TABLE I

Per cent. kill	Probits	Per cent. kill	Probits	Per cent. kill	Probits	Per cent. kill	Probits
1.0	1.87	50.0	5.00	80.0	6.13	95.0	7.21
5.0	2.79	52.0	5.07	81.0	6.18	96.0	7.35
10.0	3.28	54.0	5.14	82.0	6.23	97.0	7.53
15.0	3.61	56.0	5.20	83.0	6.28	98.0	7.76
20.0	3.87	58.0	5.27	84.0	6.34	98.5	7.92
25.0	4.09	60.0	5.34	85.0	6.39	99.0	8.13
30.0	4.30	62.0	5.41	86.0	6.45	99.1	8.18
34.0	4.44	64.0	5.48	87.0	6.51	99.2	8.24
36.0	4.52	66.0	5.56	88.0	6.58	99.3	8.30
38.0	4.59	68.0	5.63	89.0	6.65	99.4	8.38
40.0	4.66	70.0	5.70	90.0	6.72	99.5	8.46
42.0	4.73	72.0	5.78	91.0	6.80	99.6	8.57
44.0	4.80	74.0	5.86	92.0	6.89	99.7	8.69
46.0	4.86	76.0	5.95	93.0	6.98	99.8	8.87
48.0	4.93	78.0	6.04	94.0	7.09	99.9	9.16

the intermediate values in a symmetrical manner. These arbitrary probability units have been termed "probits" and are given above in an abbreviated table.

The method just described for the analysis of toxicological curves has been applied successfully by the author to a large series of data from the literature, as well as to unpublished records secured by himself or his associates. An example of this transformation is that of the curve in Fig. 1 into that shown in Fig. 2. Aside from an increased accuracy in calculating dosage-mortality curves and in interpolating dosages from such curves over a more extended range of mortalities than has been practicable with the usual asymmetrical S-curve, this type of presentation has led to the following advantages: (1) a test of the proposed theory of toxic action that (a) the variation in susceptibility among individuals is normal, and that (b) the effectiveness of the dose increases as its logarithm; (2) a closer scrutiny of experimental technique to determine if the organisms exposed to each dosage were truly equivalent and if the amounts administered experimentally were uniformly proportional to the effective dosage over the entire range covered by the experiment; (3) the disclosure of change in the mode of lethal action with certain poisons over different sections of the dosage range, indicated by an abrupt change in slope as illustrated in Fig. 2; and (4) a simple method of expressing, in the slope of a straight line, the relative uniformity or diversity between individuals in their susceptibility to a poison.

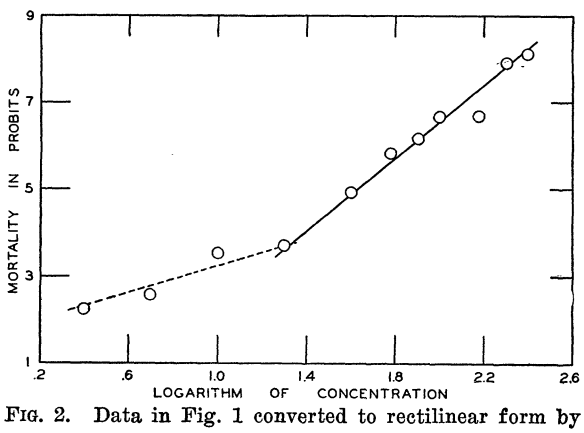

FIG. 2. Data in Fig. 1 converted to rectilinear form by use of logarithms and probits as explained.

The experimental records from the entomological literature to which this theory has been applied successfully include such diverse cases as the action of nicotine sprays upon aphids,[4] of several fumigants upon adult Tribolium,[5] of hot water upon Japanese beetle pupae,[6] of x-rays upon Drosophila eggs,[7] and of acid lead arsenate upon fourth instar silkworm larvae.[8] A more detailed table of probits and a more extended consideration of insect toxicological tests will be presented later.

C. I. BLISS

OXIDATION-REDUCTION REACTIONS BETWEEN NATURAL HYDROCARBONS AND OIL-FILLED WATERS

As far as known to the writers, it was G. S. Rogers who first pointed to certain constant relations between the occurrence of sulphide and sulphate waters on the one hand and of the composition of the associated petroleums on the other.[1] Rogers suggested that this relation might be interpreted as indicating that sulphate waters were reduced to sulphide waters by petroleums with paraffin as a base, the latter at the same time becoming oxidized and polymerized so as to yield naphthene or asphalt bases. Subsequently Bastin and his associates demonstrated that certain bacteria may serve as agents in such or similar changes and it may well be suggested, on the basis of Bastin's experimental evidence, that at moderate temperatures bacterial action is not only a sufficient but a necessary cause.[2]

In 1928 and 1930 Colacurcio and Bengtson,[3] at the

[4] F. Tattersfield and C. T. Gimingham, *Annals Appl. Biol.*, 14: 217, 1927.

[5] A. L. Strand, *Ind. and Eng. Chem.*, Analyt. Ed., 2: 4, 1930.

[6] W. E. Fleming and F. E. Baker, *U. S. Dept. Agr. Techn. Bull.*, 274, 1932.

[7] C. Packard, *Jour. Cancer Res.*, 10: 319, 1926.

[8] F. L. Campbell, *Jour. Econ. Entom.*, 23: 357, 1930.

[1] G. S. Rogers, "The Sunset-Midway Oil Field, California.—Part II, Geochemical Relations of the Oil, Gas, and Water," U. S. Geol. Surv. Prof. Paper 117, pp. 26–31, 1919.

[2] E. S. Bastin and others, "The Problem of the Natural Reduction of Sulphates," Am. Assn. Petrol. Geol., Bull., vol. 10, pp. 1281–1826, *et sequor*, 1926.

[3] M. J. Colacurcio, "Interactions of Hydrocarbons and Sulphate Waters," Univ. of Cincinnati, Unpublished Master's Thesis, 1928. R. A. Bengtson, "Interactions of Hydrocarbons and Sulphate Waters," Univ. of Cincinnati, Unpublished Master's Thesis, 1930.

suggestion of the senior author of the present paper and under the direction of Professor E. F. Farnau, of the University of Cincinnati, carried out experiments bearing on this hypothesis. Briefly summarized, these experiments suggested that sulphates could be reduced to sulphides at temperatures of approximately 150° C., and thus within the ranges anticipated in oil fields on the basis of the geothermal gradient but above the probable viability of bacteria.

Colacurcio, after autoclaving the reagents to kill bacteria, used potassium, calcium, and magnesium sulphates and obtained reduction with the aid of sulphide-free West Virginia paraffin-base crude petroleum. He employed iron bombs, cadmium chloride as indicator, temperatures ranging from 85° to 250° F., and periods varying from 1 to 24 hours. Though positive results were obtained at the elevated temperatures mentioned, room temperatures for periods of as much as two months gave negative results only.

Bengtson used longer periods, glass bombs, and strip silver as a more delicate indicator. In the main his results also were positive, the sulphate reduction being most pronounced in the presence of ferrous sulphate and of clay as catalysts. His governing temperatures ranged up to 257° F. and his periods were chiefly three days long. Negative results only were obtained at temperatures approaching those of the room despite increases in time up to a total of seven days. The oil was Pennsylvania "crude."

The purpose of this brief notice is two-fold. First, it is desired to present the results of the experiments described above in abstract, in view of their obvious bearing upon the possible derivation of "asphalt"-base petroleums from those with paraffin as base; especially is this summary desirable because of the fact that the results have never been available to students of the subject. Second, the present authors take this occasion to announce the fact that they are now essentially repeating and extending the experiments of Colacurcio and Bengtson with the aid of a furnace constructed to maintain slightly higher but static temperatures for several months at a time. They will vary (a) temperatures and pressures within the ranges known or estimated to exist in present reservoir rocks, (b) the paraffin compounds used, confining themselves, however, to simple paraffin group members in place of complex natural petroleums, (c) the oxidizing agents, and (d) the catalysts which might occur in nature, such as colloidal silica and "kaolin."

C. H. BEHRE, JR.
R. K. SUMMERBELL

DEPARTMENTS OF GEOLOGY AND CHEMISTRY
NORTHWESTERN UNIVERSITY

ON A SCURVY-LIKE DISEASE IN CHICKS

HOLST and Halbrook recently reported[1] that in the course of nutritional studies on baby chicks they observed the development of a "scurvy-like" disease the symptoms of which they say are nervousness and lameness, external and internal hemorrhages, bones often brittle and extremely low hemoglobin content of the blood. A cure was said to be effected by feeding five grams of cabbage per bird.

In an attempt to confirm the observation of Holst and Halbrook, three lots of twenty-five day-old Leghorn chicks each were placed on the following diets. Lot 101 was fed the Holst-Halbrook diet, the formula of which was kindly furnished us by Everett R. Halbrook, consisting of fish meal, 20.5 parts; ground yellow corn, 49.5 parts; ground whole wheat, 25 parts; air-dried yeast, 2 parts; ground oyster shell, cod liver oil and salt, 1 part each. Lot 102 received the above diet, except that autoclaved yeast was substituted for 8 parts of yellow corn and for the air-dried yeast. Lot 103 received the Holst-Halbrook diet, except that meat scrap meal was substituted for the fish meal.

At the end of eight weeks no symptoms of vitamin deficiency had been observed in any of the chicks. When the growth data were given statistical treatment it was found that lots 102 and 103 showed significantly better growth than the Holst-Halbrook lot, lot 102 showing the best growth.

No attempt is made to explain the observations of Holst and Halbrook; however, a "scurvy-like" disease could not be reproduced, and better growth was obtained by adding autoclaved yeast to the diet.

The authors are indebted to Professors J. S. Hughes and H. M. Scott for assistance in this study.

ROMAYNE CRIBBETT
JOHN T. CORRELL

KANSAS STATE COLLEGE

[1] SCIENCE, 77: 354, April 7, 1933.

BOOKS RECEIVED

ANTONIADI, E. M. *L'Astronomie Egyptienne.* Pp. x + 157. 50 figures. Gauthier-Villars, Paris. 40 fr.

COUPER, ARCHIBALD S. *On a New Chemical Theory and Researches on Salicylic Acid.* Pp. 45. Alembic Club, Edinburgh.

FREUDENBERG, K. *Stereochemie: Eine Zusammenfassung der Ergebnisse, Grundlagen und Probleme.* Pp. xvi + 1377–1509. Franz Deuticke, Leipzig.

HOWARTH, O. J. R. and ELEANOR K. HOWARTH. *A History of Darwin's Parish, Downe, Kent.* Pp. viii + 88. Russell, Southampton.

ROSE, MARY S. *The Foundations of Nutrition.* Revised edition. Pp. xi + 630. 101 figures. Macmillan. $3.00.

Sciencepictures. Pp. 93. Illustrated. Science Service, Washington, D. C. $0.25.

SHERMAN, HENRY C. *Food Products.* Third edition, revised. Pp. xii + 674. 41 figures. Macmillan. $3.00.

STEPHENS, J. M. *The Influence of the School on the Individual.* Pp. iv + 106. Edwards Brothers, Ann Arbor.