cast include quartz, glauconite, and numerous foraminifers, with a clay binder. The living nut very likely came from a plant that grew on or near the coast and was washed into fairly deep water, as the kinds of globigerinid foraminifers seem to indicate.

The nuts of *Phytelephas* palms are at first relatively soft and edible but on ripening become very hard, with an ivorylike endosperm, and are enclosed in a thin skin or endocarp. Four or more of these covered nuts, closely pressed together (hence the angular faces) make a burlike or warty cluster. They supply much of the "vegetable ivory" of commerce from which buttons and other articles are turned.

The species of *Phytelephas,* variously estimated from 3 to 15 in number, include low, erect or prostrate plants with graceful, arching, pinnate leaves that are sometimes 15 to 20 ft long. The commonest species is *P. macrocarpa* Ruiz and Pavon, which is widely esteemed and cultivated. The genus inhabits tropical America, and the species grow along streams and swamps, generally in coastal situations.

The fossil record of the palms dates back certainly to the early Jurassic, as exemplified by impressions of fan-shaped leaves from Normandy, and perhaps to the Triassic, if the palmlike leaves I have described (*2*) from southwestern Colorado are indeed palms and not some other monocotyledon. The only other record of fossil *Phytelephas,* however, is part of a stem from the Miocene of Antigua, described as *P. sewardi* Kaul (*3*), and now in the Natural History Museum, South Kensington, London.

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References

1. Roland W. Brown, *Am. J. Sci.* 244, 554 (1946).
2. Roland W. Brown, *U.S. Geol. Survey Profess. Paper 274-H* (1956).
3. K. N. Kaul, *Proc. Linnean Soc. London* 155, 3 (1943).

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Effect of Gibberellin on Elongation, Water Uptake, and Respiration of Pea-Stem Sections

Gibberellin, which induces hyperelongation in many kinds of green plants (*1*), has been shown (*2*) to be a type of substance that has growth effects different from those of auxin. It reduces the growth inhibition brought about by concentrated solutions of auxin and by some other growth inhibitors, such as maleic hydrazide (*3*). It exerts no effect on root growth but inhibits root formation (*3*).

Preliminary to a study of the mechanism of action of gibberellin, its effects on elongation, on water uptake, and on respiration of pea-stem sections were examined (*4*).

Stem sections 5 mm in length were prepared from the third internodes, which were about 15 to 20 mm in length, of etiolated pea seedlings that had been grown for 7 days in a darkroom at 25°C. The sections were set afloat in 0.03*M* phosphate buffer solutions at *p*H 7.0, with and without addition of crystalline gibberellin A (*5*), and were kept in the same darkroom until the experiments were finished.

As is shown in Table 1, pea-stem sections elongated in acid solution, either with or without gibberellin. If the elongation of gibberellin-treated sections is compared with that of the controls at the same *p*H, it may be seen that the effect of gibberellin is most pronounced at *p*H 7.0.

Water uptake was determined by the increase in 24 hours in fresh weight of ten stem sections. Just as in the case of elongation, water uptake was higher in acid solution, and the effect of gibberellin was the greatest at *p*H 7.0 (Table 2).

The oxygen uptake of freshly prepared pea-stem sections was measured, using the Warburg respirometer, which was shaken at 80 rev/min at 30°C in the dark. Each flask contained ten sections, bathed in 2 ml of 0.03*M* phosphate buffer solution, with or without 10 mg/lit of gibberellin. Experiments ran for 4.5 hr; they were preceded by a ½-hour equilibration period. The results, presented in Table 3, show that the oxygen uptake of stem sections stimulated by gibberellin was about 15 percent greater than that of the controls. When the sections were pretreated by 10 mg/lit of gibberellin for 8 hours, their oxygen uptake was about 20 percent higher than that of controls, other conditions being the same.

Table 1. Effect of gibberellin (10 mg/lit) and *p*H on the elongation of pea-stem sections in 24 hours. Initial length, 5 mm. Each value is the average of ten sections.

*p*H	Increase in length of section (mm)		Increase over control (%)
	Control	Gibberellin	
5.3	1.11	1.71	54
6.0	1.02	1.63	60
7.0	0.74	1.30	76
8.0	0.66	0.97	47

Table 2. Effect of gibberellin (10 mg/lit) and *p*H on the water uptake of pea-stem sections. Each value is the average of values obtained in three experiments.

*p*H	Water uptake (% of initial fresh wt.)		Increase over control (%)
	Control	Gibberellin	
5.3	42	57	36
6.0	49	69	41
7.0	25	40	60
8.3	31	36	16

Table 3. Effect of gibberellin (10 mg/lit) on the respiration of pea-stem sections.

Expt. No.	O_2 uptake [μlit/10 mg (dry wt) hr]		Increase over control (%)
	Control	Gibberellin	
1	52.0	59.6	15
2	51.3	59.2	16
3	45.3	52.2	15
Average			15

The effect of gibberellin in stimulating respiration was not observed with stem sections from the first and second internodes.

Although gibberellin does not cause the inward curvature of split pea stem as do auxins (*2*), it does increase the elongation and the water absorption of the unsplit material. The essential difference in the physiological effects of gibberellin and auxin is not yet known. Some clue to this difference may be found when the effects of enzyme inhibitors on the gibberellin-stimulated respiration are studied and compared with the effects described for auxin-induced respiration.

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References and Notes

1. Y. Sumiki *et al., Atti Congr. intern. Microbiol. Rome* 1, 173 (1953).
2. J. Kato, *Mem. Coll. Sci. Univ. Kyoto Ser. B* 20, 189 (1953).
3. J. Kato, unpublished data.
4. This investigation was supported by the Science Research Fund granted by the Ministry of Education of Japan. I am grateful to Joji Ashida for his helpful guidance.
5. Supplied by Y. Sumiki, Tokyo University.
6. J. Bonner, R. S. Bandurski, A. Millerd, *Physiol. Plantarum* 6, 511 (1953).

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They know enough who know how to learn.—HENRY ADAMS.