since the deflection factor for a signal amplified only by these two stages is 1.5 d-c volts per inch, a d-c amplifier having a gain of only 100 could be used as a pre-amplifier, to obtain a deflection factor of approximately 15 mv per inch.

A differential d-c amplifier described by Schmitt (*6*) was adapted for this purpose. It was designed to amplify small potential differences between two points, each of which has a high impedance with respect to ground. This is a condition often found in biological systems and is characteristic of the living system in the present investigation, since the approximate resistance between the nonpolarizable electrodes on the plants and the grounded soil was several hundred thousand ohms. The input voltage as a function of output voltage of this amplifier is essentially linear for output, peak to peak up to 100 v, and the differential property is nearly perfect until the mean grid potential deviates by more than 200 mv from normal. The gain of the amplifier was about 160.

In order to adapt it for use as a d-c amplifier for the direct-coupled stages of our oscillograph, a slight modification was introduced. Since the total voltage input to the first stage of the oscillograph was designed to be limited to 11 v d-c, this requirement was satisfied at the expense of some of the extra gain by inserting a megohm carbon potentiometer across the output of the pre-amplifier. The positive side of the reduced output was then connected to the oscillograph while the negative terminals were connected to a common ground. The carbon potentiometer also served as the grid return circuit for the first d-c-coupled oscillograph stage.

An example of the photographic recordings of the transient wave form resulting from a mechanical stimulation of the inner surface of the trap of *Dionaea* is shown in the figure. The connections between the metallic input circuit and the surface of the leaf were bridged by nonpolarizable Ag-AgCl electrodes in 0.7% KCl solution, terminating in glass capillary tubes from which a 0.1-mm brush of asbestos fibers protruded.

The stimulus to excite the electrical activity, but not sufficient to produce mechanical closure of the trap, was applied by suddenly bending one of the trigger hairs with a fine glass hook, until the hair made an angle of 45° with the plane of the supporting irritable inner surface of the leaf.

In accordance with the practice commonly used in representing neural action potentials, positive decreases in potential are graphed upward on the *Y*-axis, with the resting potential set at zero. The record shows the rise and fall of potential between the electrodes placed at two opposite but structurally similar points on the outer surface of the lobes of the trap.

The start of the action potential is gradual—there is no evidence of a sudden or explosive change, although the initial acceleration is very great. Its rising phase is smooth, and its crest is reached in 0.1 sec. The falling phase is much slower, so that the peak is situated well toward the side of the rising phase. Overlapping and immediately following the spike, as in neuron compound action potentials, there occurs a negative after potential which shows marked independence of behavior. Next comes the positive after potential. It attains its maximum value in about 0.07 sec, and then decreases until restoration to its resting potential is completed in about 1.5 sec. As the action potentials are picked off at successively greater distances from the point of stimulation, the transients broaden and become lower.

The action potentials run a course characteristic of mammalian nerve in normal physiological condition. Departures from this normal form are governed by the position of the electrodes, health and age of the plant, temperature and intensity of stimulus. The action potential can run its course without producing closure of Venus's-flytrap.

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Contamination in Orthophosphates Irradiated in a Neutron Pile[1]

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In the course of an investigation with plants grown in sand fertilized with rock phosphate irradiated in a neutron pile, the specific activity of phosphorus in the plant material was as much as three times as great as the specific activity of phosphorus in the fertilizer. The specific activities were determined by precipitation of the phosphorus as magnesium ammonium phosphate according to the method of MacKenzie and Dean (*3*). For no apparent reason a selective absorption of P^{32} seemed to be taking place. One possible explanation was the presence of some radioactive contaminant. An investigation was undertaken to determine the nature of the contaminant, if any, and the extent of its presence in different units of pile-irradiated phosphates.

A sample of $KH_2P^{32}O_4$ obtained by neutron pile bombardment of KH_2PO_4 was dissolved in water and made to volume. Not enough potassium was present to affect the total radioactivity appreciably. An aliquot was removed, the phosphorus was precipitated in acid solution as the phosphomolybdate, and the filtrate was made to volume. The phosphomolybdate was then dissolved in 1*N* NH_4OH and made to volume. A second aliquot, just twice the size of the first, was treated in a like manner. A third

[1] Since this paper was prepared for publication, E. D. E. Thomas and D. J. D. Nicholas reported similar findings for Na_2HPO_4 placed in the neutron pile at Harwell, England. (*Nature,* Lond., 1949, **719**, 163).

TABLE 1
PERCENT OF THE TOTAL ACTIVITY IN THE FILTRATE FROM A PHOSPHOMOLYBDATE PRECIPITATION OF AN ALIQUOT OF AN IRRADIATED UNIT OF KH_2PO_4

Portion of sample examined	Method of counting	Relative amounts of sample	Activity in cts/sec	Percent of total activity
Total	Solid	1 ×	41.3	
Filtrate	Solid	1 ×	1.81	4.4
Total	Liquid	4 ×	32.3	
Filtrate	Liquid	4 ×	1.42	4.2
Total	Liquid	8 ×	64.7	
Filtrate	Liquid	8 ×	2.72	4.4

and a fourth aliquot were made to the same volume for the total activity determination. The radioactivity of the solutions was determined by means of a solution counter. An additional aliquot was prepared for solid counting with an end window counter. Instead of making the final solutions to volume, the phosphorus was reprecipitated as magnesium ammonium phosphate. The results are presented in Table 1. An average of 4.3% of the activity was left in the filtrate when phosphorus was precipitated as the phosphomolybdate.

TABLE 2
PERCENT RADIOACTIVE CONTAMINATION BY LOWER VALENCE FORMS OF PHOSPHORUS IN SHIPMENTS OF ORTHOPHOSPHATES

Material	Date of shipment	Percent contamination
Rock phosphate	10/18/48	12.1
KH_2PO_4	4/19/49	4.3
KH_2PO_4	5/10/49	0.0
KH_2PO_4	6/25/49	0.0

A check was made to determine whether the activity in the filtrate was due to incomplete precipitation or the presence of a possible lower state of oxidation of phosphorus. Samples of the stock solution were oxidized in one case by means of bromine water and in a second case by means of $KMnO_4$. The phosphorus was then precipitated as the phosphomolybdate, and the radioactivity in the filtrate was measured. No detectable amount of activity was found in the filtrate. This suggested that some lower oxidation state of phosphorus was present in a radioactive form. A further check on the nature of the contaminant was made. From another aliquot of the $KH_2P^{32}O_4$ phosphorus was precipitated in alkaline solution as magnesium ammonium phosphate. Phosphites are not soluble under these conditions. Pyro and meta phosphates are soluble, although small amounts may conceivably be adsorbed. The fact that no activity was found in the filtrate suggests the contaminant is a phosphite. Hull (*1*) working with P^{32} separated by cyclotron bombardment found $H_3P^{32}O_3$ as a contaminant in an $H_3P^{32}O_4$ solution. These results were repeated using H_3PO_3 as carrier and the same percent of contamination was found.

Three separate samples of $KH_2P^{32}O_4$ from Oak Ridge and one sample rock phosphate irradiated in a neutron pile have been examined for this contaminant, using H_3PO_3 as carrier. The results are presented in Table 2.

The reason for the difference in extent of contamination is not known. The half-life of the contaminant has been determined and found to equal the theoretical 14.3 days for P^{32}. In all probability the contaminant is principally a salt of phosphorus acid. Wilson (*4*) has shown that phosphorus in this form will not exchange for orthophosphate phosphorus. Libby (*2*) has shown that bombardment of P^{+5} with neutrons from a Ra-Be source surrounded by water results in a 50% conversion to P^{+3}. Phosphite salts are quite stable. The lower oxidation states of phosphorus are relatively easily oxidized to the phosphite in the presence of air and moisture.

The implications in the practical use of neutron-irradiated phosphates are twofold. First, any possible use of radiophosphorus, either in tracer work or therapeutically, should take into account the possible presence of this phosphite contaminant of probably high specific activity. Second, a possible method for the preparation of carrier-free phosphorus suggests itself. It would be valid only if the lower oxidation state of phosphorus were caused by the ejection of the phosphorus atom due to some specific nuclear reaction. This would probably be the reaction with sufficient recoil energy for ejection. It would necessitate a slow rate of reoxidation of the P^{+3}.

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Recovery of Growth Regulator from Plants Treated with 2,4-Dichlorophenoxyacetic Acid

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Although plant growth regulators are being extensively employed in a variety of practical applications, relatively little is known of the physiological mechanisms involved and virtually nothing as to the fate of such substances after absorption by the plant. Many of the developmental responses of plants following local application of exogenous growth-regulating chemicals serve to demonstrate that there is transport of a stimulus within the organism. In a few instances evidence has been obtained that the translocated substance is the applied compound itself, or some closely related derivative thereof, rather than an endogenous hormone the formation or movement of which has been influenced by the treatment (*2*, *3*, *5*). Experiments with a radioactively labeled growth regulator (2-iodo^{131}-3-nitrobenzoic acid) have indicated that the *radioactivity* becomes concentrated in meristematic

[1] The authors are indebted to Don C. Wood for performing the indoleacetic acid color tests and to Jean C. Nickerson, Katharine N. Taylor, and Edwin L. Wilson for assistance with the bioassays.