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Report for 1927-28

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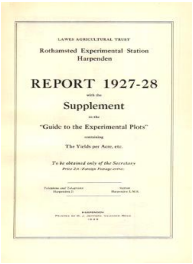
LAWES AGRICULTURAL TRUST
Rothamsted Experimental Station
Harpenden

REPORT 1927-28

Supplement

"Guide to the Experimental Plots"

The Yields per Acre, etc.

To be obtained only of the Secretary

The Plant in Disease; Control of Disease

Rothamsted Research

Rothamsted Research (1928) *The Plant in Disease; Control of Disease ;* Report For 1927-28, pp 79 - 88 **- DOI: https://doi.org/10.23637/ERADOC-1-85**

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LXVI. B. M. Bristol Roach. *"The Present Position of our Knowledge of the Distribution and Functions of Algæ in the Soil."* Proceedings and Papers of the First International Congress of Soil Science, 1927. Vol. III., pp. 1-9.

A summary: special attention is given to the distribution of algæ in the soil, to methods for distinguishing between resting and vegetative cells, to the carbon nutrition of soil algæ and to the nitrogen cycle in the soil.

(*e*) Insects.

LXVII. H. M. Morris. *"The Insect and other Invertebrate Fauna of Arable Land at Rothamsted, Part II."* Annals of Applied Biology. Vol. XIV., 1927, pp. 442-464.

Samples of soil were taken from six of the plots of Barn Field on the farm of the Rothamsted Experimental Station, and insects and other invertebrates found therein are recorded together with the approximate depth at which they occurred. Of these plots one receives no manure, one superphosphate only and one ammonium salts only, while of the other three, all of which receive dung, one receives superphosphate and potash, and another ammonium salts in addition. The total number of insects and other invertebrates per acre in the undunged plots were 1,208,000, 1,410,000 and 1,734,000 respectively. Of these, 673,000, 999,000 and 1,424,000 respectively were insects. Similarly in the dunged plots the total numbers of insects and other invertebrates per acre were 12,948,000, 9,448,000 and 10,516,000 respectively, and of these 2,323,000, 2,215,000 and 4,677,000 respectively were insects. Each sample was taken in five layers so that it was possible to record the approximate depth at which each individual occurred. The greatest number, both of insects and of other invertebrates, occurred in the upper five inches of the soil. It appears that artificial manures have little or no effect on the soil fauna, while the effect of dung in increasing the fauna is very considerable.

V.—THE PLANT IN DISEASE; CONTROL OF DISEASE.

(Chemical, Entomological, Insecticides and Fungicides, and Mycological Departments.)

(*a*) Insect Pests and their Control.

LXVIII. H. F. Barnes. *"The British Gall Midges of Peas."* Bulletin of Entomological Research, 1928. Vol. XIX., pp. 183-185.

In Britain three species of gall midges exist whose larvæ may be found in pea pods: the pea midge, *Contarinia pisi*, which is the most common and is sometimes a pest; *Lestodiplosis pisi*, a predator on the former; and *Clinodiplosis pisicola*, an inquiline. The larvæ of these three species are discussed and the last-named midge is described in detail for the first time.

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LXIX. H. F. BARNES. *" Wheat Blossom Midges (Cecidomyidæ, Diptera). Differences between ' Contarinia tritici ' (Kirby) and ' Sitodiplosis mosellana ' (Gehin)."* Bulletin of Entomological Research, 1928. Vol. XVIII., pp. 285-288.

In the past, wherever Cecidomyid larvæ have been found in the ears of wheat, the presumption has been that the species concerned was *C. tritici* : this error has been made both in England and North America. It is shown that in the vast number of cases of infection the species concerned is *S. mosellana,* which attacks the kernel and not the anthers as in *triciti.* Full descriptions and figures are given for separating the two species in question.

LXX. J. DAVIDSON. *" On Some Aphides infesting Tulips."* Bulletin of Entomological Research, XVIII., Sept., 1927, pp. 51-62.

A detailed technical description is given of three species of aphids obtained from various sources on tulip bulbs and iris corms. These species were reared and observations made on the progress of infestation on tulips. *Anuraphis tulipæ* is shown to be a serious pest of stored bulbs, and when the latter are grown early in the season in glasshouses, multiplication becomes rapid on the growing leaf-spathes which leads to distortion of the plants. The other species, viz., *Rhopalosiphoninus tulipælla* and *Macrosiphum gei* are of less importance : the first mentioned along with *Anuraphis tulipæ* have up to the present been imperfectly known and detailed figures illustrating their distinctive characters given. Infested stored bulbs should be collected and subjected to treatment in order to prevent widespread infection of other bulbs in the same store and various methods of treatment are given.

LXXI. J. DAVIDSON. *" On the Occurrence of the Parthenogenetic and Sexual Forms in Aphis rumicis, with Special Reference to the Influence of Environmental Factors."* Annals of Applied Biology, 1929. Vol. XVI., pp. 104-134.

This Paper discusses in detail experimental evidence as to the factors which tend to the production of alate dispersal forms, apteræ and sexuales. Especially notable are the effects of overcrowding on the host plant leading to the production of alate forms : the effects of removal of the growing points of bean plants on the degree of infestation of the latter by the aphids : and the effects of duration of daylight and temperature on the incidence of the sexual forms.

LXXII. W. M. DAVIES. *" The Effect of Variation in Relative Humidity on Certain Species of Collembola."* British Journal of Experimental Biology, 1928. Vol. VI., pp. 79-86.

It was found that, with the exception of the genus *Entomobrya,* Collembola devoid of a tracheal system, are very susceptible to atmospheric dryness. Species which possess a tracheal system

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are capable of withstanding complete dryness for a period of 10 hours or double the maximum time found for non-tracheate forms. The influence of variation in relative humidity in the death-rate of various species has been studied, and at a uniform temperature of 25° C. a saturated atmosphere was found necessary for survival. The work has a definite practical bearing, since it explains why methods of controlling *Bourletiella hortensis* require to be carried out in early morning or after heavy rain during the day : at other times this insect retreats below the soil.

LXXIII. W. M. Davies. "*The Bionomics of Apion ulicis (Gorse Weevil) with Special Reference to its Rôle in the Control of Ulex europæus in New Zealand.*" Annals of Applied Biology, 1928. Vol. XV., pp. 263-286.

The external morphology of this species in its different stages is described and the details of its biology and feeding habits are given. The effects of the feeding of the adults and larvæ on the host plant are described, together with tabular results of a study of pod infection from samples taken from 62 districts in Great Britain. As high as 92 per cent. infection was observed in some cases. Prolonged tests were carried out with respect to the possibility of the *Apion* attacking cultivated leguminous plants, but gave negative results. The species is considered valuable for the purpose of attempting the control of the spread of gorse in New Zealand and shipments have been made to that country for this purpose.

LXXIV. F. Tattersfield and C. T. Gimingham. "*Studies on Contact Insecticides, Part V. The Toxicity of the Amines and N-Heterocyclic Compounds to 'Aphis Rumicis L'.*" Annals of Applied Biology, 1927. Vol. XIV., pp. 217-239.

The toxicities to *Aphis rumicis* of certain alipathic and aromatic amines and of some of the simpler nitrogen-heterocyclic derivatives have been quantitatively determined.

Tetramethylammonium hydrate and chloride are more toxic than the corresponding tetraethylammonium compounds. This is in keeping with the findings of Dale and his co-workers, who have shown that tetramethylammonium has certain physiological effects similar to those of nicotine, which are not shown by tetraethylammonium.

The aromatic amines, on the whole, show little insecticidal action. Aniline and most of the aliphatic anilines are only slightly toxic to *A. rumicis*. The substitution of aromatic groups in the amino group of aniline increases toxicity more than the substitution of aliphatic groups. There are interesting relationships in regard to toxicity among these compounds.

o-Nitraniline is one of the most toxic of the aniline derivatives.

Among the heterocyclic compounds, nicotine is highly poisonous to *A. rumicis*. The heterocyclic rings constituting the molecule of nicotine are much less toxic than nicotine itself; pyrrole and pyridine show comparatively slight insecticidal action. The

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order of increasing toxicity of the simpler N-heterocyclic compounds is pyrrole, pyridine, picoline, lutidine, quinoline and isoquinoline, acridine.

Hydrogenation of pyridine and pyrrole increases their toxicity, piperidine is more toxic than pyridine and pyrrolidine than pyrrole.

Benzyl-pyridine is the most toxic pyridine derivative tested.

LXXV. F. TATTERSFIELD AND C. T. GIMINGHAM. "*Studies on Contact Insecticides, Part VI. The Insecticidal Action of the Fatty Acids, their Methyl Esters and Sodium and Ammonium Salts.*" Annals of Applied Biology, 1927. Vol. XIV., pp. 331-358.

The toxicities to *Aphis rumicis L.* of the fatty acids from formic to stearic and of the sodium and ammonium salts and methyl esters, applied as spray fluids, have been quantitatively determined. Two unsaturated acids, undecenoic and oleic, are included.

There is a rise in toxicity of the acids with increase of molecular weight as the series is ascended from acetic to undecylic acid. Formic acid is exceptional. Beyond undecylic acid, there is a fall in toxicity, and acids higher in the series than tridecylic, show only slight toxic action.

The sodium salts of the fatty acids are in most cases much less toxic than the corresponding acids, though the difference is less marked with the higher acids. Oleic acid and sodium oleate are of the same order of toxicity.

The ammonium salts are generally less toxic than the corresponding acids, but the differences are much less than in the case of the sodium salts. With some of the higher acids, *e.g.*, myristic and oleic, neutralisation with ammonia increases toxicity. The relatively high toxicity of the ammonium salts may be due, at least partly to liberation, by hydrolysis, of free fatty acid in a very finely divided state.

Methylation of the fatty acids reduces toxicity; all the methyl esters are less toxic than the acids or ammonium salts.

Both the ammonium salts and the methyl esters show, like the acids themselves, increase of toxicity with increase of molecular weight up to a certain point. The formates are exceptional.

The fatty acids do not show marked toxicity to the eggs of *Selenia tetralunaria* Hüfn. at concentration below 2 per cent.

Possible relationships between certain physical properties (physical state, volatility, dissociation constants, partition coefficients and surface tension) of the fatty acids and their insecticidal action are discussed.

Determination of partition coefficients as between olive oil and water and comparison of the figures with the relative toxicities show a steady rise in toxicity with a decrease in the partition coefficients (water/oil) from acetic to capric acid. Formic acid is again exceptional. With lauric and oleic acids there is a break in correlation. The bearing of the solubility relationships of the acids on these results is considered.

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LXXVI. F. TATTERSFIELD. *"The Relationship between the Chemical Constitution of Organic Compounds and their Toxicity to Insects."* Journal of Agricultural Science, 1927. Vol. XVII., pp. 181-208.

An analysis is made of the relationships between chemical constitution and insecticidal action in the vapour phase. There is rough correlation between the molecular weights and volatilities of organic compounds and toxicity, but it is probable that these relationships are only indirectly involved and that they indicate a connection of a more direct kind with some other property such as adsorption.

An account is given of the toxicity to insects of certain plant products. The most potent of these are certain tropical leguminous plants used as fish-poisons. A brief account is given of the chemical derivatives found in these plants. One of them, "tubatoxin," is one of the most potent contact insecticides known.

A list of the groups of organic chemicals tested for their toxic action on *Aphis rumicis* and the eggs of *Selenia tetralunaria* is given. A more detailed account is given for each group of the relationships between chemical constitution and insecticidal action. It is shown that the substitution of certain radicals in the benzene ring profoundly affects toxicity, but that toxic action depends not only upon the radicals, but the number substituted and, in certain cases upon their relative position.

An analysis is made of the bearing of certain of the physical properties of these acids upon toxicity; such are volatility, physical state, partition coefficients, dissociation constants and surface tensions of their solutions in water. None of these properties entirely accounts for the toxicities shown by the fatty acids, but to a certain extent with some of them correlation is sufficiently close to indicate the necessity of further study but on simplified lines.

LXXVII. F. TATTERSFIELD. *"The Decomposition of Naphthalene in the Soil and the Effect upon its Insecticidal Action."* Annals of Applied Biology, 1928. Vol. XV., pp. 57-80.

When naphthalene is incorporated thoroughly with soil, it shows a fairly potent toxic action on wireworms; uneven distribution lessens its efficiency as, owing to its low vapour pressure and consequent slow, spread, it produces only a small zone of toxic action.

The persistence of the toxic action depends upon the soil type. In soils rich in organic matter, toxicity disappears more rapidly than in soils less rich in organic matter. Toxicity persists longer in sterile soils and in sand than in unsterilised soils, and in dry than in moist soils.

The rate of disappearance of naphthalene from soil has been determined. It depends very little upon volatilisation, but almost entirely upon some factor inherent in the soil, which is more active in soils rich in organic matter than those poor in organic matter, and in unsterilised soils than in sterile soils.

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The bacterial numbers of the soils are at first decreased by the addition of naphthalene, but there is a rapid rise during the period when acceleration in the rate of decomposition of the naphthalene is taking place. All the evidence indicates that the loss of naphthalene from the soil is mainly due to bacterial decomposition.

Methods of estimating naphthalene are described. They depend on formation of naphthalene picrate. Picric acid can be more readily titrated by alkali in orange and yellow coloured light than in white light.

LXXVIII. J. C. F. Fryer, F. Tattersfield and C. T. Gimingham. *"English-grown Pyrethrum as an Insecticide, I."* Annals of Applied Biology, 1928. Vol. XV., pp. 423-445.

The toxicity to *Aphis rumicis L.* and to certain caterpillars of spray fluids prepared from samples of pyrethrum (*Chrysanthemum cinerariæfolium*) grown in England from Swiss and Japanese seed, have been quantitatively determined.

Pyrethrum flowers, grown in six different localities, showed only slight differences, and, for practical purposes, all the samples had approximately the same toxicity. They did not differ in this respect significantly from a sample grown on the continent.

The toxicities of extracts of equal weights of pyrethrum flowers tested at different stages of development differed very little. Artificial drying of the flowers had no significant effect on the toxic properties. The flowers were about ten times as toxic as the stalks, weight for weight. Prolonged exposure of pyrethrum to wet conditions led to some loss of toxicity, but contrary to the usual opinion, if stored in a reasonable manner, it remained for long periods without deterioration. Caterpillars of different species showed marked differences in susceptibility to the action of pyrethrum. The biological method employed has proved suitable for evaluating samples of pyrethrum.

LXXIX. C. T. Gimingham and F. Tattersfield. *"Laboratory Experiments with Non-arsenical Insecticides for Biting Insects."* Annals of Applied Biology, 1928. Vol. XV., pp. 649-658.

A convenient technique for experiments with insecticides for biting insects is described.

The silicofluorides of sodium, potassium, aluminium and calcium, used in the form of spray-fluids, showed considerable toxicity to young larvæ of several species of moths. The degree of resistance varies with different species and is greater with older larvæ. Considerable, but irregular, injury to foliage was noted, and much further work is required to establish the conditions under which these compounds could be safely used.

Foliage sprayed with extracts of certain tropical plants is extremely repellent to young larvæ. Even with high dilutions of the extracts, the foliage remained uneaten, and the larvæ eventually died of starvation.

A short review of some recent work on laboratory experiments with non-arsenical insecticides for biting insects is given.

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LXXX. F. TATTERSFIELD, R. P. HOBSON AND C. T. GIMINGHAM. *" Pyrethrin I. and II. Their Insecticidal Value and Estimation in Pyrethrum (' C. cinerariæfolium ') I."* Journal of Agricultural Science, 1929. Vol. XIX., pp. 266-296.

Pyrethrin I. and II. have been isolated by the method of Staudinger and Ruzicka from the insecticidal plant Pyrethrum (*Chrysanthemum cinerariæfolium*). Both are shown to be highly toxic to the insect *A. rumicis*.

Pyrethrin I. was found to be the most toxic substance so far tested by us and it was about ten times as toxic to these insects as pyrethrin II., it is concluded that it is mainly responsible for the insecticidal value of pyrethrum.

Two micro-analytical methods of determining the pyrethrin content are described : (*a*) by means of the acids after hydrolysis ; (*b*) by means of the semicarbazone.

The analytical results are obtained for a series of pyrethrum samples agreed with their observed insecticidal properties.

Comparisons of the pyrethrin contents, as estimated, with the results of direct toxicity experiments both on the pyrethrum samples and the pure pyrethrins, confirm the validity of the analytical methods.

LXXXI. F. TATTERSFIELD AND R. P. HOBSON. *" Pyrethrin I. and II. Their Estimation in Pyrethrum (' Chrysanthemum cinerariæfolium ') II."* Journal of Agricultural Science, 1929. Vol. XIX., pp. 433-437.

The analytical method previously described is found applicable to flowers grown from Japanese seed. A short analytical method for evaluation is described.

(*b*) FUNGUS PESTS AND THEIR CONTROL.

LXXXII. S. DICKINSON. *" Experiments on the Physiology and Genetics of the Smut Fungi.-Seedling Infection."* Proceedings of the Royal Society (B), 1927. Vol. CII., pp. 174-176.

The apparatus devised by the author (see 1925-1926 Report, Paper No. LXXII.) for isolating individual spores from a culture has made possible the present investigation. The results show that no infection of oat or barley seedlings by pure cultures of smut fungi occurs when one gender (sex) is present, but when, under similar conditions, two genders are present, 90 per cent. infection and over is obtained.

LXXXIII. S. DICKINSON. *" Experiments on the Physiology and Genetics of the Smut Fungi. Cultural Characters, Part I. Their Permanence and Segregation."* Proceedings of the Royal Society of London, 1928. Series B, Vol. CIII., pp. 547-555.

The Smut Fungus used in the experiments described is the Covered Smut of Oats (*Ustilago levis*). After isolating a chlamydospore and allowing it to germinate on a suitable medium, the

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first sporidium formed by each of the four segments of its promycelium was isolated, transferred to test-tube slopes, and allowed to develop in culture. Four cultures of strains were in this way obtained from one chlamydospore. This has been repeated with a number of chlamydospores of known parentage.

The strain obtained from any one of these isolated sporidia was found to differ in one or more cultural characters from the other three strains arising from the same chlamydospore. A brief description of certain of these cultural characters is given.

The segregation of these cultural characters was found to be on a 2 :2, 3 :1 and 4 :0 basis. It is deduced that this segregation may take place in either the first or the second of the "reduction divisions." So far the segregation of any one character was found to be independent of that of any other.

No conclusive evidence of somatic segregation has up to the present been obtained, the strains remaining constant during the time they have been in culture. The cytoplasm has been shown to have no determining influence on the cultural characters so far described.

LXXXIV. W. A. Roach. *"Immunity of Potato Varieties from Attack by the Wart Disease Fungus, 'Synchytrium endobioticum' (Schilb.) Perc."* Annals of Applied Biology, 1927. Vol. XIV., pp. 181-192.

The present investigation is an attempt to determine, by grafting together pieces of immune and susceptible plants, whether the cause of immunity from wart disease of potatoes is carried by chemical compounds which can traverse unchanged a graft fusion layer or by those which are unable to do so.

For this purpose all the eight possible types of plants have been built up by grafting together root, shoot and tuber systems from either immune or susceptible plants.

In none of these experiments was the reaction of the tubers towards wart disease changed; hence the cause of the immunity is probably not carried by any compound which is able to traverse the plant, and the problem is thus considerably narrowed down. Examination of the proteins from immune and susceptible varieties by immuno-chemical methods is a hopeful future line of attack.

LXXXV. W. A. Roach and Mary D. Glynne. *"The Toxicity of Certain Sulphur Compounds to Synchytrium endobioticum, the Fungus causing Wart Disease of Potatoes."* Annals of Applied Biology. 1928. Vol. XV., pp. 168-189.

The toxicities towards the winter sporangia of *Synchytrium endobioticum* of certain of the simpler sulphur compounds which are at all likely to be formed when sulphur is added to soil were tested and compared with that of sulphuric acid. Sulphuric (H_2SO_4), sulphurous (H_2SO_3), dithionic ($H_2S_2O_6$), trithionic ($H_2S_3O_6$), tetrathionic ($H_2S_4O_6$), and pentathionic ($H_2S_5O_6$) acids were toxic, and this toxicity was of the same order in each case at the same hydrogen ion concentration. Their neutral salts were non-toxic. These facts suggest that the toxicities of these acids are mainly due to their hydrogen ion concentrations.

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Acidified solutions of sodium thiosulphate ($Na_2S_2O_3$), sodium hydrosulphite ($Na_2S_2O_4$) and sodium formaldehyde sulphoxylate were about ten times as toxic as sulphuric acid.

The evidence suggests that the toxicity of these acidified solutions, in excess of that accounted for by the hydrogen ion concentration, is due to the thiosulphuric acid present in each of them. In view of the instability of some of the compounds and the length of time taken to exert their toxic action on the fungus, this conclusion must be regarded as tentative.

Of the other compounds tested sodium hydroxide was found to be a little more toxic than sulphuric acid and persulphuric acid about ten times as toxic; hydrogen peroxide, calcium polysulphide and sulphuretted hydrogen were only slightly toxic.

LXXXVI. E. M. Crowther, Mary D. Glynne and W. A. Roach. *"Sulphur Treatment of Soil and the Control of Wart Disease of Potatoes in Pot Experiments."* Annals of Applied Biology, 1927. Vol. XIV., pp. 422-427.

In a series of pot experiments on potatoes grown in an acid soil artificially infected with the wart disease fungus, treatments with sulphuric acid and various combinations of sulphur and calcium carbonate, yielding a wide range of soil reaction, gave almost complete freedom from infection when the acidity of the soil had been raised to a very high value (pH 3.4 or less).

Heavy dressings of calcium carbonate, alone or with sulphur, giving a soil reaction of pH 7.5 or more, also reduced infection.

The fact that partial and even, in one experiment, complete suppression of disease was obtained at lower acidities, where the effects on the disease was not closely related to the degree of acidity, supports the tentative conclusion already drawn from field experiments that sulphur, in controlling wart disease, does not depend entirely on its effect in raising the acidity, but has also some other mode of action. Whether this toxicity which sulphur exerts apart from its effect on the acidity can be enhanced sufficiently to be of any practical value requires further investigation.

(*c*) Bacterial Diseases.

LXXXVII. R. H. Stoughton. *"The Influence of Environmental Conditions on the Development of the Angular Leaf-Spot Disease of Cotton."* Annals of Applied Biology, 1928. Vol. XV., pp. 333-341.

The serious disease of cotton caused by *Bacterium malvacearum E.F.S.*, is associated with unfavourable climatic conditions. An apparatus has been devised for controlling air temperature and humidity within a chamber. It has been found that the limiting air temperature at humidities above 80 per cent. relative saturation for secondary attack by the disease is 32° C. above which infection does not occur. At 70 per cent. relative humidity, infection is slight at 25° C. At lower humidities, no infection occurs at a temperature of 28° C.

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LXXXVIII. R. H. STOUGHTON. *"A Method of Maintaining Constant Humidity in Closed Chambers."* Journal of Scientific Instruments, 1928. Vol. V., pp. 365-366.

The instrument depends for its action on the vaporisation of water from muslin covering a carbon filament resistance lamp enclosed in a tin through which a stream of air is blown, and controlled by a hair hygrostat within the chamber.

(*d*) VIRUS DISEASES.

LXXXIX. J. HENDERSON SMITH. *"Experiments with a Mosaic Disease of Tomato."* Annals of Applied Biology, 1928. Vol. XV., pp. 155-167.

A description is given of a mosaic disease produced in tomato by a virus, possibly identical with Johnson's Tobacco Virus 6, which differs from that of ordinary tomato mosaic in the brilliance and intensity of its leaf-symptoms, but in other respects is indistinguishable from it by the characters investigated.

The filtered juice of infected plants transmits the disease in dilutions in water up to 1 in 10,000, retains its activity for a year or more at room temperature, and withstands heating for 10 minutes at 80° C., but is inactivated at 90° C.

It is not inactivated by alcohol up to 90 per cent. The virus comes down with the precipitate, and is not destroyed when the formation of precipitate is prevented by the addition of NaOH.

Attempts at cultivation of the virus outside the living plant are described; all were unsuccessful. The methods employed in filtration, inoculation, etc., are given in detail.

XC. J. HENDERSON SMITH. *"The Transmission of Potato Mosaic to Tomato."* Annals of Applied Biology, 1928. Vol. XV., pp. 517-528.

Inoculation by leaf-mutilation with the foliage of normal potatoes produced no disease in tomato. Nine varieties of potato were tested.

Similar inoculation with foliage of mosaic potatoes produced a characteristic disease in tomato. Five varieties of potato were used, of which three had been tested in the experiments with normal foliage.

The characters of the disease are described. It is transmissible back to potato again and to other solanaceous plants. The virus is filterable, is still infectious after high dilution of the extracted juice, and remains active on keeping for several months. It is less resistant to heat and alcohol than ordinary tobacco mosaic.

The disease resembles closely the spot-necrosis disease described by Johnson as obtained by inoculation of tobacco with foliage of normal potatoes, the chief difference being the greater resistance of the potato mosaics here described.

It is probable that there exist several strains, differing in resistance, of the virus causing mosaic in the potato.