TABLE 2

EFFECT OF BORON ON TRANSLOCATION OF VARIOUS GROWTH MODIFIERS FROM LEAVES TO STEMS OF BEAN PLANTS*

Growth modifier	Amount of acid applied per leaf (γ)	Average curvature (degrees)		Average increase in curvature (%)
		Acid + sucrose	Acid + sucrose + boron	
3-Indoleacetic acid	0.5	2.8	34.2	1120
2,4,5-Trichlorophenoxyacetic acid	0.9	8.0	36.5	356
Alpha naphthaleneacetic acid	2.0	13.4	28.8	115

* One-hundred-sixty micrograms of boron (as boric acid) plus 2000 μg of sucrose were applied together with the designated amounts of acid per leaf. Average curvature based on four replications.

In subsequent experiments boron, 2,4-D, and sugar, separately and in all combinations, were applied directly to the leaves of plants grown in composted soil in a greenhouse. Stem curvatures were used to indicate translocation of 2,4-D. Black Valentine bean plants were subjected during the test to light from Daylight fluorescent tubes (700 ft-c intensity). The primary leaves were 3–4 cm wide and the trifoliate leaves still folded in the terminal buds. The entire upper surface of one primary leaf of each plant (with a lanolin barrier at the distal pulvinus) was treated with 0.02 ml of an aqueous mixture containing ammonium 2,4-dichlorophenoxyacetate (2,4-DNH_4) and 0.1% of Tween 20. Eight plants were used for each type of treatment.

Nine-tenths microgram of the salt induced moderate stem curvature. Ten micrograms of boron together with 0.9 γ of 2,4-DNH_4 increased by approximately 50% the average curvature developed within 3 hr. Larger amounts of boron, including 160 γ per leaf, caused still greater increases in curvature.

Considerable variability in curvature resulted when 2,4-DNH_4 was used alone, probably due to variability in physiological activity of individual leaves (Table 1). Compared with 2,4-DNH_4 alone, 0.9 γ of the salt plus 2000 γ of sucrose reduced the average curvature 75%, apparently because of dilution of the 2,4-DNH_4 by the sugar. In contrast, addition of boron to the 2,4-DNH_4-sucrose mixture more than overcame this dilution effect by increasing stem curvature almost 14-fold (Fig. 1).[2] Even without externally applied sugar, boron accelerated translocation of 2,4-DNH_4 by 114% over that which resulted from the use of 2,4-D salt alone. This experiment was repeated twice and similar results were obtained each time but the magnitude of response varied.

Boron also accelerated the translocation of 3-indoleacetic, 2,4,5-trichlorophenoxyacetic, and alpha naphthaleneacetic acids from leaves to the stems of bean plants (Table 2).

Sucrose, fructose, and glucose plus 0.9 γ of 2,4-DNH_4 and 160 γ of boron were compared as external sugar sources. Two thousand micrograms of the sugar being tested were applied to each leaf. For comparison, leaves of comparable plants were treated with equal amounts of the sugar and 2,4-DNH_4 without boron. Boron with sucrose increased stem curvature by an average of 235, with fructose 427 and with glucose 1520% over that observed on plants not receiving boron.

It is concluded that the accelerating effect of boron observed in these experiments was directly upon movement of sugars and that translocation of growth modifiers was thus indirectly accelerated.

[2] When these experiments were repeated with both solutions adjusted to a pH of 5.4 (pH of the latter) a similar response was obtained.

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A Transplantable Rat Lymphoma

Margaret Reed Lewis[1]

The Wistar Institute of Anatomy and Biology, Philadelphia, Pennsylvania

A neoplasm arose spontaneously in the region of the submaxillary gland of a 1953 female breeder of the Lewis inbred strain of rats. The animal had already borne 3 litters; consequently, her offspring were available for transplantation of the tumor. Microscopical examination of the primary tumor and its metastases showed it to be a lymphoma.[2] Identification of the neoplastic cells by their mode of locomotion in tissue cultures (*1–3*) indicated that the majority of the cells were lymphoblasts, although large and small lymphocytes were also present.

Metastases were found in the mediastinal, axillary, inguinal, and lumbar lymph nodes of the host, and the spleen and thymus were greatly enlarged by growths of tumor cells. Macroscopical examination failed to

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[2] We are indebted to Balduin Lucké, School of Medicine, University of Pennsylvania, for the identification of the tumor.

disclose metastases in the mesenteric and intestinal lymph nodes (Peyer's patches), or in the adrenals, kidneys, liver, lung. intestine, stomach, or thyroid of the host.

The lymphoma proved to be 100% transplantable during 8 passages in rats of the Lewis strain. The majority of rats were 50–70 days old. In rats of this age range, the subcutaneous transplants grew to a moderately large size (20 g) in about 3 wk. The rats developed paralysis of the hind quarters and died about 4 wk after implantation. The rate of growth of transplanted lymphomata was consistently more rapid in younger rats than in older ones.

Transplanted lymphomata are unlike sarcomata in appearance. They are flatter, much flabbier, and more translucent. They have a soft consistency throughout, are free from necrosis, and do not become encapsulated.

When this tumor was cut up in serum or balanced salt solution, many neoplastic cells became free and formed dense suspensions of the lymphocytic cells. Microscopical preparations of the area of tumor implantation showed that the neoplastic cells had disseminated into the surrounding tissue of the host. Multiplication and migration of these cells brought about a widespread local invasion which was considerably thicker in the central portion where the mass of implanted tumor was located. Continued multiplication and migration of the cells resulted later in the extensive flat tumors characteristic of this lymphoma.

In rats bearing transplanted lymphoma, metastases were found in the lymph nodes (with the exception of the mesenteric and Peyer's patches) and in thymus and spleen, but not in every one of these sites in every animal. Many rats bearing advanced lymphomata had metastatic growth in the thoracic intervertebral muscle, and in a few instances metastases were located in the roof of the cranial cavity and around the pituitary. Some rats exhibited malformations of the head which were indicative of intracranial metastases.

The presence of neoplastic cells in the blood stream was demonstrated by stained preparations and also by passage (intravenous, intraperitoneal, and subcutaneous) of blood from tumor-bearing rats into normal rats. Subcutaneous injections of 1–3 ml of whole blood drawn from the heart of a rat with advanced lymphoma resulted in the growth of typical lymphomas at the injection sites.

Subcutaneous implantations of the metastases located in various sites in lymphoma-bearing rats all gave rise to lymphomata similar to those arising from transplants of the primary neoplasm. The origin of implanted metastatic tissue did not influence the type of metastasis arising later in the host. For example, rats implanted with metastases located in the cranial cavity failed to develop an overlarge number of cranial metastases.

A few experiments were carried out in an effort to determine whether early ablation of transplanted lymphoma in rats would prevent the later development of metastases. Owing to the widespread dissemination of the neoplastic lymphoblasts during transplantation of the lymphoma, it was difficult to avoid recurrences when the tumors were excised by the usual surgical procedure.[3] However, when the lymphoma and a large area of the surrounding skin and subcutaneous tissue were first sewed off and then excised, as described by Lewis and Maxwell (*4*), recurrence was slight. Nevertheless, metastases developed in a number of the operated rats even when the tumor had been excised within 5–8 days after its transplantation. The failure of ablation of lymphomata to render the hosts resistant to later development of metastases is consistent with the finding of Lewis and Maxwell that excision of a sarcoma growing in a rat does not protect the host from the growth of a subsequent implantation of tumor tissue.

The rat lymphoma proved unsuitable for studies (*5–8*) in which occlusion of a tumor's blood supply causes it to be absorbed and enables the host to develop tumor resistance. In many instances, the rubber tourniquet used to obstruct the blood supply for the necessary 8–24 hr failed to enclose some of the scattered neoplastic cells. Although the tumors damaged by lack of adequate blood supply became absorbed within 1–2 wk, the scattered neoplastic cells not included within the tourniquet later multiplied and formed a lymphoma.

In studies of the influence of certain therapeutic agents on the growth of carcinomata and sarcomata in mice and rats, it has been found that the majority of these tumor-inhibitory agents, and especially dyes (*9, 10*), bring about atrophy of the thymus without commensurate loss of lymphoid tissue in the treated animals. Since the rat lymphoma metastasizes to the thymus as well as to the lymph nodes, it seemed worth while to study the influence of tumor-inhibitory agents on the thymus and lymph nodes of rats bearing this tumor. The results of these experiments, which will be published later in detail, indicate that oral administration of antitumor substances brings about atrophy of the thymus gland. Frequently, metastases occurred in the lymph nodes of rats in which the entire cortex of the thymus was lacking. The results suggest that the small thymic cells may be influenced by factors that fail to exert an equal effect on the lymphocytic cells in rats bearing transplanted lymphomata.

The addition of this transplantable lymphoma to the large group of primary and transplantable carcinomata, sarcomata, and hepatomata already available for cancer research may prove of value in studies concerning agents that influence the behavior of metastasizing neoplastic cells.

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A New Articular Facet in the Upper Jaw of the Cyprinid Fish Genus *Pseudorasbora*

L. S. Ramaswami[1, 2]

Natural History Museum,
Stanford University, California

In the teleosteans, the upper jaw articulates with the cranium in two regions: anteriorly, the palatine gains articulation with the lateral aspect of the preethmoid bone and there is also a ligamentary connection of the palatine in front of this; posteriorly, the hyomandibula articulates by a single or double head with the sphenotic-pterotic region. This is the methyostylic suspension.

While examining the skulls of fishes of the subfamily Gobioninae (Cyprinidae), I noticed in *Pseudorasbora parva* (Temminck and Schlegel) an interesting additional articulation of the upper jaw. Besides exhibiting the palatine (Fig. 1: ligament facet; preeth. fac.) and hyomandibular (hyomand.) articulations, the upper jaw of *Pseudorasbora* has also gained an articulation by its entopterygoid (entoptery). The latter has a prominent process (prevom. facet) mesially, slightly anterior to its joint with the palatine, by which it articulates with a well-developed facet on the prevomer. This articulation is just behind that of the palatine with the lateral face of the preethmoid.

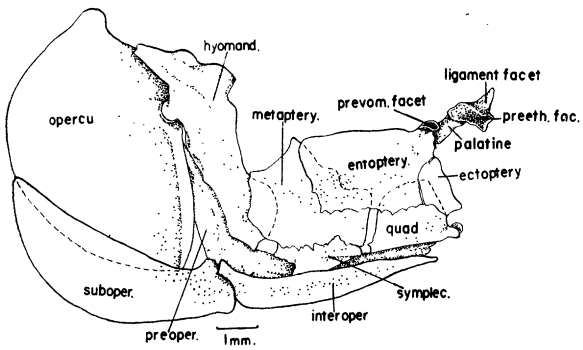

FIG. 1. Mesial aspect of the upper jaw of *Pseudorasbora parva*.

[1] Ford Scholar, Present address: Department of Zoology, University of Wisconsin, Madison.

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The entopterygoid and palatine articulations are both anterior to the lateral ethmoid bone. Exactly how this additional strengthening is helpful to the animal is difficult to say. The fish lives in placid waters, and therefore the new joint may not be adaptational. Even the young of *Pseudorasbora* show the presence of a typical entopterygoid-prevomer joint.

As far as I am aware, the entopterygoid articulation of the upper jaw with the prevomer in the ethmoid region has so far not been recorded for any fish.

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Synergism and Antagonism of Auxin by Antibiotics[1]

M. R. S. Iyengar and Robert L. Starkey

Department of Microbiology,
Agricultural Experiment Station,
Rutgers University, New Brunswick, New Jersey

Various compounds have been found to increase the activity of auxins and others to inhibit or reverse their action (*1–3, 6, 8–10*). This report is concerned with similar effects produced by antibiotics. Three methods were used to test the effects of antibiotics on growth responses of plant materials to indoleacetic acid (IAA): (1) the *Avena* section test of Bonner (*7*), (2) development of cucumber seedlings in sterile agar, and (3) development of cucumber seedlings in moist chambers.

According to the first method, IAA increases elongation of sections of *Avena* coleoptiles floated in the test solution. When used alone, the antibiotics oxytetracycline (terramycin), chloramphenicol, and streptomycin, up to 25 ppm, had no significant effect on elongation, but when used together with IAA (1 ppm) there was greater elongation than from IAA alone. There were no consistent differences in the effects of concentrations of the antibiotics between 1 and 25 ppm. The response to streptomycin in repeated tests was more variable than that to the other two compounds. Citrinin, thiolutin, and clavacin, when used alone, inhibited elongation somewhat, but when used with IAA they reduced the growth-induc-

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