lowing proportions: Whites: arteriosclerotic 41.3%; hypertensive 36.4%; syphilitic 4.9%; rheumatic 2.8%; other 14.7%. Negroes: arteriosclerotic 8.2%; hypertensive 32.7%; syphilitic 32.7%; rheumatic 6.1%; other 20.3%. Among white patients, the arteriosclerotic-hypertensive group constituted 40.5% of the whole and contributed 77.7% of the large Q waves. Among the negroes, this group was 36.7% of the whole, and contributed 40.9% of the large Q waves found among negroes.

Among 150 patients without evidence of heart disease, 3, or 2%, showed a large Q wave in lead III, but two of these Q waves were not typical and were barely included on the basis of the criteria given by Pardee.

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Physiological Effects of Injections of Various Benzene and Furan Derivatives into the Cockroach.

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This is a report of experiments upon the physiological effects of injections of various benzene and furan derivatives into the cockroach, *Periplaneta orientalis* (Linn.). Some of these compounds have been used in spray[1, 2] and vapor[3] form upon certain insects but nothing is known of the effects of injections of the substances into the roach. Injection studies on insects have been largely confined to larvae.[4, 5] In these experiments, large nymphs and a few adults were used, all in apparently normal condition.

Each experiment consisted of the following procedure: (1) The body weights of 6 normal animals were obtained. (2) Initial heart rates and estimates of the degree of contraction were obtained, using a method of illumination already described.[6] (3) An estimate of the amount of crop peristalsis was noted. (4) Meanwhile, solutions or emulsions, stabilized with 10 mg. Witte's peptone per 5 cc. emulsion, were prepared in 1, 2, 4, 6, 8 and 10% concentrations in Hob-

[1] Richardson, C. H., and Smith, C. R., *U. S. D. A. Bull.*, 1160, 1923.

[2] Moore, Wm., *J. Agr. Res.*, 1917, **9**, 371.

[3] Holt, Jos. J. H., *Lancet*, 1916, **1**, 1136.

[4] Campbell, F. L., *J. Gen. Physiol.*, 1926, **9**, 433.

[5] Hockenyos, G., *J. Ec. Ent.*, 1932, **25**, 253.

[6] Yeager, J. Franklin, *Ann. Ent. Soc. Am.*, 1931, **24**, 739.

son's solution[7]; the latter consists of 0.161 M NaCl, 0.003 M KCl and 0.002 M $CaCl_2$. (5) The animals were injected through the conjunctiva of the coxa-femur joint of the left third thoracic leg by means of an improvised, capillary injection pipette (glass) of 0.1 cc. capacity and graduated to 0.001 cc. Each animal was injected with a single concentration in amount equal to 10% of its body weight. (6) The animal was immediately observed for (a) general activity, (b) rate of locomotion, (c) maintenance and recovery of equilibrium, (d) activity of antennae and mouth-parts, (e) activity of legs (excepting the injected leg), (f) body twitches, (g) rate and degree of heart contraction, (h) activity of crop and (i) body muscle twitches (thorax). Observations (g), (h) and (i) were made with transmitted light. (7) Each animal was thus injected and observed. (8) Later the same observations were again made upon each animal, so that all animals were subjected to 2 complete post-injection examinations.

The compounds used were benzene, furan; toluene, sylvan; orthoxylene, 2.5-dimethylfuran; nitrobenzene, 2-nitrofuran; furfuryl alcohol; benzyl alcohol; furfural, benzaldehyde; ethyl benzoate; ethyl furoate; sodium benzoate, sodium furoate; acetophenone, furyl methyl ketone; benzoyl chloride and furoyl chloride. These compounds were all in chemically pure form.*

The results have been summarized in Table I. Except for experiments 6, 9, 16, and 18, the corresponding concentrations are arranged into 2 groups. Control experiments indicated that the injection of Hobson's solution up to 15% body weight or of the saline plus an amount of peptone equivalent to that used in the experiments is without injury to the animal.

Analysis of these results has indicated no consistent relationship between chemical constitution and physiological effect. In general, however, it would seem that those compounds, in the relatively low concentrations used, permitting general activity to continue in an apparently "purposeful" manner fall into 2 groups: (1) compounds with the methyl radical substituted into the ring (toluene, sylvan, dimethyl furan, orthoxylene) and (2) the acid derivatives or esters and acid chlorides (furfuryl alcohol, Na benzoate, ethyl benzoate, Na furoate, ethyl furoate, benzyl chloride). The methyl substituted compounds would appear to be relatively less toxic and to permit relatively earlier recovery.

[7] Hobson, A. D., *Br. J. Exp. Biol.*, 1928, **5**, 385.

* The authors are indebted to Dr. Henry Gilman of Iowa State College for the furan derivatives used in these experiments.

TABLE I.

Exp. No.	Substance	Concn. in Hobson's soln.	Activity	Type Behavior	Equilibrium	Locomotion	Legs: 1st pair	Legs: 2nd pair	Legs: 3rd right leg only	Body twitches	Body muscle twitches	Heart: Rate	Heart: Degree contracting	Crop
1	Benzene	1-4	—	X	—	—	N	N	N	+		+	—	—
		6-10	—	X	—	—	N	N	—	+	+	—	—	—
4	Furan	1-4	—	X	—	—	N	—	—	+	+	—	—	+
		6-10	—	X	—	—	N	—	—	+	+	—	—	—
2	Toluene	1-4	N	P	+	—	N	N	N	—	—	+	N	
		6-10	N	P	+	N	N	N	N	—	—	+	N	N
3	Sylvan	1-4	S	P	+	S	N	N	N	—	—	—	—	+
		6-10	—	X	—	—	N	N	—	+	+	—	—	—
6	Orthoxylene	1-8	—	P	+	—	N	N	N		+	—	—	N
		10	—	X	—	—	—	—	—		—	—	—	—
5	2.5-Dimethyl	1-4	+	P	+	—	N	N	N	—	—	N	—	+
	Furan	6-10	—	X	—	—	N	—	—	+	+	—	—	—
7	Nitro-ben-	1-4	—	X	—	—	N	—	—	+	+	—	—	—
	zene	6-10	—	X	—	—	N	—	—	+	+	—	—	+
8	Nitro-furan	1-4	—	X	—	—	—	—	—	—	—	—	—	—
		6-10	—	X	—	—	—	—	—	—	—	—	—	—
10	Benzyl Al-	1-4	—	X	—	—	—	—	—	—	—	—	—	—
	cohol	6-10	—	X	—	—	—	—	—	—	—	—	—	—
9	Furfural Al-	1	N	P	+	—	N	—	—	+	+	—	—	N
	cohol	2-10	—	X	—	—	—	—	—	—	—	—	—	—
11	Benzalde-	1-4	—	X	—	—	—	—	—	—	—	—	—	—
	hyde	6-10	—	X	—	—	—	—	—	—	—	—	—	—
12	Furfural	1-4	—		—	—	—	—	—	—	—	—	—	
		6-10	—		—	—	—	—	—	—	—	—	—	
14	Ethyl ben-	1-4	—	P	—	—	N	N	—	—	—	+	—	—
	zoate	6-10	—	X	—	—	—	—	—	+	+	—	—	—
16	Ethyl fur-	1-6	—	P	—	—	N	—	—	—	—	+	—	—
	oate	8-10	—	X	—	—	—	—	—	—	—	—	—	—
13	Sodium ben-	1-4	N	P	+	N	N	N	N	—	—	+	—	—
	zoate	6-10	—	X	—	—	—	—	—	—	—	—	—	—
15	Sodium fur-	1-4	—	P	—	—	N	N	—	—	—	+	+	+
	oate	6-10	—	X	—	—	—	—	—	—	—	+	N	—
17	Acetophenone	1-4	—	X	—	—	—	—	—	—	—	—	—	—
		6-10	—	X	—	—	—	—	—	—	—	—	—	—
20	Furyl Methyl	1-4	—	X	—	—	—	—	—	+	+	+	—	—
	Ketone	6-10	—	X	—	—	—	—	—	—	—	—	—	—
18	Benzyl	1	N	P	+	N	N	N	N	—	—	+	—	—
	Chloride	2-10	—	X	—	—	—	—	—	—	—	—	—	—
19	Furoyl	1-4	—	X	+	N	—	—	—	—	—	—	—	—
	Chloride	6-10	—	X	+	—	—	—	—	—	—	—	—	—

Physiological effects of injecting into the cockroach, *P. orientalis*, quantities equal to 10% of body weight of relatively low (1, 2 and 4%) and relatively high (6, 8 and 10%) concentrations of various benzene and furan derivatives dissolved in or emulsified in Hobson's solution (0.161 M NaCl, 0.003 M KCl, 0.002 M $CaCl_2$) using 10 mg. Witte's peptone per 5 cc. emulsion as a stabilizing agent.

The symbols used in the table have the following meanings:

N = unchanged or normal, *i. e.*, negligible effect.

P = purposeful behavior

X = purposeless behavior.

+ = increase in activity, recovery of equilibrium, occurrence of twitches, increase of heart rate or degree of contraction.

— = opposite effect of +.

S = occurrence of spasms.

Several points of physiological interest were noted during the experimental work that are not shown in the table. (1) In most animals a decrease in activity was accompanied by an obvious "purposeless" type of behavior, but in some animals a decrease in activity was associated with a "purposeful" behavior (Na benzoate, ethyl benzoate, Na furoate, ethyl furoate, benzyl chloride, furfuryl alcohol). The activity was observed to be in no case normal or increased and at the same time purposeless. (2) Immediately following the injection of sylvan, dimethyl furan (4 and 6%), orthoxylene or furfuryl alcohol, the animal became quiescent or completely inactive; following this short period of quiescence, activity was again resumed. (3) In experiments where observation of the animals could be extended, recovery was noted to occur in the cases of benzene, toluene, furan, sylvan, nitrobenzene (incomplete recovery), benzyl alcohol (1% only) and benzaldehyde (1% only). (4) The opacity of the animal to transmitted light was increased by benzene, benzaldehyde, nitrobenzene, and furfural. In some cases, the increase of opacity was sufficient to interfere seriously with observations. (5) The orderly contractions of the heart were changed to a disorganized functioning by benzene, sylvan, nitrobenzene, nitrofuran, furfuryl alcohol, benzyl alcohol, benzaldehyde, furfural, Na benzoate, ethyl benzoate, furoyl chloride, furyl methyl ketone; and by Na furoate (2%), ethyl furoate (8%) and benzyl chloride (2 and 4%). The disorganization of heart function occurred in several different ways: (a) thoracic and abdominal portions contracted at different rates and to different extents; (b) contractions of extreme anterior end of heart only or of extreme posterior end only or of both extremes only; (c) reversal of heart beat in the case of furyl methyl ketone. (6) In a number of animals, in which injection was followed by complete cessation of heart beat, recovery of heart beat appeared first at the posterior end of the heart and then gradually progressed anteriorly.

Although injection into the body cavity may be expected to result in effective contact between injected fluid and the various body tissues, due to the presence of an open circulatory system, the reactions of the animals seem to indicate that the primary effect is upon the nervous mechanism.

Summary. Various benzene and furan derivatives, dissolved or emulsified in Hobson's solution, have been injected quantitatively into the cockroach, *Periplaneta orientalis* (Linn.). The effects of the injections upon various body activities are given in condensed and tabular form. No clear-cut relationship between chemical structure

and physiological effect has been detected, although the methyl groups appear to be associated with lesser toxic effects. Several observations of physiological interest are described.

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Estimation of Ethanol in the Embalmed Brain.

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Methods for the quantitative determination of ethanol in the brain have required that the tissue be fresh. A method has been devised in the hope that ethanol may be estimated after embalming of the body. The procedure of Gettler and Tiber,[1] is modified as follows: The tissue is steam distilled. The distillate is slowly refluxed with H_2SO_4 and $K_2Cr_2O_7$ for 30 minutes, prior to distillation. This completely oxidizes the formaldehyde and methanol to CO_2 and H_2O, but the oxidation of ethanol is carried only to acetic acid. After distillation the acetic acid is determined by titration against N/20 NaOH. The ethanol in the tissue is calculated by the formula: 1 cc. of N/20 NaOH = 2.3 mg. ethanol. By this procedure ethanol can be accurately determined in a standard mixture of ethanol, methanol, formaldehyde and water.

Following the preliminary chemical study, the investigation was extended to 4 series of rabbits. Ten rabbits were given 6 gm. ethanol per kilo weight, by stomach tube and were killed 5 hours later by the neck stroke. The ethanol content of the brain varied from 0.36% to 0.45% with an average of 0.40%. A second group of 10 rabbits received the same treatment but were embalmed before analysis of the brains for ethanol. The figures varied from 0.21% to 0.52%, with an average of 0.34%.

A third group of 5 rabbits were killed and embalmed without the administration of ethanol. The figures for this series were practically identical with the figures from a fourth series of 5 control rabbits which were killed and whose brains were analyzed immediately for ethanol, namely about 0.005%.

[1] Gettler, A. O., and Tiber, A., *Arch. Path. and Lab. Med.*, 1927, **3**, 75.