TABLE 1

Date caught	Place released	Date recaptured	Remarks
7/21/49	Castle Harbor near causeway	7/25/49	13 released 3 recaptured
7/22/49	where caught	7/30/49	
7/21/49	Castle Harbor near causeway	7/30/49	
7/25/49	Castle Harbor near causeway	7/30/49	20 released 4 recaptured
7/21/49	Castle Harbor near causeway	8/2/49	
7/27/49	where caught	8/2/49	eggs shed when caught; when recaught, with newly laid eggs
7/22/49	where caught	8/2/49	
7/30/49	deep water, 2 miles off Castle Roads	8/4/49	released in water 1,500 ft deep
7/30/49	deep water, 2 miles off Castle Roads	8/6/49	released in water 1,500 ft deep
7/22/49	where caught	8/6/49	
7/27/49	where caught	8/11/49	
8/6/49	wharf of Frick estate on Castle Point, Castle Harbor	8/13/49	eggs when recaptured; newly shed when released
7/21/49	Castle Harbor near causeway	8/13/49	new eggs when recaptured; eggs when released
8/2/49	Castle Harbor near causeway	8/26/49	
7/21/49	Castle Harbor near causeway	8/26/49	
8/26/49	Ferry Reach at Biological Station jetty	9/28/49	

quarter-mile square outside area off Nonsuch Island, near the mouth of Castle Harbor. The waters in this area are rough and stormy, with swells, and have abundant coral heads and boiler reefs. Trapping operations were conducted throughout 2 months, and the traps were visited about twice a week.

Spiny lobsters, *Panulirus argus* (Latreille 1804), caught in this area were transported to various sites and released. The tagging experiments were considered as entirely preliminary in nature, but have produced such interesting results as to warrant discussion at this time.

In the first experiments on migration, the spiny lobsters were taken from the Nonsuch area and released 2 miles up Castle Harbor at a point in the middle of the harbor opposite Castle Harbor Hotel. Later experiments entailed releases behind land masses at various situations in Castle Harbor or in Ferry Reach, where the causeway largely obscures free passageway. Some lobsters were released where caught. In one experimental release the lobsters were carried 2 miles out to sea, where the waters were 1,500 ft deep, and were released there.

The dates and points of release and of recapture at the original site off Nonsuch Island are shown in Table 1.

The high incidence of recovery of specimens released at various sites (about 20%) indicates that we are probably concerned here with a remarkable homing instinct in these crustaceans. The recoveries of the specimens released in deep water 2 miles out at sea seem particularly significant. The return to the original site after release at the Biological Station jetty entailed migration against tides conflicting with those originally prevailing, and migration around land masses for about 5 miles.

It seems apparent that the lobsters are fully "aware" of their locations and can return to their original summer feeding grounds when released elsewhere. How this is accomplished remains an unanswered and puzzling biological mystery. The degree and nature of these local migrations are of very great scientific interest and equally important in a consideration of the management of the species commercially.

More detailed and extensive experimentation is planned for the future.

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Acetaldehyde Accumulation in Excised Wheat Roots Induced by Plant Growth Substances[1]

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It is commonly held that the observed effects of indole-3-acetic acid and other compounds of similar physiological activity must be referable to some basic influence of these compounds on the metabolism of the plant cell. Attempts to reveal this primary effect of the plant growth substances have led to postulated mechanisms concerned with the plasticity of the cell wall (*3*), a relationship between the 4 carbon dicarboxylic acids and auxin (*2*), a coenzyme function for auxin (*9*), a shunt mechanism for 2,4-D (*7*), and others (*1, 9*). Respiratory effects range from stimulation to inhibition (*6*), and may be insignificant at concentrations that have other marked effects (*7*). Current interest in compounds that inhibit pyruvate oxidation because of their similarity to a postulated 2 carbon derivative of pyruvate (*4*) suggested that a number of plant growth substances characterized by side chains of acetate or related to acetate might also affect pyruvate oxidation. Since a convenient and sensitive method for acetaldehyde exists (*11*) it appeared that the formation of this compound from added pyruvate would be a desirable subject to study.

Excised roots of 4-day-old wheat seedlings of the White Federation variety grown in redistilled water according to a technique previously described (*7*) were used. Each sample contained 24 roots cut to 45 mm in length. Before the roots were counted out, all the sections were

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pooled and thoroughly mixed. It was found in some exploratory experiments that all but insignificant quantities of the acetaldehyde produced by the roots could be carried from the flask containing the roots to a receiving tube containing 2% sodium bisulfite by a continuous gas stream. Apparatus used in the experiments consisted of a battery of 25-ml Erlenmeyer flasks, each connected with rubber tubing to a receiving tube (18 × 150 mm). Acetaldehyde produced by the roots in each flask was carried over to the 2% sodium bisulfite solution in the receiving tube by an air or nitrogen stream. The air passed through a dilute NaOH solution and then through water before it entered the flasks. Nitrogen was used directly from the tank. The gas was passed through at a vigorous though undetermined rate. A second bisulfite receiving tube included on several occasions did not pick up acetaldehyde. This demonstrated that rate of gas movement was not too great to prevent complete absorption of the acetaldehyde. The flasks and receiving tubes were mounted on a shaking unit with the flasks in a water bath controlled at 25° C and the receivers in the air at room temperature. Shaking was at about 110 times a minute at an amplitude of 1 cm.

TABLE 1

ANAEROBIC PRODUCTION OF ACETALDEHYDE FROM PYRUVATE* AS AFFECTED BY CERTAIN GROWTH SUBSTANCES

Growth substance	Concentration moles/liter	Acetaldehyde/24 roots	
		µg	% control
Control	.....	8.5	100
Indole-3-acetic acid .	$1\ 10^{-4}$	11.25	131
Indole-3-acetic acid .	$1\ 10^{-3}$	18.25	209
Indole-3-butyric acid	$1\ 10^{-4}$	8.5	100
Indole-3-butyric acid	$1\ 10^{-3}$	14.0	164
Control	.....	5.85	100
2,4-Dichlorophenoxyacetic acid	$5\ 10^{-4}$	26.30	449
2,4-Dichlorophenoxyacetic acid	$1\ 10^{-3}$	6.70	114
Control	.....	5.75	100
Naphthaleneacetic acid	$1\ 10^{-5}$	5.65	98
Naphthaleneacetic acid	$1\ 10^{-4}$	7.50	130
Naphthaleneacetic acid	$1\ 10^{-3}$	17.15	298

* Pyruvate 0.0005M in all cases, adjusted to pH 6.0 with KOH except for naphthaleneacetic experiment at pH 4.8.

The earlier experiments of this study were done with the roots in an atmosphere of nitrogen and a solution of 0.0005M pyruvate, adjusted with KOH to pH 4.5 or 6.0, as indicated in the table. Results of several such experiments involving 4 compounds—indoleacetic, indolebutyric, naphthaleneacetic, and 2,4-dichlorophenoxyacetic acids—at various concentrations are shown in Table 1. All these compounds stimulated acetaldehyde accumulation.

It occurred to us that acetaldehyde production from added pyruvate might also be demonstrated in air if one were to add a sufficient amount of the acid. Very striking effects are produced by auxin, in fact, in 1 hr at pyruvate concentrations of 0.005 M (Table 2).

TABLE 2

THE EFFECT OF INDOLE-3-ACETIC ACID ON AEROBIC PRODUCTION OF ACETALDEHYDE FROM PYRUVATE*

Indole-3-acetic acid moles/liter	Acetaldehyde µg/24 roots
None	0
2.5×10^{-4}	0
5.0×10^{-4}	4.0
7.5×10^{-4}	7.5
1.0×10^{-3}	5.0
1.5×10^{-3}	5.25

* Pyruvate 0.005M in all cases, adjusted to pH 4.5 with KOH.

TABLE 3

AUXIN EFFECTS ON AEROBIC CONSUMPTION OF ACETALDEHYDE AND PRODUCTION OF ACETALDEHYDE FROM ENDOGENOUS MATERIALS

Indole-3-acetic acid moles/liter	Acetaldehyde, µg/24 roots		
	total	excess*	of endogenous origin†
None	0	....	0
2.5×10^{-4}	1.0	....	0
5.0×10^{-4}	20.75	7.0	0
1.0×10^{-3}	25.75	12.0	21.5
2.0×10^{-3}	19.0	6.25	6.0

* Acetaldehyde recovered in excess of the 13.75 µg added originally.

† A second experiment in which no exogenous substrate was added.

It is evident that the increased acetaldehyde production demonstrated in these experiments might be due (*1*) to an increase in the quantity of pyruvate metabolized or (*2*) to a diminished utilization of acetaldehyde. A solution containing 13.75 µg of acetaldehyde was added to root samples with varying amounts of indole-3-acetic acid. The inlet and outlet tubes of the flasks were clamped off, and the flasks were shaken for 1 hr. The flasks were then connected to the receiving tubes and air was passed through in the usual fashion for 1 hr. There is a marked inhibition of the utilization of the acetaldehyde (Table 3, center columns) by addition of auxin, but one also observes that at certain concentrations there is a greater quantity of acetaldehyde recovered than was originally added to the flask. It appears that the growth substance induced production of acetaldehyde from endogenous materials. Results of an experiment run under identical conditions except for the absence of exogenous substrate support this conclusion (Table 3, right-hand column).

Pyruvate may be metabolized through the tricarboxylic cycle or in a number of other possible ways which are referred to in Fig. 1 as "alternate pathways." It is recognized that the evidence for a tricarboxylic acid cycle in higher plants is not complete, but experiments of the sort reported by Machlis (*5*) appear to justify the introduction of such a cycle into the present discussion. At present one cannot definitely assign acetaldehyde a position either as an intermediate in the main pathway of aerobic carbohydrate metabolism or as a product of side

reaction. However, this seems to be of little consequence in the present discussion. Acetaldehyde accumulation (in either event) must be due to the inhibited utilization of pyruvate or one of the products in equilibrium with pyruvate (acetaldehyde, the postulated 2 carbon intermediate, or others). The inhibition would be either one that blocked the entry of pyruvate into the tricarboxylic acid cycle or it would be among all the other reactions that involve pyruvate. The former of these two general possibilities is the more appealing because several auxin effects appear to be due to diminished tricarboxylic acid cycle activity.

Work with respiratory poisons (*5*) suggests that energy released in the metabolism of the organic acids is used in salt accumulation. Inhibition of salt accumulation by indole-3-acetic acid, naphthalene acetic acid (*10*), and 2,4-D (*7*) may well be the result of diminished activity of the tricarboxylic acid cycle. Reversal of the 2,4-D inhibition of salt accumulation by citrate lends support to this idea.

Concentrations of growth substance that affect growth (*6*), and salt accumulation (*7*), do not appreciably influence respiration. This circumstance clearly indicates a qualitative change in the metabolism of the tissues. According to the present proposal, this lack of respiratory effect at low auxin concentrations is possible because

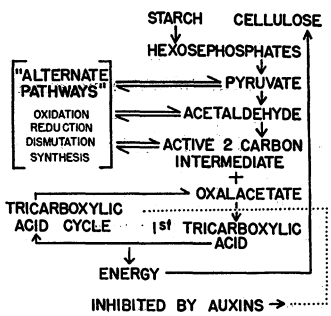

FIG. 1.

oxidations of the alternate pathways can consume all pyruvate (and its derivatives) blocked out of the tricarboxylic acid cycle. At higher levels of growth substance more pyruvate is available than the alternate pathways can utilize, so that there is an accumulation of acetaldehyde and an inhibition of oxygen consumption.

It is possible, by a somewhat less obvious argument, to relate certain growth effects of the auxins to diminished activity of the tricarboxylic acid cycle. This cycle is considered to represent perhaps the most efficient cellular mechanism for the release of chemical energy from carbohydrate. Energy is required for synthesis of the polysaccharides of the secondary cell wall from soluble precursors. Reduced activity of the acid cycle could then be associated with a restriction of these syntheses, with consequent maintenance of cell wall extensibility and capacity for further cell elongation. Increases in the soluble carbohydrates of tissues treated with indole-3-acetic acid (*8*) may also be explained in terms of an insufficiency of the chemical energy required for the synthesis of starch and other reserve carbohydrates from simple sugars.

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Antimycin A, an Antibiotic with Insecticidal and Miticidal Properties

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Antimycin A is a crystalline antibiotic isolated from cultures of an unidentified species of *Streptomyces*. It appears to be an optically active, nitrogenous phenol of the molecular formula $C_{28}H_{40}O_9N_2$ (*1*). Leben and Keitt (*2*) demonstrated the antibiotic properties of antimycin against certain phytopathogens and found that it is an extremely potent fungicide, producing inhibitory effects against *Nigrospora sphaerica* (Sacc.) Mason, for example, at dilutions as high as 1: 800,000,000. The present paper reports preliminary tests designed to investigate the insecticidal and miticidal potentialities of this material.

The initial trials showed that the antibiotic caused mortality to insects which ingested the material rather than by the contact action of the substance on the exoskeleton. For example, the common housefly *Musca domestica* L., sprayed with 10 ppm of antimycin A, showed no adverse effects, whereas 38% of the flies allowed to feed on a ball of absorbent cotton saturated with 10 ppm of antimycin A dispersed in water were killed in 24 hr. Similar results were obtained with the large milkweed bug *Oncopeltus fasciatus* (Dall.). Specificity was indicated, however, since certain insects, e.g., the German cockroach, *Blatella germanica* (L.), were able to ingest 10 ppm of antimycin A dispersed in water and live as long as those feeding on water alone.

The specificity of action was very apparent in a preliminary trial when the standard test wool fabric was immersed in a water dispersion containing 10 ppm antimycin A and offered to larvae of the webbing clothes moth, *Tineola biselliella* (Hum.), and the black carpet beetle, *Attagenus piceus* (Oliv.). The larvae of the webbing clothes moth ate the test swatches with impunity, while duplicate test pieces inhibited the feeding of the black carpet beetle. Further tests were conducted with this beetle comparing antimycin A with sodium aluminum silicofluoride, which is widely used for fabric protection against insects. The standard wool fabric was