

end, so that contact in the mercury switch is broken with the desired amount of depression of mercury in the float containing arm of the U-tube.

The lengths of the uprights (A and B) are 7.5 inches and 6.5 inches, respectively. Board (A) needs to be slightly longer than (B) to allow for the lever action of (D). The length of board (C) is 6.5 inches, which makes the horizontal distance between (A) and the bamboo rod 6 inches. This latter distance is critical, as it determines the amount of rise and fall of the bamboo rod hence fluctuation in air pressure, required to make and break the electric circuit in (E). As stated above, this mercury switch will make and break contact when tilted through an angle of 3.5 degrees. Considering the lever arm (D) 6 inches it has been determined by calculation and actual measurement that the total vertical action of the bamboo rod, through make and break of the electric circuit, is  $0.6 \pm$  inches. In other words, with the dimensions as

given the mercury level fluctuates up and down over a distance of  $0.6 \pm$  inches with each cycle of start and stop of the electric air pump. If less variation in pressure in the air reservoir is desired one needs only to move (A) and (B) closer together by shortening (C).

A steel drum is being used as the air reservoir. The air pressure in the reservoir is maintained at a deficit, with respect to the atmosphere, by an air pump whose operation is controlled by the automatic pressure switch. A wide-mouth glass bottle of 5-gallon size would probably be quite as satisfactory as the steel drum. A large rubber stopper (K) in the air reservoir is fitted with glass tubes. One of these tubes is connected to the air pump, while the others are connected with absorption towers or other gas analyzing devices as desired.

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## DISCUSSION

### "TEN-EIGHTY," A WAR-PRODUCED RODENTICIDE

THE work described in this article was one accomplishment resulting from a transfer of funds, recommended by the Committee on Medical Research from the Office of Scientific Research and Development to the Fish and Wildlife Service of the Department of the Interior. Administration of this project and the studies connected with it were conducted by the Wildlife Research Laboratory in Denver as part of its long-established search for new rodenticides. It was aided greatly by chemists at the Economic Investigations Laboratory at the Patuxent Research Refuge in Maryland. During the biennium following the grant of funds more than a thousand substances, largely synthetic in origin, were prepared or obtained from co-operators and bioassayed at the Patuxent Laboratory and the more toxic ones subjected to confirmatory tests at the Denver laboratory.

Initial experimentation was carried out with albino rats, but in view of the inherent limitations in the use of these animals in solving problems associated with wild creatures, the later tests were conducted with captive wild Norway rats, prairie dogs and other field rodents in the control of which the new rodenticides eventually would be used. Subsequent to the laboratory work with caged animals the more promising materials were tested under actual field conditions.

Several potentially effective rodenticides have been disclosed in the course of this work. One, commonly referred to under its laboratory serial number, "1080," but chemically designated as sodium fluoroacetate,

has been subjected to sufficiently adequate field testing to warrant the assertion that a promising new rodenticide has been discovered. Although its toxicity to laboratory animals had been known for some time, knowledge of its utility as a practical rodenticide now rests largely on the work to which reference is here made.

Compound "1080" is extremely toxic to a variety of small mammals, a fact which has called for the utmost caution in handling it because of its potential hazard to human beings, domestic livestock and beneficial wildlife that might accidentally come in contact with it. The following approximately LD50 per cent. doses for "1080" when administered in food baits have been determined by those engaged in this study:

|   |             |
|---|-------------|
| Leghorn hens .....  | 10.00 mg/kg |
| Deer mice ( <i>Peromyscus</i> ) .....                         | 5.0 mg/kg   |
| Wood rat ( <i>Neotoma</i> ) .....                             | 5.0 mg/kg   |
| Wild Norway rats ( <i>R. norvegicus</i> ) .....               | 5.0 mg/kg   |
| Tame white rats .....   | 2.5 mg/kg   |
| Black-tailed prairie dogs ( <i>C. ludovicianus</i> ) .....    | 2.5 mg/kg   |
| Meadow mice ( <i>Microtus</i> ) .....                         | 0.5 mg/kg   |
| Domestic dogs .....   | 0.35 mg/kg  |
| Fisher's ground squirrel ( <i>C. beecheyi fisheri</i> ) ..... | 0.35 mg/kg  |
| Wild black rats ( <i>R. rattus</i> subsp.) .....              | 0.1 mg/kg   |

In addition to its high toxicity to small mammals, several of the other characteristics of "1080" have a bearing on its ultimate utility as an effective and usable rodenticide. It is very soluble in water, and when this factor is combined with its high toxicity, the very dilute solutions needed reduce to a minimum any objectionable tastes that might lessen acceptance by rodents. Early tests have shown that there is no significant difference in its toxicity with respect to the

sexes of laboratory animals. There is, however, indication that laboratory rats acquire a tolerance to "1080" by the ingestion of sublethal doses over a period of from 5 to 14 days. This factor might lower effectiveness of this poison when premises are re-treated after a short interval of time, but cessation of dosing for a period of 7 days caused laboratory rats to lose this tolerance.

Caged wild Norway and black rats also developed a gradually increasing aversion to the material when offered as water-solutions, but here again this aversion was not sufficiently pronounced to disrupt actual operational procedures. As a matter of fact this material exposed as a water solution has given results in rat control in Southern States seldom if ever matched in thoroughness by previously used poisons or other control methods. Similarly effective control has been recorded when the material has been used on grain baits against such field rodents as Beechey's and Fisher's ground squirrels in California, Richardson's ground squirrels in South Dakota, black-tailed, Gunnison and Zuni prairie dogs in Colorado, and the Norway, black, Alexandrine and frugivorous rats, as well as the house mouse, in the South.

With a material as new as "1080" much remains to be learned regarding its worth and hazards. Little is known of its effect on creatures other than those it is aimed to control. Its high toxicity to domestic dogs and cats precludes its use where those pets have free range, and by inference one must conclude its action will be severe on beneficial wild predators and fur bearers were the material ill-advisedly exposed. Of still greater importance is the possible danger to operators who may use it carelessly, no effective antidotes having yet been developed.

It is therefore more as an expression of caution and withheld judgment than of an announcement of accomplished fact that this statement has been prepared. Research personnel of the Fish and Wildlife Service to whom major credit should be given for the development and demonstration of the effectiveness of "1080" are continuing their studies in collaboration with various other Federal, State and local agencies and the Armed Services here and abroad to the end that the action of this material may have the fullest scrutiny before it is adopted for widespread use.

In conclusion it seems eminently fitting that recognition for the obtaining and "screening" of "1080" from a multitude of other potential rodenticides being done under contract from the O.S.R.D. should be given to Dr. Ray Treichler of the Economic Investigations Laboratory at the Patuxent. Further demonstration of toxicity to caged wild rodents and the immediate direction of the "search for new rodenti-

cides" project of the Fish and Wildlife Service, of which the O.S.R.D. contract has become a part, has been an accomplishment of Justus C. Ward of the Denver Laboratory. To D. A. Spencer of the same staff goes credit for able demonstration of the utility of the material against western field rodents, and the organization of field tests generally, while H. J. Spencer, a field representative of the laboratory, is in large part responsible for the development of this poison in water solutions as a raticide in typhus areas of the South.

The manufacture of "1080" is still on a limited scale and for the experimental work under way. Indications are that, because of its high toxicity, the material will become, under volume production, a relatively cheap poison. At the present time, the many unknowns regarding it and the restricted basis on which it is being produced preclude the use of "1080" by the public or even by rodent control operators generally. It is reasonably certain that the discovery of "1080" assures this nation of a highly effective economic poison which can not be denied this country through any future interruptions of world trade.

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#### PECTIN INTRAVENOUSLY

IN a recent paper, Baier, Bryant, Joseph and Palmer<sup>1</sup> stated that intravenously injected pectin is not accumulated in the liver as it is easily hydrolyzable and thus differs fundamentally from other plasma substitutes, such as acacia. Previous studies of Hueper<sup>2</sup> and Popper, Volk, Meyer, Kozoll and Steigmann,<sup>3</sup> however, have unequivocally shown that pectin, even when partly degraded, is apparently retained in various organs (liver, kidney, bone marrow, spleen, arteries) and gives rise here to foam cellular formations, hyaline necroses, foreign body giant cells and calcium incrustations. Such observations have been made in experimental animals as well as in men to whom pectin solutions were given for therapeutic reasons. Intravenously injected pectin is therefore not as harmless and fundamentally superior to other macro-molecular colloidal plasma substitutes as this may appear from the statement of Baier, Bryant, Joseph and Palmer.

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<sup>1</sup> W. E. Baier, E. F. Bryant, G. H. Joseph and G. H. Palmer, *SCIENCE*, 101: 670, 1945.

<sup>2</sup> W. C. Hueper, *Arch. Path.*, 34: 883, 1942.

<sup>3</sup> H. Popper, B. Volk, D. D. Meyer and Fr. Steigmann, *Arch. Surg.*, 50: 34, 1945.