	Ratio of phosphorus-32 to total phosphorus in organism × 10^{-7}
Alga	660
Sphagnum	10
Cranberry	3
Leather leaf	1
Yellow water lily	2
Sponge	500
Zooplankton	13
Fish	2

As the table shows, maximal values are observed for alga and sponge, the simplest forms dealt with. Next, but much lower, come sphagnum and *Diaptomus*. Fish and higher plants make up a still more sluggish group. The high value for *Diaptomus* as compared with fish is, perhaps, related to (*a*) the short life of a generation of plankton organisms, making a rapid turnover of material necessary, and (*b*) the mass of inorganic phosphate in a fish skeleton, which is renewed fairly slowly. This slow exchange is demonstrable by radioautographs. No specific deposition was observed at nine days, but by fifteen days *Notemigonus*, as shown in Fig. 2, had laid down the phosphorus-32 in the axial skeleton and at the bases of the fins.

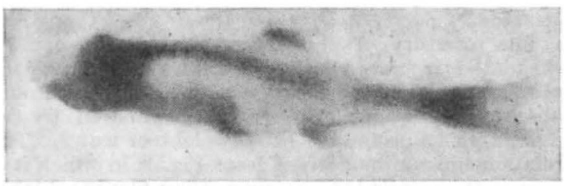

Fig. 2

In both systems of measuring intensity of uptake, the sphagnum ratios are below some of the others. Nevertheless, sphagnum is believed to be the main agent for the removal of phosphorus-32 in this lake, because of its great abundance.

A full account of this work will be published elsewhere.

D.D.T.-RESISTANCE IN HOUSE-FLIES IN DENMARK

By J. KEIDING and H. VAN DEURS
Statens Skadedyrlaboratorium, Springforbi, Denmark

SINCE early in 1944, when insecticidal products containing D.D.T. were first put on the market in Denmark, a great proportion of the available D.D.T. has been used for fly control on our farms. The commonest practice has been to spray the inside of cowsheds, pigsties, etc., with a water suspension or emulsion, usually containing not more than 0·05–0·1 per cent D.D.T., at the rate of about 0·1–0·2 gm. D.D.T. per sq. metre. The spraying must be carefully done. This dosage may seem rather small; but in the first year or two it worked well in most places, and many farmers were able to keep their farm buildings free from flies by spraying two or three times a year.

In 1944 only a comparatively small percentage of the farmers in Denmark used D.D.T. against flies. In 1945 many dairies started control of flies by regular spraying of the cowsheds, etc., of their suppliers, and in 1946 this organised control was in action all over the country.

Already in 1946 there were some isolated complaints of failing effect, and in the summer of 1947 the fly control failed in a great many places. It was attributed to careless spraying, as well as to the unusually hot summer, the effect of the high temperature being an increased production of flies in the dung-heaps, etc., a decrease in the toxicity of D.D.T. to insects[1], and possibly a more rapid deterioration of the deposits on limewashed surfaces[2].

Early in 1948 we received accounts from various places of flies which "could not be killed with D.D.T.", even with much higher dosages than usually recommended. Houseflies (adults, pupæ and larvæ) were collected from six of these places and the strains so obtained (r_1, r_2, r_3, etc.) were bred by a modified N.A.I.D.M. procedure[3] in parallel with the non-resistant laboratory strain (lab) which has been bred from flies taken on a farm near Copenhagen in October 1945.

The results of the first laboratory tests showed unmistakably that all six *r*-strains were several times more resistant to D.D.T. than the laboratory strain.

In order to simulate our common type of stable wall, lime-washed flowerpots (6 in. in diameter) were used as test containers and sprayed (or dusted) evenly on the inside with measured dosages of insecticide. Most of the tests were made by exposing the flies continuously to the treated surface, the opening of a container being covered with a loose glass plate during tests.

The first results were confirmed in a great number of laboratory tests with several D.D.T. residual-spray formulations, dusts, etc., using later generations of the *r*- and lab-strains. Whereas the lab-flies might be 'knocked down' and moribund within an hour or even half an hour with a dose of 2 gm. D.D.T. per square metre, some of the *r*-flies could live for days exposed to the same surface; we have even had *r*-flies, white all over with 33 per cent D.D.T.-dust, which lived for several days. In the accompanying table, examples are given of some of the initial tests with three of the *r*-strains and the lab-flies.

Reaction of lab-flies and *r*-flies to continuous exposure to residual-spray deposits of D.D.T. on limewash

Insecticide dose	Flies: Strain	Flies: Number	Av. percent. of flies knocked down after ½	1	3	6	24	48 hr.
D.D.T 5% oil-solution 2 gm. D.D.T./m.^{2}	lab	29+26+31	94	100				
	r_1	19	0	0	0	0	11	11
	r_2	25+18	0	2	37	40	58	72
	r_3	22+11	0	0	3	6	18	36
D.D.T. 25% wettable powder 2 gm. D.D.T./m.^{2}	lab	22+29+34	87	100				
	r_1	22	0	0	0	0	68	68
	r_2	40+20	2	17	38	47	98	98
	r_3	22+7	0	7	21	24	66	76
D.D.T. 25% wettable powder 1 gm. D.D.T./m.^{2}	lab	25+31+32	90	100				
	r_1	21	0	0	0	10	43	52
	r_2	42+30	0	6	28	40	100	
	r_3	20+7	0	0	7	7	52	70

The resistance was not quite the same in all the *r*-strains, as one might expect; in later generations, however, the differences have become slight, as the resistance of the most resistant strains has decreased although it is still remarkably high after seven to nine generations. In order to secure a highly resistant strain, some flies were bred in a cage treated with a whitewash containing about 0·3 per cent D.D.T.

Since the demonstration of D.D.T.-resistance in the laboratory, we have had numerous reports of

© 1949 Nature Publishing Group

D.D.T. failing to control flies even with high dosages. Although no thorough survey has been made, we have enough information to show that populations of flies resistant to D.D.T. in greater or less degree occur commonly in most parts of Denmark, and dominate in some districts.

In almost all cases of which we have information, the flies did not show high resistance during the first D.D.T.-treatments. In some cases resistance was noticed the year after the first D.D.T.-treatment; but, in general, resistant flies were not observed until after two to three years of successful control with D.D.T.

Obviously the resistance has developed simultaneously in a great number of populations (the flies of a single farm probably often acting as an isolated population), and to us the most reasonable explanation is that these populations already contained a small proportion of flies with genes determining D.D.T.-resistance; through a number of generations this proportion has increased rapidly as a result of a continuous selective extermination of non-resistant flies, until finally the entire population consists of the resistant genotype.

In our attempts to find ways of controlling the D.D.T.-resistant flies, tests have been made with six contact insecticides, which may be grouped as follows:

(1) Compounds with a D.D.T.-like structure:
'Methoxychlor': 2,2-di-*p*-anisyl-1,1,1-trichloroethane;
'Gix': 2,2-*bis*(*p*-fluorophenyl)-1,1,1-trichloroethane;
D.D.D. or T.D.E.: 1,1-*bis*(*p*-chlorophenyl)-2,2-dichloroethane.

(2) Other chlorinated cyclic hydrocarbons:
Benzene hexachloride (B.H.C.): 1,2,3,4,5,6-hexachloro-*cyclo*hexane;
'Chlordane': 1,2,4,5,6,7,8,8-octachloro-4,7-methano-3*a*,4,7,7*a*-tetrahydroindane;
'Toxaphene': a chlorinated camphene.

Using the same technique as mentioned above, but supplementing it with tests with restricted time of exposure, we found that the *r*-flies showed a similar resistance towards the insecticides of group 1 as towards D.D.T., the difference in 'knock-down' and kill between the *r*- and lab-flies being very considerable. Towards group 2, on the other hand, the *r*-flies and the lab-flies reacted uniformly (unlike the D.D.T.-resistant flies developed in the laboratory in Orlando, U.S.A.[4]).

Practical trials have already shown that benzene hexachloride can be used to control D.D.T.-resistant flies, although the residual effect in many cases has been rather short-lived. In fact, this substance has already been used on many Danish farms.

In addition to the publications on D.D.T.-resistant flies developed in laboratories in the United States[5,6,7], we have been able to find published reports on only two naturally occurring cases of D.D.T.-resistance in house-flies, these reports coming from Sweden[8] and Italy[9,10]. From verbal information and from correspondence we know, however, that similar phenomena have been noted in other places, where D.D.T. has been used against flies for some time, not only in Europe but also in the United States.

[1] Lindquist, A. W., Wilson, H. G., Schroeder, H. O., and Madden, A. H., *J. Econ. Ent.*, **38**, 261 (1945).
[2] Van Deurs, H., *Ugeskrift for Landmænd*, **93**, 71 (1948).
[3] Anon., *Soap Blue Book* (1945).
[4] Wilson, H. G., and Gahan, J. B., *Science*, **107**, 276 (1948).
[5] Lindquist, A. W., and Wilson, H. G., *Science*, **107**, 276 (1948).
[6] Blickle, R. L., Capelle, A., and Morse, W. J., *Soap Sanit. Chem.*, **24** (8), 139 (1948).
[7] Barber, G. W., Starnes, O., and Starnes, E. B., *Soap Sanit. Chem.*, **24** (11), 120 (1948).
[8] Wiesmann, R., *Mitt. Schweiz. Ent. Ges.*, **20**, 484 (1947).
[9] Saccà, G., *Riv. di Parassit.*, **8**, 127 (1947).
[10] La Face, L., *Riv. di Parassit.*, **9**, 199 (1948) (added in proof).

AWARDS OF STALIN PRIZES IN THE U.S.S.R.

A LIST of awards of Stalin Prizes for 1948, for distinguished achievement in the U.S.S.R., has been published in *Izvestia* of April 9; the awards are of 200,000 roubles (first class) or 100,000 roubles (second class). A translation of the names of recipients and grounds of awards is given below:

A. PHYSICO-MATHEMATICAL SCIENCES

First-class prizes: S. N. Vernov, professor in the University of Moscow, for the study of cosmic rays; Academician M. A. Lavrentiev, for theoretical studies on hydrodynamics; G. D. Latyshev, corresponding member of the Academy of Sciences, for the study of the atomic nucleus.

Second-class prizes: G. A. Grinberg, corresponding member of the Academy of Sciences, for theoretical studies in mathematical physics relating to electricity and magnetism; L. V. Kantorovich, professor in the University of Leningrad, for work on functional analysis; I. A. Khvostikov, professor in the military aero-engineering Academy, for studies on atmospheric optics.

B. TECHNICAL SCIENCES

First-class prizes: G. V. Kourdumov, corresponding member of the Academy of Sciences, for work on metallography; G. I. Petrov, member of the Central Institute of Aviation Motors, for work on gas dynamics.

Second-class prizes: I. I. Kirillov and S. A. Kantor, professors in the Leningrad Polytechnic Institute, for joint work on the theory and construction of steam turbines; A. P. Krylov, M. M. Glogovsky, M. F. Mirchink, N. M. Nikolaevsky and I. A. Charnom, members of the Moscow Petroleum Institute, for a joint work on the scientific exploitation of petroleum deposits; Y. M. Parkhomovsky, N. V. Alkhimovich and L. S. Popov, members of the Central Aero-Hydro-dynamic Institute, for theoretical and experimental studies in mechanics; E. P. Popov, professor in the Military Aero-Engineering Academy, for studies in the theory of elasticity; K. A. Rakhmatulin, Academician, Usbek Academy of Sciences, and professor in the University of Moscow, for work on the theory of waves; M. I. Yanovsky, corresponding member of the Academy of Sciences, for work on steam turbines.

C. CHEMICAL SCIENCES

First-class prize: Academician B. A. Kazansky, for work on the catalytic transformations of hydrocarbons.

Second-class prizes: B. A. Dolgoplosk, professor in the Synthetic Rubber Institute, for work on polymerization; V. V. Korshak, professor of the Moscow Chemical-Technological Institute, for work on high-molecular compounds; S. S. Perov, member of the Agricultural Academy, for work on the biochemistry of proteins.

D. BIOLOGICAL SCIENCES

First-class prize: Academician T. D. Lysenko, president of the Agricultural Academy, for work in biology as presented in a book entitled "Agrobiology" published in 1948.

Second-class prizes: L. S. Davitashvili, member of the Georgian Academy of Sciences, for a book entitled "History of Evolutionary Palæontology from Darwin to the Present Time", published in 1948; V. A. Movchan, professor in the University of Kiev,

© 1949 Nature Publishing Group