B-Complex Vitamins in Certain Brown and Red Algae

With the world population continually expanding at a rapid rate, it has been predicted that future generations may have to depend more and more, for food, upon products from the sea (*1*). Such products include the algae, which are found in great abundance in many areas and about the nutritional value of which with respect to B vitamins, except for a small number of reports on some of the water-soluble factors in certain species (*2*) comparatively little is known. In this report (*3*) are presented the results of an investigation of the B-vitamin content of certain red and brown algae.

The plants analyzed were *Fucus spiralis, Ascophyllum nodosum, Laminaria agardhi,* and *Chondrus crispus.* They were taken from the coast line of New Hampshire and of York, Maine, through the months of October and November 1956. The algae were dried in a large, forced-hot-air dryer, at not over 85°C, and were then ground in a Wiley mill before analysis.

Analyses for the various vitamins were carried out by microbiological procedures (*4*); *Lactobacillus arabinosus* 17-5 (ATCC 8014) was used for niacin, pantothenic acid, and biotin; *Lactobacillus casei* (ATCC 7469), for riboflavin; *Streptococcus fecalis* (ATCC 8043), for folic acid; *Lactobacillus fermenti* 36 (ATCC 9833), for thiamine; and *Lactobacillus leichmannii* (ATCC 7830), for vitamin B_{12}.

The average results of the vitamin-content analyses are presented in Table 1. The four algae gave rather high results for niacin content when compared to many vegetables, fruits, and animal feeds. However, even the species containing the greatest amount of niacin, *Chondrus crispus,* contains considerably less than the 60 or more micrograms per gram found in barley and wheat. It can be concluded that these algae are a moderately good source of niacin. While all four of the algae studied are rich sources of pantothenic acid, the red alga *C. crispus* contains much more of the vitamin than do the three brown algae. This same relationship holds also for riboflavin and, to a lesser extent, for thiamine and vitamin B_{12}, indicating perhaps that in general the red algae are superior to the brown as a source of B vitamins.

In addition to being a good source of niacin and pantothenic acid, the algae are apparently a relatively good source of riboflavin and folic acid and a fair source of biotin and vitamin B_{12}. They are comparable with many fruits and vegetables as a source of thiamine.

It may be concluded, therefore, that the algae constitute an important potential source of certain water-soluble vitamins for animal, or human, consumption. Of the species studied, this is particularly true for the red alga *Chondrus crispus.*

Table 1. Average vitamin content (in micrograms per gram) of various species of algae. The average results were figured from three to seven determinations.

Vitamin	*Fucus spiralis*	*Ascophyllum nodosum*	*Laminaria agardhi*	*Chondrus crispus*
Niacin	22.8	14.6	30.2	31.8
Pantothenic acid	23.0	49.4	33.0	150.0
Biotin	0.063	0.021	0.042	0.032
Riboflavin	10.0	3.50	12.6	25.0
Folic acid	1.91	1.50	10.00	9.50
Thiamine	0.40	0.23	0.46	0.83
Vitamin B_{12}	0.080	0.096	0.052	0.312

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References and Notes

1. H. G. Mautner, *Econ. Botany* 8, 174 (1954).
2. G. E. Fogg, *The Metabolism of Algae* (Wiley, New York, 1953); Y. Ishihara, S. Umemoto, Y. Matsubara, *Hokkaidô Daigaku Nôgakubu Kiyô* 1, 83 (1951); M. Tsujimura, K. Tabei, T. Wada, *Nippon Nôgei-kagaku Kaishi* 26, 11 (1952); L. E. Ericson *et al., Arkiv Kemi* 6, 427, 511 (1953); L. E. Ericson and Z. G. Banhidi, *Acta Chem. Scand.* 7, 167 (1953); B. A. Southcott and H. L. A. Tarr, *Fisheries Research Board Can. Progr. Repts. Pacific Coast Stas. No. 95* (1953), p. 45.
3. This report is published with the approval of the director of the New Hampshire Agricultural Experiment Station as scientific contribution No. 219.
4. E. C. Barton-Wright, *The Microbiological Assay of the Vitamin B Complex and Amino Acids* (Pitman, New York, 1952); *Difco Manual for Microbiological and Clinical Laboratory Procedures* (Difco Laboratories, Detroit, Mich., ed. 9, 1953).

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Chemical Induction of Male Sterility in Inbred Maize by Use of Gibberellins

The effects of gibberellin on flowering of inbred maize were studied during the winter of 1957. Unexpectedly, plants sprayed with relatively high concentrations (500 to 1000 parts per million) of gibberellic acid developed sterile or partially sterile tassels. Possibilities of chemical induction of male sterility in maize by means of gibberellin were thus suggested.

The following summer this phenomenon was further investigated under field conditions. A relatively early-flowering inbred line, R53, was planted on 1 June and 1 July, and a relatively late-flowering inbred line, OH51, was planted on 1 June and 8 July. Potassium gibberellate (*1*) in concentrations of 100, 1000, 2000, and 2500 parts per million, and a wetting agent (Tween 20 at 0.1 percent) were used as a foliar spray. The estimated amount of gibberellin per plant ranged from 1.0 to 10 mg for the 1 June plantings and from 12 to 35 mg for the two later plantings. Approximately 40, 55, and 90 plants per treatment were sprayed and scored for the 1 June, 8 July, and 1 July plantings, respectively.

The critical stage of plant development for the most effective chemical induction of male sterility appeared to be when the immature male inflorescence (immature tassel) was approximately 1 in. in length. Plants were defoliated (with