# Drift of Sprays, Dusts, Spores

## radioactive tracers used in determining distribution pattern of small airborne particles

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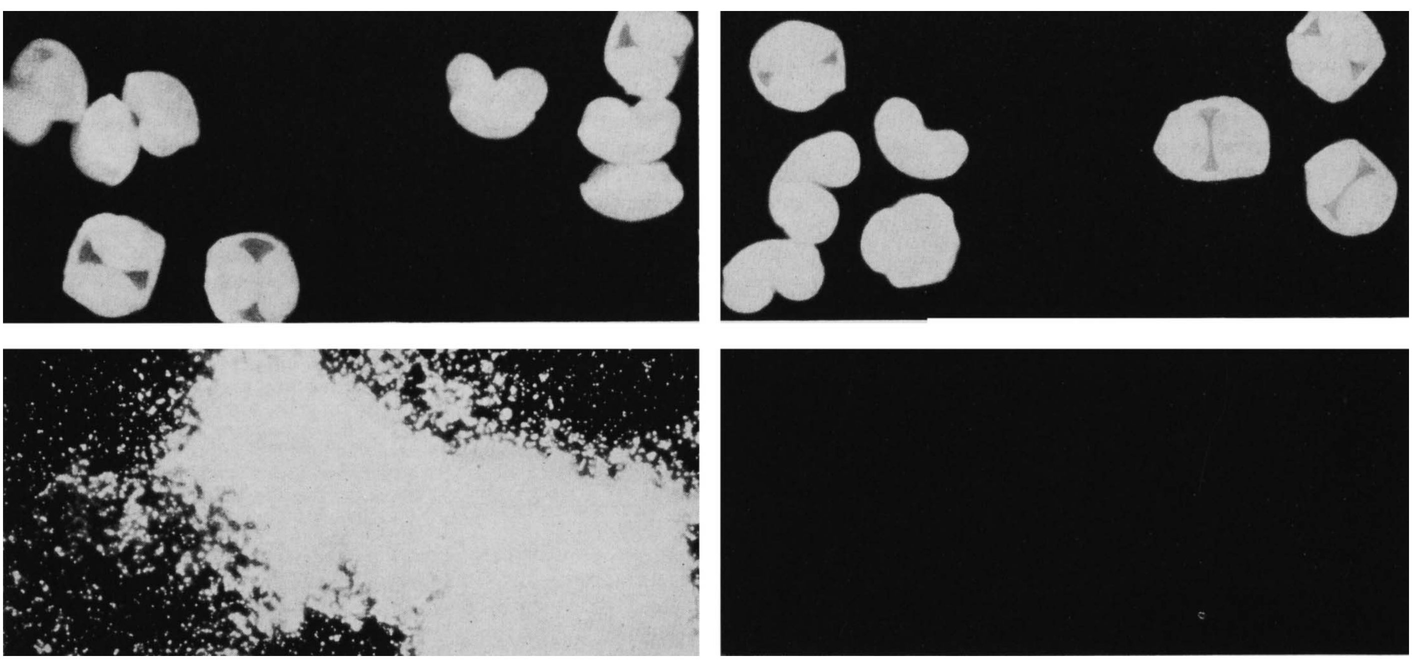
**Spraying and dusting** of agricultural crops with insecticides, fungicides, herbicides, hormones or fertilizers can be made more effective through accurate information as to the distribution pattern obtainable under various sets of conditions.

Possible injury to nearby crops or animals caused by the drifting of these chemicals emphasizes the importance of such information, especially where distribution is made from aircraft, thus increasing the opportunities for drift.



***Upper left and right.*** **Photomicrographs—enlarged 210 times—of treated and untreated pine pollen respectively, showing that treatment has not noticeably altered the size or shape of pollen grains nor their tendency to adhere to each other.** ***Lower left and right.*** **Radioautographs, contact size, of treated and untreated pine pollen, respectively, made by dusting comparable amounts of pollen on a piece of filter paper and placing in contact with X-ray film for 13 days. Only treated pollen grains activate the film.**

Similarly, detailed information regarding 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 various distances from the infection source.

*2.* A plant breeder, attempting to produce genetically superior seed for planting, 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 inferior pollen.

A method which may prove generally useful in determining the distribution pattern of small particles, and thereby help to solve the foregoing problems, is suggested by an experiment with pollen of Coulter pine which was labelled with a radioactive tracer to facilitate its detection and quantitative analysis. One object of this experiment was to estimate the likelihood, at various distances from the point of pollen release, that the pollen will drift to Jeffrey pines and result in the formation of Coulter-Jeffrey hybrids—thereby combining the good tree form of Jeffrey pine with the fast growth and weevil-resistance of Coulter pine.

In the experiment freshly collected pollen was either soaked or vacuum infiltrated in an aqueous—water—solution of radioactive phosphorous—P32 in the form of $Na_2HPO_4$. 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 soaking in the solution.

Upon drying, the particles were found to have the same size, shape, and state of aggregation as the untreated pollen and to have the same rate of fall through a long vertical glass tube. From this it was concluded that the particles are ballistically unchanged by the treatment.

The radioactivity per treated pollen grain was established with a Geiger counter and found to be quite constant. This permitted estimates to within about 10% as to the number of radioactive pollen grains in a sample from Geiger

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## DRIFT

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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.

The treated pollen was then released in the field under conditions simulating its normal release from the tree.

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 millicuries 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

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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 forms a combined 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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