tures was estimated in terms of colony diameter; two diameters of each colony were measured at approximately 3-day intervals for three weeks.

The agar medium in each case was a balanced stock base having the following composition: distilled water, 1,000 cc, dextrose, 20 g, $MgSO_4$, 0.5 g, KH_2PO_4, 1 g, KCl, 0.5 g, $FeSO_4$, 7 H_2O, .01 g, agar, 15 g. To each liter of medium was added 2 grams of a nitrogen source. The salts $NaNO_3$ and $(NH_4)_2SO_4$, the amino acid asparagine and the protein egg albumin served as nitrogen sources. Peptone was not used as a source of nitrogen, since it masks the effect of sulfanilamide. This fact was ascertained by preliminary experiments, thus confirming for the test-fungus the results obtained by Lockwood for bacteria.[5]

Each Petri dish was prepared in such a way that when the nutrient agar was added there was the appropriate amount of sulfanilamide (1: 1,000), or p-aminobenzoic acid (1: 5,000, 1: 10,000, 1: 50,000, 1: 100,000, 1: 500,000) or both. Control plates contained only the nutrient agar.

Experimental Results and Discussion

The addition of sulfanilamide in 1: 1,000 concentration to any of the above-mentioned media caused complete inhibition of mat growth, although germination of spores occurred. This inhibition was entirely nullified by the addition of p-aminobenzoic acid in concentrations as low as 1: 500,000. However, addition of the acid alone to the culture media had no effect in increasing the rate of growth.

Differences in source of nitrogen brought about slight changes in the basic growth-rate, but did not materially alter the inhibiting effect of the sulfanilamide nor the antagonistic effect of the acid.

These results agree with those obtained by Woods for bacteria; in both cases the p-aminobenzoic acid exerts a striking interference with the inhibitory action of sulfanilamide. Woods has offered the suggestion that p-aminobenzoic acid is a substance, occurring naturally in yeasts, which acts as a co-enzyme in a phase of bacterial metabolism and is therefore an essential growth-substance for bacteria.[6] He further suggests that sulfanilamide, because of its structural similarity to the acid, is able to substitute for the latter in the enzyme reaction and thus interfere with normal metabolism. Only by the addition of an excess of the acid can the inhibitory effect of sulfanilamide be overcome. The fact that relatively small quantities of the acid are able to counteract the effect of the sulfanilamide appears to indicate a preference on the part of the organism for the acid. Although the experiments herein reported do not in themselves confirm such a hypothesis, they do give added evidence for its plausibility.

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[5] J. S. Lockwood, *Jour. Immunol.*, 35: 155–190, September, 1938.

[6] S. Ansbacher has recently found the acid to be a growth-promoting factor for the chick, and believes it to be one of the factors of the vitamin B complex. SCIENCE, 93: 164–5, 1941.

THE INHIBITION OF BRAIN OXIDATIONS BY A CONVULSANT BARBITURATE

QUASTEL and his collaborators[1] hold the view that narcosis is essentially an inhibition of brain glucose oxidation. They have shown that barbiturates, as well as other narcotics, depress the *in vitro* oxidation of glucose, pyruvate and lactate by brain slices, apparently by inhibition of dehydrogenases.[2] They believe that this inhibition occurs with concentrations which are of the same magnitude as those which produce anesthesia *in vivo*. The oxidations of yeast, and the oxidation by brain of succinate, p-phenylenediamine and a-glycerophosphate remain uninhibited by the same concentration. Thus they differentiate narcotics from tissue poisons which inhibit oxidations in general.

Sodium 1,3-dimethyl-butyl-ethyl barbiturate[3] has recently been synthetized and studied by Swanson and Chen.[4] It differs chemically from sodium pentobarbital only in the 3-methyl substitution on the butyl side chain, but in contrast to the depressant action of pentobarbital, this compound produces convulsions in warm-blooded animals. In view of the inhibitory effect of pentobarbital on glucose oxidation by brain slices it seemed possible to use this closely related compound, with its strikingly aberrant action in the intact animal, to test this theory of narcosis.

The oxygen consumption was measured by the direct method of Warburg, using 1.9 cc of Kreb's phosphate-saline, pH 7.2 at 38° C. Fifty to 100 mgms wet weight of freshly sliced whole rat brain were used. The barbiturate was dissolved in the same medium, and added from the side arm of the vessel after allowing a preliminary period for determination of the normal respiratory rate of the tissue. Control vessels were run in all cases. To eliminate the possibility that this compound is a tissue poison in the concentrations used, its effect on yeast oxidation was tested by the same method. No inhibitory effect was observed in a concentration of 50 mgm per cent.

[1] J. H. Quastel and A. H. M. Wheatley, *Proc. Roy. Soc. London*, B 112: 60, 1932; M. Jowett, *Jour. Physiol.*, 92: 322, 1938; J. H. Quastel, *Physiol. Rev.*, 19: 135, 1939.

[2] D. R. Davies and J. H. Quastel, *Biochem. Jour.*, 26: 1672, 1932.

[3] We wish to thank Dr. E. E. Swanson of the Lilly Research Laboratory for kindly supplying this compound.

[4] E. E. Swanson and K. K. Chen, *Quart. Jour. Pharm. and Pharmacol.*, 12: 653, 1939.

TABLE I

THE EFFECT OF SODIUM 1,3-DIMETHYL-BUTYL-ETHYL BARBITURATE ON RAT BRAIN SLICE RESPIRATION

Final barbiturate concentration	Substrate	Number of experiments	Average per cent. 0–60 Min.	Inhibition of QO_2 60–120 Min.
Mgm per cent.	200 mgm per cent.			
0.1	Glucose	3	+ 3	− 6
1.0	"	5	− 7	− 6
5.0	"	2	−17	−19
10.0	"	6	−16	−25
50.0	"	6	−43	−77
10.0	Succinate	2	− 7	− 3
50.0	"	2	+ 3	− 2

From the results given in Table I it is apparent that sodium 1,3-dimethyl-butyl-ethyl barbiturate is effective in producing inhibition of glucose oxidation of rat brain slices. Assuming equal distribution of the drug, calculations from data of Swanson and Chen,[3] on the rat, establish approximate tissue concentrations of 1 and 2 mgm per cent. for convulsive and lethal doses, respectively. A comparable inhibition of rat brain oxidation is observed with equivalent concentrations of sodium pentobarbital, but when administered to the intact animal in doses equivalent to those of the aberrant barbiturate it produces depression. These results are not explained by Quastel's theory of anesthesia.

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INDICATIONS OF AN INCREASE IN NUMBER OF C-ATOMS IN ACIDS AND NUMBER OF ACIDS IN SEED FATS WITH ADVANCE IN EVOLUTIONARY POSITION

IN the latest compilation of analyses of seed fats,[1] data from 16 natural orders (Engler and Prantl classification) are given. When the component acids of the families of these orders are considered it is found that 7 orders have an increase in the number of acids, 8 have an equal number of acids and one has a decrease in the number of acids with an advance in evolutionary position of their constituent families.

When the number of carbon atoms of these acids is considered it is found that 8 orders have an increase in the number of C-atoms, 6 have equal number of C-atoms and 2 have a decrease in the number of C-atoms with an advance in evolutionary position. If, however, the terminal families of those analyzed of the Malvales, Myrtiflorae, Contortae and Tubiflorae (*i.e.,* respectively, Sterculiaceae, Myrtaceae, Asclepiadaceae and Acanthaceae) be removed from consideration, then 3 of these 4 orders show an increase in the number of acids and all 4 show an increase in the number of C-atoms in these acids with an increase in evolution. An increase in the number of C-atoms indicates in these instances an increase in molecular weight of the acids which contain them.

The data may be summarized as follows: *Fagales*—Betulaceae Number of C-atoms 14–16–18, number of acids 5; Fagaceae 16–18–24, acids 6: *Urticales*—Ulmaceae, 10–12, acids 2; Moraceae 18, acids 3: *Santalales*—Santalaceae 16–18, acids 2; Olacaceae 16–18–20–26, acids 8: *Ranales*—Berberidaceae 16–18, acids 4; Menispermaceae 16–18–20, acids 6; Magnoliaceae 16–18, acids 4; Anonaceae 16–18–24, acids 6; Myristicaceae 10–12–14–16–18, acids 8; Lauraceae 10–12–14–16–18, acids 6: *Rhoeadales*—Papaveraceae 14–16–18–20, acids 9; Cruciferae 16–18–20–22–24, acids 9: *Rosales*—Rosaceae 14–16–18–20, acids 10; Leguminosae 14–16–18–20–22–24, acids 9+: *Geraniales*—Tropaeolaceae 16–18–22, acids 5; Linaceae 14–16–18–20, acids 7; Rutaceae 16–18–24, acids 6; Simarubaceae 10–12–14–16–18, acids 10; Burseraceae 16–18–20, acids 5; Meliaceae 14–16–18–20, acids 7; Vochysiaceae 12–14–16–18, acids 5+; Euphorbiaceae 14–16–18–20, acids 10: *Sapindales*—Buxaceae 18–20, acids 3; Anacardiaceae 14–16–18–20, acids 6; Celastraceae 16–18, acids 6; Salvadoraceae 8–10–12–14–16–18, acids 7; Staphyleaceae 16–18, acids 4; Hippocastanaceae 16–18, acids 5; Sapindaceae 10–12–14–16–18–20–22–24, acids 11: *Rhamnales*—Rhamnaceae 16–18, acids 5; Vitaceae 16–18–20–22, acids 8: *Malvales*—Tiliaceae 16–18, acids 4; Malvaceae 14–16–18–20, acids 7; Bombacaceae 14–16–18–20–24, acids 7; Sterculiaceae 16–18, acids 4: *Parietales*—Caryocaraceae 14–16–18, acids 5; Theaceae 14–16–18–20, acids 6; Guttiferae 14–16–18–20–22, acids 7; Dipterocarpaceae 14–16–18–20, acids 6; Flacourtiaceae 16–18, acids 7; Passifloraceae 16–18–20–26, acids 8; Caricaceae 16–18–20, acids 5: *Myrtiflorae*—Elaeagnaceae 16–18, acids 5; Lecythidaceae 14–16–18, acids 5; Combretaceae 14–16–18–20, acids 6; Myrtaceae 16–18, acids 5: *Umbelliflorae*—Araliaceae 16–18, acids 4; Umbelliferae 16–18, acids 4: *Contortae*—Oleaceae 16–18, acids 4; Apocynaceae 16–18–20–24, acids 7; Asclepiadaceae 16–18, acids 4: *Tubiflorae*—Convolvulaceae 16–18, acids 5; Verbenaceae 16–18, acids 4; Labiatae 18, acids 3; Solanaceae 14–16–18–20, acids 6; Scrophulariaceae 16–18, acids 5; Pedaliaceae 16–18–20, acids 5; Acanthaceae 14–16–18, acids 6: *Rubiales*—Rubiaceae 10–14–16–18–20, acids 7; Caprifoliaceae 16–18–20, acids 6; Valerianaceae 16–18, acids 5; Dipsacaceae 16–18, acids 4.

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[1] T. P. Hilditch, "The Chemical Constitution of Natural Fats," John Wiley and Sons, 1940.