tory effect was diminished considerably. No hemagglutinin was detectable in the 24-hr harvest but after 48 hr the virus titers were similar to those of the controls. The effect was also less pronounced when the challenge dose of virus was increased to 10,000 EID_{50} and injected immediately after the HMF solution.

The influence of the HMF on the 48-hr growth curve of the PR8 virus is shown in Fig. 1. In this experiment, one series of 40 embryos was inoculated with a solution of 20 mg of HMF in 0.5 ml of saline by the allantoic route, and a 2nd series of 40 embryos with 0.5 ml of saline by the same route. Immediately thereafter both series were challenged intra-allantoically with 100 EID_{50} of PR8 virus. The allantoic fluids of groups of 5 eggs from each series were harvested at the indicated time intervals and pooled, and the infectivity titers for chick embryos of the pools were determined. In this experiment, HMF of low potency had to be used because none of the more potent fractions were available in the quantity needed for growth curves, yet significant differences in the treated and control series could be demonstrated up to the 48th hr of incubation (Fig. 1).

Mumps: Eight-day-old chick embryos were injected with 20 mg of HMF in 0.5 ml of saline solution intra-allantoically and subsequently infected with 10,000 EID_{50} of mumps virus by the same route. The allantoic fluids were harvested after 6 days and pooled. Viral hemagglutinin could not be demonstrated in the pools. The infectivity titrations of the 6-day pools of allantoic fluid showed 0.01% of the virus present in the control samples.

The inhibitor for influenza and mumps virus multiplication found in human breast milk is not identical with the mucoprotein inhibitor of hemagglutination since (a) the HMF does not inhibit hemagglutination; (b) its inhibitory effect is not destroyed by RDE or by incubation with active virus; and (c) the HMF's have been deproteinized.

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Comments and Communications

2,4-D Herbicides Pose Threat to Cotton and Other Susceptible Crops

QUITE reminiscent of the cattle-sheep wars of the Old West is the present controversy between the cotton growers and rice growers in the South. The focal point of this argument is the vast fertile area known as The Delta in the state of Mississippi. However, the controversy is going on in many other areas, wherever 2,4-D herbicides are being used near susceptible crops such as cotton, grapes, beans, and several others.

The problem has become acute in the Mississippi Delta because of the recent introduction of rice as a crop. The growing of rice in this section is economically feasible. But one of the great problems is that of controlling coffee-weed, and this is where the 2,4-D herbicide enters the picture. Rice, of course, is a member of the grass family and as such is not sensitive to 2,4-D, but the coffee-weed is killed by it. The result is that 2,4-D in its various forms is sprayed on the rice paddies to control this weed. The herbicide can be applied by means of ground equipment, but it can be applied much cheaper as a spray from airplanes. This is where the trouble starts that has resulted in damage suits totaling several hundreds of thousands of dollars.

What makes the problem of scientific interest is the fact that cotton, especially, is almost fantastically sensitive to 2,4-D and related compounds. It has been stated facetiously that if one walks through a field of cotton with a label from a 2,4-D container in one's pocket the cotton will be damaged. Yet it is possible that if 2,4-D had been spilled on the label some damage to nearby cotton might occur.

To illustrate a similar condition, a case may be cited that occurred several years ago. On one large plantation a dry spray rig was driven down a plantation road between fields of cotton. This spray rig had not been used to spray 2,4-D since the year before. The amazing fact is that moderate but typical 2,4-D damage showed up on one side of this road for several hundred feet. Presumably this was on the side toward which the wind was blowing at the time the equipment was moved.

The above is an extreme case, to be sure, but many other instances could be cited almost as spectacular. During the summer of 1953 typical 2,4-D damage to cotton appeared along several highways in a number of southern states. As nearly as can be ascertained, this was caused by leaking containers of the herbicide that were being hauled along highways in trucks.

Most of the damage to susceptible crops appears to result from spray application either from the ground or from the air. The use of dusts containing 2,4-D or other hormone-type herbicides was outlawed by the Civil Aeronautics Authority several years ago because of the extreme hazard from drift. The spraying of 2,4-D from airplanes has often resulted in great loss. In one instance 4000 acres of vineyards were damaged by drift from air application of herbicide over grain fields 4–15 miles away. Case after case might be quoted where cotton was damaged both from the ground and from aerial application. It is not at all unusual for

severe damage to occur 4 or 5 miles away from the site of ground applications. There have also been cases where insecticides have been contaminated with minute amounts of 2,4-D. In one such case an insecticide manufacturer paid damages of $50,000 to a large cotton plantation owner for such alleged damage.

In many cases the manner by which the herbicide drifted onto the susceptible crop is almost inexplicable. There have been cases where severe damage occurred to cotton that was up-wind from the site of 2,4-D application. The only explanation is that later air currents picked up the herbicide and transported it. Another rather amazing case occurred in the South during 1953. Cotton was damaged by 2,4-D that was applied before the cotton was planted. What appears to have happened is that the herbicide was applied to control willows. The season was dry, and the chemical collected in the dust and soil. Later, winds picked up the contaminated dust and carried it for many miles to damage cotton.

In order to determine just how much 2,4-D is required to cause damage to cotton, the Mississippi Agricultural Experiment Station ran some tests last year. It was found that less than ½ g/acre was sufficient to cause deformation of the leaves of seedling cotton. This is an infinitesimal amount when it is considered that it is spread over an acre. Some types of 2,4-D are much more volatile than others, but the fact remains that any of them may be carried by air currents for considerable distances and that after leaving the spray nozzle they are no longer under human control.

The result of all of this is that various states have passed regulations in an attempt to reduce the damage caused by 2,4-D, 2,4,5-T, and related hormone-type herbicides. Some states even require that all sales of these compounds be recorded as in the case of narcotics. Texas requires that a $20,000 surety bond be posted before permission may be obtained to apply 2,4-D. Other regulations specify minimum distances from susceptible crops.

ROSS E. HUTCHINS

Mississippi State Plant Board
State College, Mississippi

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Malignant Tumors and High Polymers

A possible explanation of "Malignant Tumors Resulting from Embedded Plastics in Rodents" (*1*) is that many high polymeric materials contain free radical groups as the result of residual initiator, enclosure of growing chains, or pyrolysis or peroxidation of polymer or plasticizer during calendering or molding. In the case of cellophane, radical-forming groups are introduced in the xanthane stage. By transfer of unpaired electrons to (or capture from) molecules in surrounding tissues, free radical chain reactions would be started identical to those initiated, for example, by x-radiation or radioactivity. Many, if not all, carcinogens are compounds capable of forming free radicals (*2*).

If such be the case, the following predictions may be made as to the relative carcinogenicity of polymers and should serve as a basis for testing this hypothesis.

a. The most actively carcinogenic resins should include proliferous ("popcorn") polymer (*3*), because of its extraordinary reactivity, and products of negative free radical initiation by metallic sodium (*4*), hydroquinone and diazoamino-benzene (*5*), or other reducing agents, because of the reduced probability of termination by initiator or growing chain radicals of like charge.

b. The usual peroxide-initiated addition polymers should possess the same order of magnitude of carcinogenicity regardless of their functional groups or chemical reactivity.

c. Polyvinyl alcohol (*6*) and acetals (*7*) might be expected to contain fewer free radicals than polyvinyl acetate because of the alcoholysis and acetalization steps in their preparation.

d. Ionic polymerization, initiated, for example, by aluminum chloride (*8*), should give resins of low carcinogenicity, as should condensation polymerization of polyesters and polyamides.

It must be pointed out that oxidation and pyrolysis during high-temperature processing could alter the content of polymeric free radicals. Preferably, films for the proposed experiments should be cast from solution in solvents other than ketones or ethers.

It might be questioned whether Dr. Oppenheimer's two principal limitations on the free-radical hypothesis, the problem of transport and carcinogenesis by condensation polymers, might not be explained by chain transfer reactions within the body and by peroxidation at secondary or tertiary carbons during processing, respectively. In the case of nylon, a possible course of the latter would be:

$$\text{—CH}_2\text{—CO—NH—} \xrightarrow{O_2} \text{—}\dot{\text{C}}\text{H—CO—NH—} \xrightarrow{O_2} \text{—CH(OO}\cdot\text{)—CO—NH—}$$

$$\xrightarrow{RH} \text{—CH(OOH)—CO—NH—} \rightarrow \text{—CH(O}\cdot\text{)—CO—NH—} + \text{HO}\cdot\text{, etc.}$$

ANDREW F. FITZHUGH

Shawinigan Resins Corporation
Springfield, Massachusetts

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REFERRING to the comment by Andrew F. Fitzhugh dated September 16, 1953, we would like to submit the following: The appearance of tumors of malignant character adjacent to or surrounding embedded synthetic high polymers would seem to indicate the diffusion of carcinogenic agents into neighboring cells,