been a much better substance to use than cloves, which is detected through its pungency. Accordingly, Milton F. Metfessel, of the Psychology Department, and the senior author repeated the experiment on olfactory identification during exhalation, using β-phenyl ethyl alcohol, a substance that smells very much like roses.

Although a mere trace of the substance in a room produces a strong fragrance, under the conditions of the experiment most subjects (5 of 7) reported only a faint or transitory smell, and the others (with which Forrester's sensations agreed) were conscious of a strange sensation which, as one of the observers said, was "not a smell exactly." These results may, perhaps, be explained by the rapid adaptation that occurs for strong doses of the substance.

A positive check on the theory may have to await a test of the type suggested above, and Metfessel and Forrester are investigating its practicability.

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The Potentiation of DDT against Resistant Houseflies by Several Structurally Related Compounds

Wooten T. Sumerford, Mary B. Goette, Kenneth D. Quarterman, and Sheely L. Schenck

Technical Development Services, USPHS, Savannah, Georgia

The discovery of a potent synergist for DDT against DDT-resistant insects would provide a means of controlling such insects in the field (especially the housefly) and might be helpful in elucidating the mechanism of resistance.

Claims have been made that at least three quinones (*1*), two fluorinated DDT-analogs (*2*), octachloro-4,7-endomethylene-tetrahydrohydrindine (*2*), several halogenated phenols (*2*), some 2,4-dinitrophenols (*3*), three diaryl sulfides (*4*), and sabadilla (*5*) promote and extend the toxicity of DDT toward certain insects. More recently, Perry and Hoskins (*6*) reported a marked increase in effectiveness of DDT-piperonyl cyclonene (the latter in considerable excess) against DDT-resistant houseflies, but not against susceptible strains.

Most of the synergists listed above were tested in this laboratory at a 1 : 10 ratio with DDT against DDT-resistant houseflies and were found to be weakly or only moderately active. This appears to confirm the observation of Perry and Hoskins (*6*) that the DDT-resistance of houseflies depends on one or more biological factors not encountered in the normal fly.

It is possible that the mechanism of DDT-resistance developed by the insect could be interrupted by a compound structurally related to DDT, and more especially by an analog which shared a good measure of its physical properties. In fact, this is borne out by the fair degree of synergistic activity provided for DDT by its *p,p'*-difluorine analog, 2,2-bis(*p*-fluorophenyl)-1,1,1-trichloroethane (*2*). It therefore appeared worth while to test a series of DDT analogs, both with and without insecticidal activity, for their synergistic effect toward DDT, with especial reference to field strains of resistant flies. This is the first report of an investigation of this series of compounds for their synergistic activity.

The selected compounds, listed in Table 1, were tested as synergists for DDT by dissolving 125 mg of each separately in 25 ml of a 5% solution of DDT in methyl ethyl ketone. This solution was pipetted on a poster board surface at the rate of 200 mg DDT and 20 mg of candidate synergist per sq ft. (Conventional glass panels could not be used in these tests because of the failure of the DDT-synergist combinations to crystallize adequately even with waiting and stroking.) The solvent was allowed to evaporate, and test lots of approximately 40 wild DDT-resistant flies were held in contact with the deposits in Petri-dish wall cages (*7*) for a period of 2 hr. The flies then were removed and held under optimum conditions for recovery for a period of 24 hr. Mortality counts were made, and the percentage kills of female flies are given in Table 1.

TABLE 1

TWENTY-FOUR HOUR MORTALITY OF WILD FEMALE DDT-RESISTANT HOUSEFLIES FOLLOWING A 2-HR EXPOSURE TO A DEPOSIT COMPOSED OF DDT (200 MG/SQ FT) AND A CANDIDATE SYNERGIST (20 MG/SQ FT) ON A POSTER BOARD SURFACE

No.	Synergist	Ratio of percentage mortality*
1	2,2-bis-(*p*-Chlorophenyl)-1,1,1-tribromoethane	10/1, 16/17
2	2,2-bis-(*p*-Chlorophenyl)-1,1-dichloroethane	14/7
3	1,1-bis-(*p*-Chlorophenyl)-ethanol	89/0, 63/7, 80/11
4	1,1-bis-(*p*-Chlorophenyl)-2,2,3-trichlorobutane	4/7
5	2,2-bis-(*p*-Fluorophenyl)-1,1,1-trichloroethane	11/7, 10/0
6	2,2-bis-(*p*-Bromophenyl)-1,1,1-trichloroethane	3/7
7	2,2-bis-(Phenyl)-1,1,1-trichloroethane	18/7
8	2,2-bis-(*p*-Ethylphenyl)-1,1,1-trichloroethane	10/7
9	2,2-bis-(*p*-Hydroxyphenyl)-1,1,1-trichloroethane	6/17, 3/1
10	2,2-bis-(*p*-Ethoxyphenyl)-1,1,1-trichloroethane	3/1, 34/17
11	1-(*p*-Chlorophenyl)-2,2,2-trichloroethanol	9/7, 8/0

* The numerators in these ratios are the average percentage kills produced by replications of the DDT-synergist combination on a single day. The denominators are the average percentage kills produced by DDT alone in a comparable number of replications. The multiple ratios were obtained by repeating the tests on more than one day.

1,1-bis-(*p*-Chlorophenyl)-ethanol is the outstanding compound among those under test, as judged on the basis of its consistent performance in the individual tests and the relative potency of its combination with DDT. This compound, which has been advanced as a miticide under the name *p,p'*-dichlorodiphenyl methyl carbinol (DMC), is the active ingredient of the proprietary product "Dimite" (*8*). The potency of DMC, coupled with its availability, prompted additional tests. The carbinol was mixed with DDT in varying proportions and tested under the conditions described above. The results are shown in Table 2.

TABLE 2

TWENTY-FOUR HOUR MORTALITY OF WILD FEMALE DDT-RESISTANT HOUSEFLIES FOLLOWING A 2-HR EXPOSURE TO DDT-DMC DEPOSITS ON A PAPER BOARD SURFACE

Test No.	Toxicant	Concentration (mg/sq ft)	Average mortality (%)	Replications
1	DDT	200	6	9*
2	DDT DMC	200 2	15	3
3	DDT DMC	200 20	78	7†
4	DDT DMC	200 25	73	2
5	DDT DMC	200 40	87	2
6	DDT DMC	200 100	83	2
7	DDT DMC	200 200	76	5‡
8	DDT DMC	20 200	2	3
9	DMC	200	0	3

* Replications made over a period of 25 days.
† " " " " " " 21 " .
‡ " " " " " " 4 " .

The synergistic effect of DMC on DDT was evidenced at the dosage level of 1 part DMC to 100 parts DDT. Very high kills were obtained from a combination of 100 parts DDT and 10 parts DMC, but the latter mortality rates were not raised appreciably by increasing further the proportion of DMC up to 50% of the mixture. Very low kills of houseflies were obtained from a deposit composed of 100 parts DMC and 10 parts DDT, the same dosage level at which the reverse combination is quite toxic. DMC alone gave no mortality among female houseflies.

The enhanced activity of the DDT-DMC combination is further pointed up by the fact that the following combinations were highly toxic to DDT-resistant flies: (*a*) DDT with 1,1-bis(*p*-fluorophenyl)-ethanol; (*b*) 2,2-bis(*p*-fluorophenyl)-1,1,1-trichloroethane with DMC; and (*c*) 2,2-bis(*p*-fluorophenyl)-1,1,1-trichloroethane with 1,1-bis(*p*-fluorophenyl)-ethanol. The last combination was the most effective of the three.

In preliminary field tests, a residual application of 200 mg DDT and 40 mg DMC failed to give lasting results against a highly resistant strain of flies at a dairy near Savannah. However, in limited field tests of outdoor mist space sprays against the same highly resistant houseflies, a water emulsion of 5% DDT and 1% DMC has given results approaching those originally obtained with DDT against nonresistant flies.

Preliminary experiments indicate that some DDT-DMC combinations may be more toxic to white rats on an acute oral basis than either compound alone. The breadth and mechanism of the synergistic effects of DMC on DDT in both insects and mammals are under investigation in both the laboratory and the field.

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Submarine Canyons: A Joint Product of Rivers and Submarine Processes[1]

Francis P. Shepard

The Scripps Institution of Oceanography, La Jolla, California

The abandoned sea-level-lowering hypothesis. This note is written in the hope that the writer will not continue indefinitely to be tied to the now long-discarded hypothesis that submarine canyons are the result of a lowering of sea level amounting to several thousand feet, which was thought to result from the formation of huge ice caps. This hypothesis was offered as a somewhat forlorn hope that seemed, at the time, to be the only way out of an enigma. Discoveries of the past few years have indicated that no such great lowering took place during the Pleistocene. The large submergences indicated by a considerable series of oceanographic discoveries appear to be more remote in age and to have, therefore, no relation to glacial control. Despite recent articles (*1*) and talks given before scientific societies during the past two years it has proved most difficult to bury the old hypothesis. In offering an alternative explanation with little amplification it should be noted that a much longer article is being prepared. This will give a complete account of the basis for suggesting still another origin for the much-abused submarine canyons.

A new composite hypothesis. New oceanographic information can now be combined with information from drill cores along the coasts and on islands to build a composite hypothesis that accounts for submarine canyons without appealing either to enormous movements of land or of sea level or to the excavation by powerful submarine currents for which there is no

[1] Contribution from the Scripps Institution of Oceanography, New Series No. 524.