time. One need scarcely fear that the reaction to stem rust now found in Hope and in so many of its descendants is but a temporary character.

When so many different physiologic forms of rust were being identified by Stakman and his associates it was held that breeding against rust had become a very complicated problem. At first it was felt necessary to breed for resistance to one form and later to groups of forms. Melchers and Parker[6] were the first to show that the reactions in wheat seedlings, used in determining rust forms, might not be the reactions of the maturing plant. Later this finding was amply verified for spring wheats by Goulden *et al.*[7] and by other workers. Thus, while Hope is susceptible to certain rust forms in the seedling stage in the greenhouse, it has shown freedom in the field from year to year both in the seedling stage and while approaching maturity. Generally the existence of many rust forms has not seriously complicated the breeding program.

The experiences of the past 20 years have taught many things that bear upon future breeding work. One of these is that farmers will not grow a wheat variety merely because it may be resistant to, or nearly immune from, stem rust. It also must have resistance to drought, must yield well and be of good quality; otherwise, the losses in non-rust years may overbalance the gains in heavy-rust years.

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EFFECT OF CYSTINE DISULFOXIDE ON SPONTANEOUS TUMORS OF THE MOUSE

THE principle that "The sulfhydryl—partially oxidized sulfhydryl groups comprise the chemical elements of a naturally occurring chemical equilibrium through which growth by increase in cell number is regulated"[1] having been established with vertebrates—and the stimulation side (–SH) in mice and men—a next step was trial of the retarding phase (–SO) in cancer growth of the mouse.

Preliminary tests with transplanted tumors had given results consistent with the postulate, but the data were inadequate in material methods and compounds.

Differential results with compounds not naturally a part of living economy are inconclusive—particularly so are results with sodium salts of inorganic sulfur acids, since these are unpredictably sensitive to oxidative and hydrolytic changes in water solution. Extension of the principle to vertebrates depends on demonstration of proliferation retardation by partially oxidized derivatives of a *naturally occurring* sulfhydryl compound.

Preparation of these is a research problem in itself. Three years ago report was here made of the retarding action of one such—a cystine sulfinate—on proliferative growth in *Obelia gen.*[2] This was not available in sufficient amount or purity for other trials. Since that time Drs. Toennies and Lavine have prepared a cystine disulfoxide in pure form and adequate amount. They will report the chemical details elsewhere.

This note is concerned with the growth of 91 spontaneous tumors from mice injected almost daily with 0.0085 gm. of cystine disulfoxide, as compared with that of 65 tumors from untreated mice simultaneously living under like conditions of diet and environment.

The test data show that the administration of this amount was accompanied in this experiment by a lesser maximum tumor size, a lesser maximum percentage increase in size, a slower tumor growth, fewer tumors reaching a stated percentage increment, tumors with fewer cells, tumor cells with larger nuclei, a greater red cell anemia at the end and a 25 per cent. prolongation of life beyond that expected from the control data. There was no essential difference in initial maximum or terminal body weight between tests and controls.

Of significance is the fact that cell nuclei in tumors from injected mice were larger than those of controls. This result is identical with that found in other material and is correlative evidence of proliferation retardation.[3] The fact—which always appears in work of this sort—that cell size is smaller when proliferation is speeded up by sulfhydryl and larger when retarded by its partially oxidized derivatives is evidence incontrovertibly inconsistent with any hypothesis which would attribute to sulfhydryl a forwarding action on assimilatory protein synthesis—or growth by increase in cell size or mass.

Since these results demonstrate the proliferation retarding action of cystine disulfoxide in mice, they allow extension to vertebrates of the postulate developed from earlier work.

The degree of change from the usual, however, though consistent on all counts, was too small to allow any prediction as to future practical possibilities.

This was a cooperative work. Conduct of the mouse experiments was guided by S. P. Reimann. Solutions

[6] L. M. Melchers, J. H. Parker, *U. S. D. A. Bul.*, 1046, 1922.

[7] C. H. Goulden, Margaret Newton and M. A. Brown, *Sci. Agric.*, 11: 9, 1930.

[1] *Protoplasma*, 11: 382, 1930.

[2] SCIENCE, 77: 190, 1933.

[3] *Protoplasma*, 7: 535, 1929.

were made by T. Lavine. To Miss Hall belonged the care, injecting and measuring of the mice. Sections were made by Misses Chatalbash and Kiesel. Analysis of the results was the task of F. S. Hammett. Merck and Company generously supplied needed chemicals, and much support was given by The International Cancer Foundation.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN EASILY CONSTRUCTED RELAY

BLACK[1] has described a relay which possesses the features of being both inexpensive and efficient when using power up to 1.5 KW. A worker in this university has constructed a relay, employing the same principle Black used in his relay but has modified the construction.

When the current was broken by the thermoregulator in Black's relay, a plunger dropped by gravity on the column of mercury in one side of the glass tube and pushed the mercury up on the other side so that it made contact with a platinum lead. To construct the glass tube described by Black, considerable knowledge of glass blowing must be at the command of the technician.

The relay described below is much simpler to construct and any person with an elementary knowledge of glass blowing can build one. We have incorporated an entirely different principle in our relay in that the plunger *C* (see diagram), when dropped displaces mercury instead of pushing it up the other leg of the glass tube. By displacing mercury, the level is raised in a straight piece of pyrex tubing and electrical contact is made. We have retained in our relay, however, Black's magnetic coil method of raising the displacing plunger.

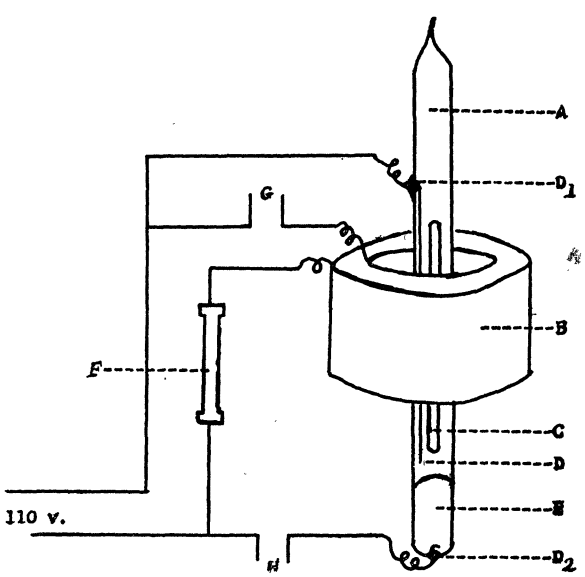

FIG. 1

A —Pyrex tube
B —Secondary of Ford coil
C —2 mm × 4 cm iron nail
D —Platinum wire, 22 ga.
D_1—Platinum contact
D_2—Platinum contact
E —Mercury
F —1000 ohm resistor
G —Leads to regulator
H —Leads to heating unit

The pyrex tube *A* (see diagram) has a 7 mm bore, and is 10–12 cm long. At D_1 and D_2, 22 gauge platinum wire is sealed directly into the glass. Wire *D* is long enough to reach within 7–8 mm of the mercury *E* when the plunger *C* is raised. The plunger is a number 6 finishing nail and is inserted with the head down. When the plunger is lowered into the mercury, the level of the mercury is raised and contact with wire *D* is made. *B* is a secondary coil from a Ford model T induction coil. When operated from a 110 v. A.C. or D.C. line with a 1,000 ohm resistor *F*, there are 35–40 milliamperes of current flowing through the thermoregulator. If resistance of 1,500 ohms is used the current can be reduced to 30 milliamperes. (A resistor of the type used in radio work is satisfactory.) This is sufficient current to operate the magnetic coil.

When contact is made in the thermoregulator at *G*, current flows through the coil *B* and creates a magnetic field which lifts the plunger out of the mercury, and contact between the point *D* and the mercury is broken. Conversely, when the contact is broken in the thermoregulator, the magnetic field disappears and the plunger drops by gravity into the mercury, and contact between point *D* and the mercury is made, thereby completing the heater circuit. It is important that the wire *D* does not touch the side wall of the glass tube as the lower portion of the tube becomes plated with mercury and contact between *D* and *E* is made through the plating. Instead of placing points in an atmosphere of hydrogen as described by Black to prevent oxidation, we obtained, with 550 watts, very satisfactory results by merely evacuating the tube before sealing. By protecting contact points D_1 and D_2 with a condenser of suitable capacity for the current required, sparking is eliminated.

This relay was used daily for a period of 4 months at the end of which time no noticeable signs of deterioration were observed. This can be adapted for use

[1] Peter T. Black, SCIENCE, 79: 322, 1934.