ward. The cold air that chills the United States between October and April acquires its chief characteristics in Canada, Alaska, the northern Pacific, or, less commonly, in the northern Atlantic or in the northern mountain states. Such winds are called "northers" in many parts of the country because of the obvious source. The moisture that accompanies such winds is not, however, derived from the same source.

An outbreak, to the south, of polar air is generally accompanied by a southward displacement of the polar front, a more-or-less continuous east-and-west boundary zone between colder air to the north and warmer air to the south. In the winter, the polar front commonly lies across the United States. On the polar front are developed local eddies (these are 300 miles across, more or less). In each eddy, the polar front may be bent northward toward an apex at the center of the eddy. The left, or west, limb is a cold front, and the right, or east, limb is a warm front. (Mirror image relationships exist between the Northern and Southern Hemispheres.)

The cold air mass, the polar front, and hence the cold and warm fronts move southward, generally from Canada. The precipitation that accompanies the cold and warm fronts, however, is derived from the south. Warm, moist Gulf of Mexico or Atlantic air, lifted by the outbreaking polar air mass, is forced 20,000 feet or more above the ground surface; in the ascent it loses part of its moisture. The cold air, then, moves from the north, but the moisture has its source to the south. The material reviewed in the preceding paragraphs can be confirmed in almost any introductory textbook on meteorology.

It should be reasonably obvious that an outbreak of polar air is not necessary to precipitation of moisture from Gulf or Atlantic air. Should saturated tropical maritime air flow northward across the continent, topographic irregularities would result in a lift similar to that associated with the cold and warm fronts. Such "orographic" rain is in part responsible for the excess precipitation that coastal-plain and foothills areas receive over midwestern states. Under otherwise constant conditions, rainfall is a function of altitude. Nor should it matter a great deal whether the topographic irregularities are composed of rocks or ice.

Many North American geologists have presented the idea that the ice sheet was about 2 miles thick (*1*). Revelle, Sverdrup, and Munk (*2*) have recently suggested that either heat flow from the rocks beneath or plastic flow within the icecap will impose a thickness limit of between 1 and 6 kilometers. If their calculations are accepted, and isotasy is considered, the ice sheet may be treated as an orographic barrier that grew to heights between 5000 and 15,000 feet above undisturbed ground level. Such an orographic barrier, extending in an east-west line across the northern tier of states (or southern Canada), would be nourished by moisture derived from the south and, to a lesser extent, from the east. The northern and northwestern slopes would receive much less precipitation.

The Himalaya Mountains constitute an east-west orographic barrier with a regional altitude at least as great as that given in the preceding paragraph. North of the mountains, annual precipitation is in general less than 25 centimeters, and at all points it is less than 50 centimeters. South of the mountains, annual precipitation falls between a low of 100 centimeters over most of the plain of the Ganges River and a high in excess of 200 centimeters in the foothills and along the southern mountain slopes.

From this description, it may be reasoned that an ice sheet, initiated southeast or south of Hudson Bay, should grow southeastward or southward. Further, the higher it grows, the faster it should grow, until it reaches certain natural limits, such as those suggested by Revelle, Sverdrup, and Munk (*2*), or that imposed by the warmer air to the south. At the time of maximum development, such an ice sheet should have, in a north-south line, an asymmetrical profile, with the steepest slope at the south end of the line, and with most of the profile appearing as a gentle northward slope, tapering off in northern Canada. The southern slope would be of the order of 1 degree.

Further, except for early growth, such an ice sheet should be actively moving only in the zone of the steep southern slope; it should be essentially stagnant in the zone of the gentle northern slope. Such an ice sheet should have, at the time of maximum development, its greatest thickness (and hence the area of greatest scour, deepest depression, and highest rebound) near the southern limits.

A south-facing topographic barrier should have a strong effect on the behavior of the jet stream. Studies in the Himalaya Mountain area (*3*) show that the jet stream passes north of the mountains during summer and south of the mountains during winter. Perhaps an ice barrier such as I have described would not be passed on the northern side; if it were, the jet stream would have no suitable source of moisture with which to nourish the northern slope.

The jet stream is associated with two zones of air, one to the north and the other to the south. At 5000 to 10,000 feet, the northern zone is much the colder, with a temperature differential of the order of tens of degrees Celsius (*4*). Localization of the jet stream south of an ice barrier might serve to stabilize, geographically, this northward temperature gradient and, thereby, help to preserve the ice sheet.

If this is correct, the jet stream would aid in the development of the asymmetrical north-south profile of the ice sheet, and it would be indirectly responsible for the concentration of glacial scour near the periphery of the ice.

An asymmetrical ice sheet with the maximum bulk of the ice centered in the Great Lakes area leads to certain conclusions regarding isostatic loading and rebound, tilting, and the distribution of various ice-formed geomorphic features.

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3 June 1955

Stilbestrol-Contaminated Feed and Reproductive Disturbances in Mice

Serious reproductive disturbances, including scrotal hernia and persistent estrus, have been encountered in the breeding colony of white Swiss mice at the Rocky Mountain Laboratory as a result of inadvertent contamination of pelleted feed with diethylstilbestrol (stilbestrol) during processing in a mill previously used to prepare cattle supplement that contained the drug. Persons in charge of breeding colonies of mice and other small laboratory animals, as well as individuals using these animals for certain endocrinological studies (bioassay for estrogenic activity, pregnancy tests, hormone research), should be alerted to this potential hazard. Although a detailed account of our experience is in preparation, we should like to recount the highlights for the immediate benefit of others who may be confronted with the problem.

The mouse feed used at this institution is prepared according to our formula by a local feed mill. It is delivered in 3000-lb lots at 7 to 10 day intervals. Four separate lots of the pellets were shown to have appreciable estrogenic activity by bioassay (*1*) in 7 to 9-g female mice. None of the basic ingredients (soybean meal, corn, alfalfa meal, and meat and bone scrap) that had been used in preparing these lots of pellets showed such activity when they were similarly tested.

At the time of the disturbance in the mouse colony, the manufacturer of the pellets had not yet begun regular production of cattle supplements containing stilbestrol. However, it was learned that at least one batch of such feed had been prepared at the request of a local veterinarian and that the same mixing equipment had been used to process both the cattle feed and the mouse pellets. As far as we could determine, the cattle supplement had been processed at about the time of preparation of the first lot of pellets that showed estrogenic activity. The processing equipment presumably contained residual drug for some time afterward, since several subsequent lots of mouse feed also had demonstrable estrogenic activity.

In view of our findings, the use of common processing equipment for the preparation of feeds for laboratory animals and livestock supplements containing stilbestrol would seem to represent a serious potential hazard. All groups concerned—feed manufacturers, breeders of laboratory animals, and the laboratory worker—should be cognizant of the problem, since undoubtedly our experience is not unique.

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Note

1. Roy Hertz, National Cancer Institute, National Institutes of Health, kindly performed the bioassays for estrogenic activity.

5 August 1955

Factors Influencing Curvature in the Avena Test for Plant Hormones

In the present study, attempts have been made to determine factors influencing the response of *Avena* coleoptiles to a given concentration of indole-3-acetic acid (IAA) (*1*). The standard *Avena* test method as described by Went (*2*) was used, but with variations as noted. Standard IAA solutions ranged from 15 to 160 μg/lit.

Preillumination by varying exposures to red light, or complete absence of light, during the 3 days of growth prior to testing did not consistently increase or decrease curvature. Red light is customarily used during this period to prevent elongation of the first internode; this facilitates pulling the primary leaf in the second decapitation but produces no effect on curvature.

Table 1. Effect of time interval between the second decapitation and the application of agar blocks. Each figure for curvature represents the average of six plants in response to the indicated IAA level

Time lapse (min)	Curvature (deg) at IAA levels			
	20 μg/lit	40 μg/lit	80 μg/lit	160 μg/lit
5	21.6	33.1	45.5	43.0
15	16.9	27.6	39.0	37.0
30	18.0	24.0	30.3	27.1
60	16.1	19.0	26.1	25.0

High temperatures, often thought to decrease the *Avena* response, had no noticeable effect. Even at 31 to 32°C, excellent curvatures were obtained.

Subsequently, a marked increase in curvature was found when the interval between the second decapitation and application of agar blocks was held to a minimum. The effect of this time lag is shown in Table 1. This effect was demonstrated repeatedly and without fail. The previous practice in this laboratory had been to decapitate the entire series of test seedlings, that is, 10 rows of 12 plants each, and then to apply the agar blocks, imposing a ½- to 1-hour delay between the operations. The present practice is to apply the agar blocks after each row is decapitated. By this method, a single plant may have a curvature of more than 50 deg in response to 100 μg/lit of IAA. By the previous method, about 30 deg was considered the maximum response.

The time lapse between the first and second decapitation had a minor effect on the curvature response. Table 2 indicates that the longer interval between decapitations is preferable.

Reexamination of data presented by Goodwin (*3*) using the soil culture *Avena* technique and by Schneider and Went (*4*) in recommending a second decapitation points to increased sensitivity in agreement with these findings.

The results of the present investigation suggest that auxin regeneration within the coleoptile tip may be responsible for the striking differences in curvature response. The longer interval between the first and second decapitation would diminish auxin regeneration after the second decapitation. The immediate application of agar blocks would permit the maximum effect of unilateral application of IAA before auxin is uniformly regenerated throughout the coleoptile tip.

Table 2. Effect of time interval between the first and second decapitation. Each figure for curvature represents the average of 8 to 12 plants. Agar blocks applied 10 to 15 minutes after second decapitation, that is, every two rows

Time lapse (hr)	Curvature (deg) at IAA levels			
	15 μg/lit	25 μg/lit	50 μg/lit	100 μg/lit
1	11.4	18.1	26.3	36.4
3*	16.4	22.6	31.9	44.7
4	15.9	29.8	38.3	46.0

* Standard interval.

Supporting evidence is found in the high curvatures reported by Skoog (*5*) in the deseeded *Avena* method in which removal of the seed prevents regeneration.

If rapid regeneration of auxin is the case, it might in turn be influenced by preillumination or high temperatures, making the immediate application of agar blocks more or less critical.

Recent reports in the literature indicate that investigators often rely on small differences between average curvatures of less than 10 deg. Increasing the sensitivity of the *Avena* plants by the immediate application of agar blocks will increase the reliability of results as well as eliminate some of the variability found between laboratories.

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References and Notes

1. Published with the approval of the director as technical paper No. 235 of the Pineapple Research Institute of Hawaii.
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8 June 1955

Influence of Thyroxin and Thyroglobulin on Rice Moth Larva

The influence of thyroxin and other thyroidal preparations in different insects has been studied from time to time by various workers (*1*); and, as has been assumed by Goldsmith (*2*), much of the experimental work carried out so far in this field is open to criticism in that dosages were not adequately controlled (possible improvement of the ration by the thyroid supplement or possible toxicity of higher concentrations), and the insects were not of known ancestry. Further, there was no uniformity in the thyroidal preparations used; many used thyroid extracts, some used hydrolyzed thyroids, while a few others used thyroid substance itself from various mammals. It was therefore considered worth while to reinvestigate this subject by using thyroidal preparations of known potency and the larva of an insect that can be easily grown and a pure strain maintained under standard laboratory conditions.