TABLE I.

	1928 Experiments					1933 Experiments
	1:50,000 (Fresh emulsion at 19°C.)	1:25,000 (Fresh emulsion at 19°C.)	1:10,000 (Fresh emulsion at 19°C.)	1:25,000 (After standing 24 hours at 24°C.)	1:10,000 (After standing 48 hours at 24°C.)	1:10,000 (Fresh emulsion at 19°C.)
	%	%	%	%	%	%
Crotalus atrox	86	64	44	88	71	70
Crotalus exsul	86	60	30	83	60	36
Bothrops atrox	82	64	18	88	63	55
Ankistrodon piscivorus	90	70	12	83	78	56
Naja (cobra)	—	53	32	—	—	—
Solanin	128	117	110	—	—	—
Saponin	127	120	120	—	110	—
Digitonin	120	100	98	—	93	—

digitonin. All the vegetable toxins hemolyzed blood corpuscles to a greater extent than did the snake venoms. When solutions of these vegetable drugs were tested on the growth of *Lupinus* seedlings, however, it was found that they caused practically no inhibition in growth. These findings agree with those from previous studies by the writer, which indicated that poisons obtained from the animal world are relatively non-toxic for plant protoplasm; and, vice versa, that poisons coming from the vegetable kingdom are usually more poisonous for animals than for plants.[6]

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Effect of Ultraviolet Rays and of Methylthionine Chloride and Heparin on Snake Venoms.

DAVID I. MACHT AND MARY E. DAVIS.

From the Pharmacological Research Laboratory, Hynson, Westcott and Dunning, Inc., Baltimore, Md.

It is well known that snake venoms in solution or suspension rapidly decompose on standing at room temperature, but few investigators have studied the effect of light on such solutions. Faust, in

[6] Macht, *Science*, 1930, **71**, 302.

Heffter's *Handbuch der Pharmakologie,* cites only 2 papers, that of Noguchi,[1] who studied the phytodynamic action of eosin and erythrosin on snake venoms in the dark and in sunlight, and of Massol,[2] who found that exposure to rays of a quartz mercury vapor lamp diminished the potency of cobra venom to a greater extent than did its antitoxin. The writer wishes to report experiments on the toxicity of snake venoms exposed to mercury vapor lamps. Solutions or suspensions of dry venom were made in saline and exposed in small, transparent quartz containers to the rays of a Kromayer lamp. The toxicity of the irradiated and control, or non-irradiated, solutions of the venoms* was studied by zoopharmacological methods on mice and on plants by phytopharmacological methods in the manner described in the preceding article.

TABLE I.
Effect of Venoms on Growth of *Lupinus albus.*

Venom of	Concentration	Phytotoxic Index of Fresh Emuls.	Phytotoxic Index of Emulsion exposed to Kromayer Lamp for 15 min.
		%	%
Crotalus exsul	1:10,000	36	77
Bothrops atrox	1:10,000	55	100
Ankistrodon piscivorus	1:10,000	54	100
Naja (cobra)	1:10,000	32	88

Table I shows the effect of exposure of venom solutions to a Kromayer lamp for 15 minutes. The poisons of the *Crotalus exsul, Bothrops atrox, Ankistrodon piscivorus* and *Naja* (cobra) were studied in this manner. It will be noted that their toxicity for *Lupinus albus* seedlings was enormously diminished by exposure to ultraviolet rays.

Experiments with irradiated and control solutions of the same venoms were made on mice by intraperitoneal and subcutaneous injections; and it was found that in the zoopharmacological experiments also the potency of the irradiated specimens was greatly diminished.

These findings with exposure of venom emulsions in quartz containers to ultraviolet rays suggested an inquiry regarding the effect

[1] Noguchi, *J. Exp. Med.,* 1906, **8**, 252.

[2] Massol, *Compt. rend de la Soc. de Biol.,* 1911, **71**, 183.

* The cobra venom used in this investigation was obtained from Professor R. N. Chopra, School of Tropical Medicine, Calcutta; and the other venoms were acquired through the courtesy of Dr. T. S. Githens of the Mulford Biological Laboratories.

of irradiation of animals with fresh venom. Such experiments were carried out on mice. It was found that mice injected subcutaneously, and even intraperitoneally, with rattlesnake venom lived much longer when irradiated with ultraviolet light than the non-irradiated controls injected with the same quantity of venom. Table II gives the results obtained in 6 experiments with the venom of *Crotalus*

TABLE II.

Venom of *Crotalus atrox* injected in mice.

1. Mouse, wt. 24 gm., injected subcutaneously with 0.5 mg., receiving no irradiation, died in 1 hour and 45 min.
2. Mouse, wt. 20 gm., injected subcutaneously with 0.5 mg., irradiated with Alpine Sun Lamp for 30 min., died in 5 hours and 44 min.
3. Mouse, wt. 24 gm., injected subcutaneously with 0.5 mg., receiving no irradiation, died in 3 hours and 7 min.
4. Mouse, wt. 20 gm., injected subcutaneously with 0.5 mg., irradiated with Alpine Sun Lamp for 30 min., died in 22 hours.
5. Mouse, wt. 20 gm., injected intraperitoneally with 1.0 mg., receiving no irradiation, died in 22 min.
6. Mouse, wt. 24 gm., injected intraperitoneally with 1.0 mg., irradiated with Alpine Sun Lamp for 15 min., died in 31 min.

atrox. However, similar experiments with cobra venom on mice exposed to ultraviolet rays revealed little diminution in its potency, indicating, as Noguchi has already noted, that different kinds of venom vary markedly in their chemical composition.

Brooks[3] and Hanzlik[4] have recently called attention to the beneficial effects of methylene blue injections in case of carbon monoxide and cyanide poisoning, and Geiger[5] actually reported favorable clinical results obtained by such treatment. This discovery prompted the writer to study the effect of methylene blue on snake venoms. Tests were made with the venoms of *Crotalus exsul, Bothrops atrox, Ankistrodon piscivorus* and *Naja* both by the phytopharmacological method on *Lupinus albus* seedlings and by the zoopharmacological method on various animals. It was found that a combination of the venom with methylene blue, 1 :50,000, did not diminish the toxicity of the poison for *Lupinus* seedlings. Similarly, injections of venoms with and without methylene blue into mice, rats, guinea pigs and pigeons, by subcutaneous, intramuscular, intraperitoneal and intravenous routes, revealed that no antagonistic or neutralizing effect was produced by the dye. The experiments indicated, if anything, a slight increase in toxicity of the venoms.

Inasmuch as snake venoms are complex mixtures of various principles, some of them being in the nature of hemagglutinins and

[3] Brooks, PROC. SOC. EXP. BIOL. AND MED., 1932, **29**, 1228.

[4] Hanzlik, *J. Am. Med. Assn.*, 1933, **100**, 357.

[5] Geiger, *J. Am. Med. Assn.*, 1932, **99**, 1944.

thrombokinase, it was deemed desirable to perform some experiments regarding the effect of heparin on snake poisons. A very potent preparation of heparin made in these laboratories was employed; and the toxicity of snake venoms with and without heparin was tested both on seedlings of *Lupinus albus* and on mice. The experiments were made with venoms of *Crotalus atrox* and of *Naja*. Neither the phytopharmacological nor zoopharmacological experiments revealed any difference in the toxicity of the venoms produced by their combination with heparin.

Summary. 1. Ultraviolet radiations from a mercury vapor quartz lamp produce rapid deterioration of the potency of snake venoms, as indicated by both zoopharmacological and phytopharmacological tests. 2. Methylthionine chloride, or methylene blue, does not affect the toxicity of snake venoms for either living animals or plants. 3. Heparin injections produce no change in the toxicity of snake venom, as tested on living animals or plants.

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Specific Inhibition of Bacteriophage by Bacterial Extracts.

PHILIP LEVINE AND ARTHUR W. FRISCH. (Introduced by Paul F. Clark.)
With the technical assistance of Marion L. Rohn.

From the Laboratories of the Department of Pathology and Bacteriology, University of Wisconsin.

There is as yet no final explanation for the specificity involved in bacteriophage action. Burnet[1] claims on the basis of experiments made with the Salmonella group of organisms that the action, in a general way, parallels the serologic definition of the heat stable factors. However, he recognized that several observations made by himself and others are not compatible with this point of view. One of these is the failure to demonstrate inhibition of phage action by means of extracts of bacteria containing specific carbohydrate material.*

In our experiments positive results were obtained using saline extracts prepared according to the method of Furth and Landsteiner,[3]

[1] Burnet, F. M., *J. Path. and Bact.*, 1930, **33**, 647.

* See also Prausnitz and Firle.[2]

[2] Prausnitz, C., and Firle, E., *Centr. f. Bact.*, 1924, **93**, 148.

[3] Furth, J., and Landsteiner, K., *J. Exp. Med.*, 1929, **49**, 727.