Dr. B. D. Barclay gave the annual presidential address at the luncheon held on Saturday in the Oklahoma Union ballroom. He spoke on "Contributions of Morphology to Modern Plant Science."

The Research Award of $50, for 1937, financed by the American Association for the Advancement of Science, was made to Dr. Milton Hopkins, of the Botany Department of the University of Oklahoma.

The annual business meeting was held on Saturday, December 4. Miss Edith R. Force, Tulsa, Okla., was made a fellow in the society, and the following officers were elected for 1938:

President: C. M. Perry, University of Oklahoma.

Vice-Presidents:

Section A—F. A. Fenton, Oklahoma Agricultural and Mechanical College.

Section B—O. F. Evans, University of Oklahoma.

Section C—J. E. Webster, Oklahoma Agricultural and Mechanical College.

Section D—G. M. Rankin, Central State Teachers College.

Secretary-Treasurer: G. L. Cross, University of Oklahoma.

Assistant Secretary-Treasurer: H. I. Featherly, Oklahoma Agricultural and Mechanical College.

G. L. CROSS,
Secretary-Treasurer

SPECIAL ARTICLES

SULPHANILAMIDE AND VIRUS DISEASES

SINCE the report of Domagk[1] in 1935 concerning the chemotherapeutic action of Prontosil in streptococcal infections, it has been found that a fraction of the Prontosil molecule, para-aminobenzene sulphonamide (sulphanilamide), is also effective in streptococcal infections and in a few other bacterial infections as well (meningitis, gonorrhea, etc.).

Naturally one of the early questions which arose was the possibility of using these chemotherapeutic agents in virus diseases. In September, 1937, Rosenthal, Wooley and Bauer[2] reported that Prontosil possessed therapeutic activity against the virus of choriomeningitis in mice but that sulphanilamide and Prontosil Soluble were inactive.

We have recently tested experimentally three additional virus diseases with sulphanilamide (Prontylin) with results similar to those described by the above authors. Since this subject is a very active one in the field of medical research at the present moment and since the mode of action of these drugs is of such interest, we wished to call particular attention to the apparent negative action of sulphanilamide on the virus diseases we have tested.

Employing sufficient numbers of animals for experimental infection and for controls we tested the activity of sulphanilamide against the viruses of poliomyelitis, rabbit fibroma and rabbit myxomatosis. In the poliomyelitis experiments a group of monkeys was inoculated intracerebrally with mixed poliomyelitis virus. Forty-eight hours later several of these animals were given subcutaneous injections of sulphanilamide, while others received no treatment with the drug and were kept as controls. The animals treated were given one-half gram of the drug, suspended in physiological salt solution, per kilogram of body weight. The treatments were continued for five successive days. The animals received a total of from six to twelve grams of the drug, depending upon their weights. All the monkeys died, including the controls, in from ten to fourteen days with typical symptoms of poliomyelitis except one monkey, which survived for twenty-seven days. This animal had received the drug daily for five days, beginning forty-eight hours following injection, and a total of 9.1 grams of sulphanilamide were administered. Kelson[3] has also reported negative results in experimental poliomyelitis when animals were infected by the intranasal route.

Rabbits experimentally infected with fibroma and myxoma viruses, respectively, were also given subcutaneous treatments with the drug. The dosage used was the same as in the experiments with poliomyelitis virus. An equal number of infected, but untreated, animals were kept for controls. In the case of myxoma virus all the animals, both treated and untreated, died with myxomatosis on the tenth to twelfth day following injection with the virus. Treatments with sulphanilamide were begun forty-eight hours following injection with virus and were continued for three successive days. Experiments with fibroma virus were carried out similarly, and all animals, treated and untreated, developed fibroma, except for two controls which died of an intercurrent infection.

These negative results with sulphanilamide in treating experimental virus infections raise certain questions regarding the mode of action of this drug, particularly in view of a few bacterial diseases in which it is apparently highly efficacious. One of the essential differences between virus and bacterial infections is that the former are invariably of an *intracellular* nature while the latter are chiefly *intercellular,* though in some bacterial diseases cellular invasion is also characteristic. It is suggested that sulphanilamide is un-

[1] G. Domagk, *Deutsch. Med. Wchnschr.*, 61: 256, 1935.

[2] Sanford M. Rosenthal, Jerald G. Wooley and Hugo Bauer, *Pub. Health Rep.*, 52: 1211–1217, 1937.

[3] Saul R. Kelson, *Proc. Exp. Biol. and Med.*, 36: 718–720, 1937.

able to exert its action (?—bacteriostatic, virustatic or what-not) against the infecting agent when it has invaded the tissue cells as in the case of virus infections. The efficacy of sulphanilamide in specific bacterial diseases may depend partly on its successful attack against extracellular organisms, while the host cells themselves are contributing to the defense against the invading microbes. On the other hand, we may assume from present evidence that viruses find conditions within the tissue cells favorable, rather than unfavorable, for survival and multiplication.

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THE SKIN INFECTIVITY OF POLIOMYELITIS VIRUS

ALTHOUGH controversy exists as to the mode of spread of poliomyelitis, a generally accepted view is that the virus gains access to the central nervous system via the olfactory nerves. This theory is supported by the fact that it has been found easier to infect monkeys intranasally than by other routes, such as the gastro-intestinal, intravenous, sub- or intra-cutaneous route. A fact which does not appear to be well known, however, is that this generalization as to infectivity via different routes does not apply equally to all strains of the virus. For with some strains of poliomyelitis virus, monkeys are readily infected on intracutaneous inoculation of doses which are not particularly large. This is illustrated by our results shown in Table 1 to which we will again refer.

The literature also furnishes evidence of this fact. In France during the course of some immunization experiments Erber and Pettit[1] inoculated subcutaneously serum-virus mixtures (which represented a pool of four different strains of virus) into 13 monkeys, and 12 of these animals succumbed to poliomyelitis as a result of this inoculation. Later two of these four strains were found to have this property of infectivity by the subcutaneous route. Levaditi *et al.*[2] have noted that as many as 10 out of 17 animals were infected subcutaneously from poliomyelitis vaccines. Further preliminary evidence bearing on this question may be found in the description of a strain (our Wfd. strain), which we reported in 1936, which in its early passages was peculiarly infective by the cutaneous route.[3] It had been isolated in the 1934 epidemic in southern California. Later two other new strains showing cutaneous infectivity were isolated in California, one by Howitt[4] and one by Kessel and his coworkers.[5]

It next seemed important to determine how frequently this property of intracutaneous infectivity could be found. Was it a rare or a common property of strains isolated in Eastern sections of this continent as well as in the West; was it a property of established strains as well as fresh strains? To this end we have examined a number of strains of virus from various sources during the last two years, and the results, which form the substance of this note, appear in Table 1.

TABLE 1
CUTANEOUS INFECTIVITY OF ELEVEN STRAINS OF POLIOMYELITIS VIRUS*

	Name of strain	Source		No. of monkey passages	Result
Established strains	Park	N. Y. C., ?	1916	Many	1/7†
	Aycock	Vermont,	1921	"	0/6
	Flexner	N. Y. C.,	1931	11–18	1/7
	We.	New Haven,	1931	9–15	0/7
	McC.	Los Angeles,	1934	3–10	0/7
	Wfd. (a)	" "	1934	3– 7	6/10
	" (b)	" "	1934	8–16	4/17
	Hub.	Boston, Mass.,	1936	4– 5	0/4
	Gr. (b)	Memphis, Tenn.,	1936	4– 5	0/2
Fresh strains	Gr. (a)	Memphis, Tenn.,	1936	1– 2	1/3
	Fx.	Toronto,	1937	(Human)	1/1
	Ah.	"	1937	"	1/1
	McL. (a)	"	1937	"	2/2
	" (b)	"	1937	1	0/1

* The same dose was used with all 11 strains, *viz.*, 2 cc of a 10 per cent. suspension of spinal cord given intracutaneously (and rarely subcutaneously) in 8 or 10 piqures in the shaved skin of the flanks or abdomen.
† 1/7 indicates that seven monkeys were cutaneously inoculated and that, of these, one was infected with clear-cut experimental poliomyelitis.

Eleven different strains were investigated. They have been arbitrarily divided into two major groups—established strains and fresh strains. Established strains are those which had been passed in series (by intracerebral inoculation) through more than three monkeys.[6] Two of these established strains (Park and Aycock) were quite old and had been through many monkey passages (perhaps 100 or more). Four fresh strains were tested, the recent (1937) epidemic in Toronto having furnished us with three of them.[7]

Most of our established strains, are (or were) of high intracerebral virulence and most of them infect by the intranasal route, but from Table 1 we note that cutaneous infectivity is seldom a prominent feature, except in one strain, the Wfd. strain, which, so far, has not been infective intranasally. At first about 60 per

1 B. Erber and A. Pettit, *Comp. rend. Soc. de biol.*, Paris, 117: 1175–1178, 1934.
2 C. Levaditi, C. Kling and P. Haber, *Bull. Acad. méd.*, Paris, 3e Série, 115: 431–440, 1936.
3 J. D. Trask and J. R. Paul, *Jour. Bacteriol.*, 31: 527–530, 1936.
4 B. F. Howitt, SCIENCE, 85: 268–270, 1937.
5 Personal communication from F. D. Stimpert.
6 A description of six of these established strains has been given in a recent article by the authors, *viz.*, J. D. Trask, J. R. Paul, A. R. Beebe and W. J. German, *Jour. Exp. Med.*, 65: 687–704, 1937.
7 For these three strains we are particularly indebted to Dr. L. N. Silverthorne, of the Hospital for Sick Children, Toronto, Canada.