For purposes of comparison results of tests on other germicides are included (Table II). It may be seen that the dyes rate very poor in comparison to some well-known germicides of a non-dye nature.

Summary. The dyes as a group are extremely poor germicidal agents. Only the triphenyl methane dyes were capable of killing *E. typhosa* and *Staph. aureus.* Brilliant green was the only dye that killed *E. typhosa* while several killed *Staph. aureus* but their extremely high toxicity to tissue showed that they are inferior to the better known non-dye germicides. Further work on the dyes is now in progress.

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The Relation of the Nervous System to Skin Potentials in the Intact Frog.

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Considerable has been written about the relation of nerve stimulation to the action potential across the frog's skin; but, to our knowledge, little is known concerning the influence of the brain and spinal cord on the resting potential of the intact animal. Roeber[1] was the first to note a definite negative variation across the frog's skin following nerve stimulation. Later Engelmann,[2] Hermann[3] and Bayliss and Bradford[4] showed an association between the degree of response to nerve stimulation and the secretory activity of the gland cells of the skin, as well as seasonal variations. Furthermore, Orbili[5] investigated in a similar way the influence of various concentrations of salts. Although these observations are of significance, it should be pointed out that they were performed either on the isolated nerve skin or after the frogs were pithed or curarized.

Since our observations show that injury to the brain and spinal cord causes definite changes in the resting potential across the skin in the intact animal we feel justified in reporting our results. Although Francis and Pumphrey[6] report no pronounced difference be-

1 Roeber, H., *Arch. f. Anat. u. Physiol.*, 1869, 633.

2 Engelmann, W., *Pfluger's Arch.*, 1872, **6**, 97.

3 Hermann, L., *Pfluger's Arch.*, 1878, **17**, 291.

4 Bayliss, W. H., and Bradford, J. R., *J. Physiol.*, 1886, **7**, 217.

5 Orbili, A. L., *Z. f. Biol.*, 1910, **54**, 329.

6 Francis, W. L., and Pumphrey, R. J., *J. Exp. Biol.*, 1933, **10**, 379.

tween the amount of potential across the intact and isolated skin our observations show that the nature of the resting potential reacts very differently in the two. The experimental procedure used was to fasten the frog, back down, on a frog board and to make a small incision in the ventral skin surface, just anterior to the cloaca. Through this opening one end of an agar-chloride bridge was inserted just under the skin, almost up to the xyphoid process. The end of the bridge was bent nearly at right angles and formed a cup which made a snugly fitting contact with the inside of the skin, the approximate area of its end being 25 sq mm. In no instance did any undue stretching of the skin occur. The other end of the bridge was led into a container of Ringer's solution into which a calomel electrode was inserted and connected with a potentiometer. In a similar manner a second agar-chloride bridge, of similar size and dimensions, was adjusted to the outside of the skin so as to fit directly over the inside bridge. A few drops of Ringer's solution were applied between the skin and the outside bridge to assure a good contact.

With this technic the resting or basal potential remained remarkably steady, reaching a constant state within 5 to 10 minutes after the bridges were first adjusted. In no case was a drift recorded which lasted 30 or more minutes, as usually found for the isolated skin. Removing or changing the position of the electrodes had very little effect on the potential readings.

The effects of the central nervous system on this preparation were investigated as follows: After a control or constant E.M.F. was obtained, the bridges were removed and the frog was taken from the board long enough to destroy the brain (single pith). Following the pithing, the frog and the bridge electrodes were replaced in a position conforming as closely as possible to that in which the control readings had been taken. The time involved to carry out this procedure was approximately 2 to 3 minutes.

Within 3 minutes after the animal and electrodes were in position, potential readings were again taken for 4 consecutive 3-minute periods. Then, by similar manipulation, the spinal cord was destroyed (double pith), and the potential readings were recorded for another 12-minute period.

Result. In the presentation of the data (Table I) the millivolts obtained on the various frogs before pithing are recorded, but any variation from the normal or constant state in skin potential, following pithing, is tabulated as a percentage of the original potential.

It was surprising that a sudden and consistent fall of potential invariably followed both single and double pithing. Although the fall

TABLE I.
Skin Potential in Intact Frog, Following Single and Double Pithing.

No. of Exp.		I Millivolts at beginning of Exp.	II Single pithing (Time in min.) 3	6	9	12	III Double pithing (Time in min.) 3	6	9	12
Frog	I	111	72	86	85	74	35	36	35	34
"	II	41	54	61	66	66	46	49	49	49
"	III	77	84	70	69	69	52	49	49	48
"	IV	52	98	92	82	84	61	58	58	56
"	V	33	76	73	70	70	51	51	48	45
"	VI	40	88	85	83	83	65	65	68	68
"	VII	80	88	78	75	75	62	62	60	60
"	VIII	46	70	68	68	68	46	46	42	42
"	IX	35	66	66	69	69	49	49	48	46
"	X	68	75	75	75	75	35	35	34	34
		Avg	77	75	74	73	50	49	49	48

Column I represents actual skin potential in millivolts at the beginning of the experiment.

Column II represents the percentage of the original potential following single pithing. Readings were taken at 3-minute intervals for a period of 12 minutes.

Column III represents the additional percentage change in potential following double pithing. Readings were taken at 3-minute intervals for a period of 12 minutes.

in potential varied in different frogs, the average fell to about 75% following single pithing, and approximately 50% after double pithing, a decrease of approximately 25% in each case.

In view of these observations, it occurred to us that if the nervous system was related to skin potential, strychnine should augment

TABLE II.
Skin Potential in Intact Frog Following Injection of Strychnine

No. of Exp.		I Millivolts at beginning of Exp.	II Time in min. 3	6	9	12	15	18	21	24
Frog	I	47	138	138	157	*178	144	108	87	83
"	II	57	107	106	112	* 77	79	81		
"	III	52	106	114	125	123	116	104	98	98
"	IV	43	126	111	107	107	105	100	93	93
"	V	49	127	108	105	103	* 83	108	108	103
"	VI	66	133	133	114	* 88	86	80	80	
"	VII	58	117	124	110	103		88	88	80
"	VIII	62	129	132	116	112	101	97	89	84
"	IX	30	140	126	123	116	116	113	110	103
"	X	52	125	119	111	105	105	96	89	81
		Avg	125	121	118	111	104	98	93	91

Column I represents actual skin potential in millivolts at the beginning of the experiment.

Column II represents the percentage of the original potential following intraperitoneal injection of strychnine sulphate (0.25 cc of 1 in 1000). Readings were taken at 3-minute intervals for a period of 24 minutes in most cases. Asterisk indicates onset of convulsions.

TABLE III.
Skin Potential in Intact Frog Following Impairment of Nervous and Circulatory Systems.

No. of Exp.		I Millivolts at beginning of Exp.	II Before removing heart (Time intervals in min.) 3	6	9	12	III After removing heart (Time intervals in min.) 3	6	9	12
Frog	I	35	60	60	60	60	60	60	60	60
,,	II	28	79	84	84	82	79	79	79	79
,,	III	41	73	73	72	73	76	76	78	79
,,	IV	60	75	68	68	68	67	67	67	67
,,	V	45	57	56	56	56	56	57	56	56
		Avg	69	68	68	68	68	68	68	68

Column I represents actual skin potentials in millivolts at the beginning of the experiment.

Column II represents the percentage of the original potential following double pithing. Readings were taken at 3-minute intervals for a period of 12 minutes.

Column III represents the percentage of the original potential following double pithing and impairment of the circulatory system by removing the heart. Readings were taken at 3-minute intervals for a period of 12 minutes.

it. To test this, potentials of 10 normal frogs were recorded and then 0.25 cc of strychnine sulphate 1 in 1000 was injected intraperitoneally. All 10 frogs showed an increase in E.M.F. above the equilibrium potential (6 to 40%) within 3 minutes after the injection, and continued to show a positive potential for 12 to 15 minutes (Table II). Twenty-four minutes after the injection the potential had returned to normal or slightly below. Although the dosage was estimated to be below the convulsive level, it was interesting to note that in 3 of the 4 cases in which convulsions did occur, a sudden drop in potential followed.

As to the mechanism involved in producing these sudden changes in potential, nothing can be said at the present time. However, the results obtained after destruction of the nervous system or administration of strychnine indicate that the skin potential in intact animals is under a type of tonic control from the central nervous system. This is also borne out by a limited number of experiments in which the skin was denervated by sectioning all possible nerve connections to the skin surface. The result was a fall of skin potential of approximately the same magnitude as that produced by pithing the animal.*

* Although these experiments show that the destruction of the nervous system causes a lowering of potential, it should be pointed out that if a frog with an opening in its ventral skin surface is put back into water for some time, there is a tendency to produce an increase in skin potential after brain and spinal cord destruction. What the cause of this change is, we do not know, but it may be related to disturbances in the isotonicity of the inside surface of the skin.

Since skin potential seems to be in some ways related to the nervous system, the question arose whether there is also a relation between skin potential and the circulatory system. A number of frogs were prepared as in previous experiments and, after equilibrium potentials had been reached, the frogs were double pithed; then, after readings had been taken for 12 minutes, the heart was removed or injured through a small opening. As the data indicate (Table III), there was no appreciable change in potential for a 12-minute period after the operation as compared with the immediate change following injury of the nervous system. This steady state following removal of the heart was maintained for 30 to 40 minutes, after which there was a gradual but definite fall in skin potential.

Conclusions. I. Potentials across the skin in the intact frog remain remarkably constant. Manipulation of electrodes or position of the frog has little influence on potential readings. II. Destruction of the nervous system causes a sudden decrease in skin potential. The average decrease in potential after brain and spinal cord destruction is approximately 25% in each case. III. Following intraperitoneal injection of strychnine sulphate into the intact frog there is an increase in skin potential for approximately 15 minutes, after which there is a gradual return to normal. IV. Alterations in circulation by removal of the heart causes no appreciable change in skin potential.

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Pantothenic Acid and Hemorrhagic Adrenal Necrosis in Rats.

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A hemorrhagic necrosis of the adrenal cortex was frequently observed in rats used for a study of vitamin B_6 deficiency in this laboratory. This abnormality was prevented when Vitab or a filtrate factor concentrate was included in the diet. Similar observations were reported by Daft and Sebrell.[1] When synthetic pantothenic acid became available it seemed desirable to investigate its relation to this adrenal pathology. While these investigations were being completed, Daft, Sebrell, Babcock, and Jukes[2] reported

[1] Daft, F. S., and Sebrell, W. H., *Public Health Rep.*, 1939, **54**, 2247.

[2] Daft, F. S., Sebrell, W. H., Babcock, S. H., Jr., and Jukes, T. H., *Public Health Rep.*, 1940, **55**, 1333.