tensity that may be introduced into a sample with a flat crystal, unless cavitation is inhibited by excess pressure at the surface or by degasifying the sample. However, since many of the effects of ultrasonic vibrations are directly attributable to cavitation, its inhibition or prevention would defeat the purpose of applying acoustical energy to a sample.

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Biosynthesis of Radioactive Asparagine from $C^{14}O_2$[1]

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As a first step toward the elucidation of the metabolism of asparagine and other nitrogen compounds, the following method of preparing radioactive asparagine has been developed. Since leguminous seedlings synthesize exceptionally large amounts of asparagine, it was decided to try blue lupin, *Lupinus angustifolius,* as experimental material. Preliminary work (*1*) has indicated that in this plant the peak in asparagine content is reached on the twelfth day after germination. This suggested the use of seedlings prior to this date.

It was reported by several workers (*2*) that plants supplied with glucose synthesize more asparagine than those which are not. Assuming that the asparagine carbon chain is produced directly from sugar, this observation suggests two different methods for the synthesis of radioactive asparagine. In both cases plants should be placed under the conditions favoring accumulation of asparagine, and either infiltrated with radioactive glucose or permitted to carry on photosynthesis in the presence of $C^{14}O_2$. The second method was adopted, and preliminary tests have indicated that in 8-day-old lupin seedlings the photosynthetic mechanism has already been developed.

In our earlier experiments about 50 g of seeds were soaked for 4 hr in distilled water and sown in vermiculite in small plastic dishes. Seedlings were grown at 25° C on a 15-hr day in a constant temperature and light chamber. When they were 8–9 days old, the plastic dish with the seedlings was placed in an 8-l desiccator, and this was filled with air containing 5% CO_2 and about 0.25 mC of $C_{14}O_2$. After 24 hr of continuous illumination with fluorescent bulbs at a light intensity of 400 ft-c, the desiccator was aerated to remove the residual CO_2. From 97–99% of the CO_2 present initially was absorbed by the seedlings. The plants were then frozen at −40° C, thawed out, and minced in a Waring Blendor. The brei was suspended in about 600 ml of distilled water, brought to 90° C, and held there for 5 min. After cooling to room temperature it was acidified with glacial acetic acid to pH 4 and left standing at 4° C for 12 hr. At the end of this time the precipitate formed was filtered off, the filtrate was decolorized with charcoal and concentrated to about 5 ml. Radioactive asparagine crystallized out on cooling without the addition of carrier. As is seen from Table 1, the activity of the asparagine obtained in these first four experiments was quite low.

TABLE 1

ACTIVITY OF THE ASPARAGINE ISOLATED

Experiment No.	Material	Duration of experiment (days)	Isolated asparagine (g)	Activity in asparagine (μc/mM)	Mc given	Percentage mc recovered
1	Blue lupin seedlings*	1	——	0.688	0.25	—
2	Blue lupin seedlings*	1	——	0.238	.25	—
3	Blue lupin seedlings*	1	——	0.279	.25	—
4	Blue lupin seedlings*	1	——	0.301	.25	—
5	Tobacco leaves†	11	——	3.72	.25	—
6	Tobacco leaves†	6	0.176	4.74	.25	2.5
7	White lupin seedlings*	3	2.724	0.73	.5	3.6
8	Blue lupin seedlings*	6	0.620	2.00	0.25	3.0
9	Blue lupin seedlings*	6	1.789	1.47	1.00	2.0

* Asparagine crystallized out without carrier.
† Asparagine crystallized out only after the addition of about 0.5 g of the carrier.

It was observed earlier (*3*) that when tobacco leaves were permitted to carry on photosynthesis for 24 hr under approximately the same conditions, they produced glucose with the activity of about 338 μc/mM, or about 1,000 times stronger than the asparagine. Assuming that the sugars in lupin seedlings had a comparable activity, the low activity of the asparagine obtained might be due to two causes. Either the immediate precursor of the asparagine carbon chain is not a sugar, but is, for example, a protein, or the amounts of radioactive asparagine produced were greatly diluted by ordinary asparagine present in the seedlings. On the basis of either explanation, it appeared desirable to extend the time of contact with $C^{14}O_2$.

Fifteen young tobacco leaves were detached and placed on 0.1% NH_4Cl in an 8-l desiccator in an atmosphere of 5% CO_2 with 0.25 mc of $C^{14}O_2$. The desiccator was placed between two 200-w incandescent bulbs, with light being filtered through about 8 cm of

[1] This work was aided by a grant from the National Research Council of Canada.

[2] Holder of a Research Council of Ontario scholarship.

water held in two museum jars. The leaves were illuminated 15 hr/day. After 11 days they were frozen and their asparagine was extracted as from the lupin seedlings described above. A duplicate experiment was run for 6 days. As indicated in Table 1, the asparagine from tobacco leaves had a much greater activity.

Longer periods of illumination were then tried with lupin seedlings. One hundred g of white lupin seeds were soaked, planted in flats in sand, and grown in a greenhouse. Eight-day-old seedlings were cut off at the ground level, and put in a desiccator with their stems immersed in 0.1% NH_4Cl. They were illuminated for 3 days, and their asparagine extracted. This experiment was repeated twice, using blue lupin seedlings illuminated for 6 days (Table 1).

It is apparent from Table 1 that by extending the time of contact with $C^{14}O_2$ the activity of the asparagine is considerably increased. It might be possible to increase it still further by raising the amounts of C^{14} in the air during the experiment. Since lupin seedlings could be utilized for such a synthesis within 8 days after germination, and since they yield larger amounts of radioactive asparagine than tobacco leaves, their use appears preferable.

References

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Comments and Communications

The Search for Truth

The New York State law referred to in your March 2 issue does not—as your headline claims—represent "A Return to Medievalism in Science Teaching." Rather, it gives the individual citizen protection against the growing tendency toward statism, with its enslavement of body and mind to the whims of the relatively few men whose aim is to force conformity to their own political, economic, or scientific views—however sincerely they may believe them to be in "the interests of society."

Who is to say what constitutes the "truth" claimed for "scientific laws . . . established beyond a doubt"? In every age there have been men who claimed privileged knowledge of "scientific truth" when, in very fact, their so-called knowledge was but the exposition of theories originated in their own minds to explain, to their greater satisfaction, certain physical or mental phenomena that were not wholly explained by previous beliefs. There is today no avenue of scientific investigation in which the intellectually honest scientist will assert that the theories on which current investigations are conducted have been "established beyond doubt." The most any such scientist will claim is that the currently accepted theories provide a more satisfactory working basis than was afforded by yesterday's theories. And the sincere scientist expects tomorrow to reveal new theories that will supersede those of today and bring man one step nearer a knowledge of incontrovertible truth.

In the light of scientific history, who can say that we have, today, an absolute knowledge of truth—and that the citizen who chooses, for religious or any other reasons, to question the desirability of accepting today's theories should be forced to relinquish his own sincerely held beliefs in favor of theories he has ample reason to believe will, tomorrow, be outmoded?

The very vehemence of the argument that the individual's exercise of his right to religious freedom may bring "a time when our scientific curricula will be demolished piecemeal" proves the weakness of this argument. As long as thinking men press their search for the ultimate truth, *theories* will be superseded, but our scientific curricula will become ever stronger and more valuable.

Any attempt to abrogate the right of the individual citizen to refuse acceptance of a scientific theory—whether it apply to biology, physics, geography, or whatever—is an expression of bigotry. And bigotry of any nature—scientific or religious—is intolerable to free men.

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Editorial Note: The following Introduction from a *Brief Urging the Repeal of Subdivision 5 of the (N. Y.) State Education Law, Section 3204, Chapter 135, August 1, 1950,* was prepared by The New York Association of Teachers of the Biological Sciences and The New York Association of Chairmen of the Biological Sciences. It summarizes the issues involved in the controversy, as viewed by science teachers.

The teaching of health and the establishment of health habits have been one of the cardinal objectives of education for many years. In 1942, the New York State Regents passed a regulation requiring the teaching of health in the high schools of the state. Bulletin 1371, *The Health Teaching Syllabus for the Junior and Senior High Schools,* was "designed to present the material for the basic course work in health required by the Regents."

In 1950, the New York State Legislature passed a law which adversely affects the teaching of health in the schools of the state. Under this law, "subject to rules and regulations of the Board of Regents, a pupil may be excused from such study of health and hygiene as conflicts with the religion of his parents or