Drift of Sprays, Dusts, Spores
radioactive tracers used in determining
distribution pattern of small airborne particles

R. N. Colwell

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len was either soaked or vacuum infil-
trated in an aqueous—water—solution of
radioactive phosphorous—P32 in the
form of Na,HPO,. It was then filtered,
spread on large pieces of wrapping paper
in a closed room, and permitted to dry.
Each pollen grain acquires approximately
2½ times as much radioactivity from
vacuum infiltration as from merely soak-
ing in the solution.

Upon drying, the particles were found
to have the same size, shape, and state

Similarly, detailed information re-
garding the density of airborne spores
at various distances from their point of
liberation may likewise be helpful in
agriculture. For example:

1. A plant pathologist, in attempting

to check the spread of a disease, may

need spore gradient data—distribution
pattern—for the infectious spores of the
pathogen—the disease-causing virus—in
order to establish the probability of the
disease spreading to host plants at vari-
os distances from the infection source.

2. A plant breeder, attempting to pro-
duce genetically superior seed for plant-
ing, may wish to know how far to locate
his seed-producing stand of selected types
from native stands of unselected types in
order to prevent contaminant pollination
within the select stand by genetically in-
ferior pollen.

A method which may prove generally
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counter readings. The necessity of making laborious pollen counts under a microscope was thereby eliminated. At the same time the Geiger counter differentiates between the treated pollen grains and untreated ones which usually contaminate samples collected under field conditions.

Later, the pollen was collected along various radii from the point of release. Within approximately 100 feet of the release point, collection was made in petri dishes—small shallow saucers—placed at intervals along the ground or at any desired elevation. At greater distances a vacuum sweeper with a filter paper or other fine screen placed over its intake was used to concentrate on a small surface the particles in a large volume of air. The period of time during which the sweeper was in operation was recorded. An estimate of the number of pollen grains per unit area in each petri dish was made by centering the dish directly beneath the window of a Geiger tube and at a fixed distance from it. The average 10 one-minute readings was taken; the background count was deducted; and the net count divided by the counts per pollen grain which were previously established from standardization tests, made with known numbers of the radioactive pollen grains uniformly distributed in petri dishes.

A similar method was used to determine the number of pollen grains collected by the vacuum sweeper, providing a sufficiently large number were present to give a significant reading with the Geiger counter. However, at distances of several hundred feet from the point of release even the vacuum sweeper collected too few pollen grains to permit analysis with the Geiger counter. In such cases radioautographs were made by placing the filter paper or other screen on which the pollen had been collected in contact with X-ray film. In this way, every individual radioactive pollen grain in a dilute sample was distinguishable on the processed autograph; whereas untreated pollen grains did not activate the film.

An advantage of the radioautograph for analyzing dilute samples is that the size of the image formed by each radioactive pollen grain on the film is several times the size of the pollen grain itself. This, combined with the sharp black-and-white contrast between the pollen grain images and adjacent portions of the autograph, permits a count of the pollen grains in dilute samples without magnification and laborious searching of a large surface. Where the density of pollen grains is so great that their images blend thereby preventing an accurate count on the autograph, there is sufficient radioactivity in the total sample to permit use of the Geiger counter. Thus the counter and autograph complement each other in establishing the entire gradient.

The volume of air which had been sucked through the vacuum sweeper during the collection period was determined by placing a small anemometer directly in front of the intake of the sweeper, fitting it tightly to the attached screen and measuring the velocity of wind sucked through the sweeper per unit time.

During the course of the experiment a continuous record was kept of wind direction and velocity, air temperature, and barometric pressure.

In a recent experiment using 10 milli-curies of P32—which costs about $5—approximately 10 billion pollen grains were vacuum infiltrated. This gave each grain an initial activity of approximately one count per minute on the Geiger counter. Since the counter used has a capacity of over 20,000 counts per minute some appreciation is given of the density range that can be analyzed. If, as in this experiment, there are as many as 40,000 pollen grains or more in a single petri dish at the peak of the gradient thus making it initially too hot to count, the dish can be analyzed after a suitable cooling-off period, the length of which depends upon the half life of the radioactive tracer used.

Experiments now in progress seek to establish simultaneously the separate spore gradients from two different points by labeling one lot of spores with P32 and the other lot with a radioactive tracer, such as radioactive sulfur—S35—having an appreciably different half life and energy of radiation. Such information is of value in certain plant breeding experiments.

The above techniques would seem directly applicable to establishing the distribution pattern of agricultural chemicals applied in dust form, with modifications perhaps being required if the size of the dust particles is quite variable. For chemicals applied in spray form, once the tracer is mixed uniformly throughout the solution to be sprayed and the activity per unit volume of solution is determined, Geiger counter readings made on the various collection surfaces should be directly indicative of the volume of solution deposited regardless of particle size of the spray during dissemination.

If, as in certain cases, effectiveness of treatment depends on the amounts of dust or spray deposited on top and bottom leaf surfaces the techniques herein described should readily yield the needed information, providing a radioactive tracer is used which has a sufficiently low energy of radiation that it cannot penetrate the thickness of the leaf.

Radiological health officers have expressed assurance that there is no appreciable health hazard involved in experiments of this type conducted in the field. However, it is advisable for those working within a few feet of the point of release to wear a respirator to avoid inhaling large quantities of the radioactive spores.

Detailed results of the experiments mentioned here and others currently in progress will be published at a later date.

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EGGS

Continued from page 6

that selection on the basis of the hen-housed production of pullets to January 1st of their first laying year presents optimum opportunities.

Primary emphasis should be laid on family averages but the superior qualities of individual pullets from good families should not be entirely neglected. This former could be a family and individual selection basis which can be applied to sister testing and to progeny testing. It seems that sister testing is a more efficient tool than progeny testing, so that for fastest gains only a limited portion—10% to 20%—of the breeding flock should be selected on the latter basis.

The plan suggested may be expected to produce relatively rapid gains in the production index, and also should cut down the current cost of breeding operations to a considerable extent. This follows from the fact that a flock under test need not be individually trapnested after January 1st—except for the birds selected for breeding.

It is possible that even without the science of population genetics, breeders in the field would eventually arrive at similar conclusions by the laborious and costly method of trial-and-error. Many techniques have been developed in the past in such a manner. There is, however, full reason to believe that the understanding of the genetic principles recently gained is bound to lead to more efficient ways of improving breeding procedures and to lead to genetic improvement in egg production more rapidly and with greater certainty than heretofore.

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