We wish to thank Parke, Davis and Company for their generous help and assistance in the various phases of this work.

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RECEIVED NOVEMBER 21, 1939

2-(*p*-AMINOBENZENESULFONAMIDO)-THIAZOLE: A NEW CHEMOTHERAPEUTIC AGENT

Sir:

Fosbinder and Walter [THIS JOURNAL, **61**, 2032 (1939)] reported the preparation of 2-(*p*-aminobenzenesulfonamido)-thiazole and stated that it had good activity in experimental streptococcic and pneumococcic infections in mice. Our own studies had already reached the point where promising pharmacologic and chemotherapeutic results (van Dyke, Rake, Greep, McKee, in press) warranted therapeutic trial of this drug and we assembled the following descriptive data for that purpose.

The 2-(*p*-aminobenzenesulfonamido)-thiazole prepared by us had the m. p. 197–197.5° (uncor.), 202.0–202.5° (cor.).

Its solubility in alcohol at 26° was 525 mg. per 100 cc. In water at 26° the solubility was about 60 mg. per 100 cc., giving *p*H 6.03, which is almost twice the solubility of sulfapyridine.

Our 2-(*p*-acetaminobenzenesulfonamido)-thiazole had m. p. 256–257° as reported by Fosbinder and Walter. **2-(*p*-Aminobenzenesulfonamido)-thiazole sodium salt** was prepared by a method essentially that described by Marshall [*Science*, **88**, 597 (1938)] for the sodium salt of sulfapyridine, m. p. 256.0–256.5° (uncor.) or 264.5–265.0° (cor.). *Anal.* Calcd. for $C_9H_8N_3O_2S_2Na$: Na, 8.30. Found: Na, 8.33. It was readily soluble in cold water. A 2% solution had a *p*H of 9.57.

2-(*p*-Aminobenzenesulfonamido)-thiazole hydrochloride was prepared by adding alcoholic hydrogen chloride to an alcoholic solution of the free base and adding ether; m. p. 193–197° (uncor.); solubility in water less than 2% with *p*H 1.28; loses hydrogen chloride on standing.

The potentiometric titration curves for the acidification of 2% solution of the sodium salts of 2(*p*-aminobenzenesulfonamido)-thiazole (Sulfathiazole), and sulfapyridine are submitted in Fig. 1. It will be seen that "Sulfathiazole" is more strongly acidic than sulfapyridine.

In addition to the 2-(*p*-aminobenzenesulfonamido)-4-methylthiazole of m. p. 237–238°, we prepared the next higher homolog, 2-(*p*-aminobenzenesulfonamido)-4-ethylthiazole, and found its melting point surprisingly lower, 149.5–150.5°.

Marshall's colorimetric method [*Science*, **88**, 85 (1938)] for the estimation of sulfapyridine has been found applicable to "Sulfathiazole." By this method, however, one cannot distinguish between sulfapyridine and "Sulfathiazole."

A good test has been found which distinguishes clearly between the two drugs. Thus, when a solution of the sodium salt of "Sulfathiazole" is treated with cupric sulfate solution, a characteristic purple precipitate is formed. With sulfapyridine an apple green precipitate is formed which gradually changes to greenish brown. This test has been used successfully on a few mg. of material. The precipitates have been characterized as follows: sulfapyridine, brown; calcd. for $(C_{11}H_{10}N_3O_2S)_2Cu$: Cu, 11.36. Found: Cu, 11.12. "Sulfathiazole," purple; calcd. for $(C_9H_8N_3O_2S_2)_2Cu$: Cu, 11.12. Found: Cu, 11.09.

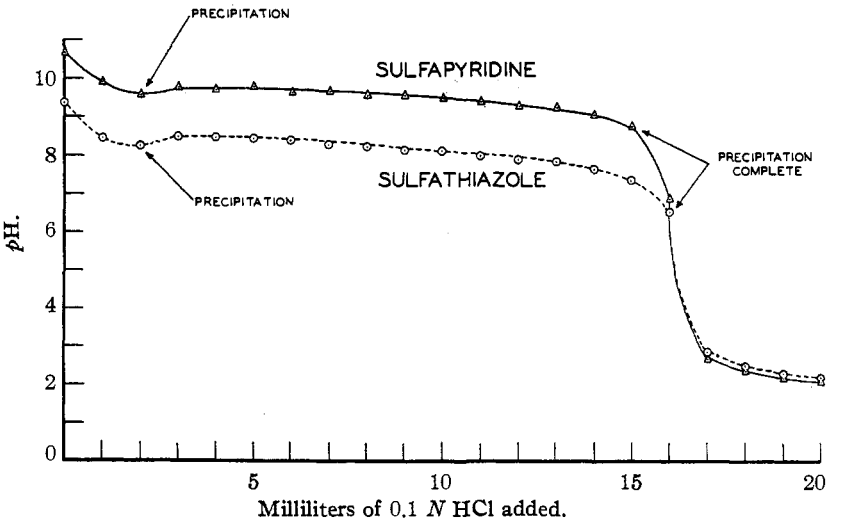

Fig. 1.—Potentiometric titrations of solutions of the sodium salts of sulfapyridine and sulfathiazole: 2% solution of sulfapyridine sodium salt, △; 2% solution of sulfathiazole sodium salt, ⊙.

Since these precipitates can be ashed and esti-

mated as cupric oxide, we are at present developing quantitative methods for these two drugs as well as sulfanilamide.

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NEW BRUNSWICK, NEW JERSEY FRANK H. BERGEIM

RECEIVED SEPTEMBER 20, 1939

BIOTIN AS A GROWTH FACTOR FOR THE BUTYL ALCOHOL PRODUCING ANAEROBES

Sir:

Recently the "growth factor" requirements of the butyl alcohol-producing clostridia has excited considerable interest.[1,2,3] It has been found that several species of these organisms require a widely distributed organic acid, which cannot be replaced by any known available growth factors.

Using the test conditions of McDaniel, *et al.*,[3] and a culture of *Clostridium butylicum* (Amer. Type Culture Coll. No. 6015), we have shown that biotin[4] is the only accessory substance required by this organism for luxuriant growth even on a synthetic medium.

The results of three tests are given in Table I, the first two on the basal medium of McDaniel, *et al.*,[3] the third using a basal medium exactly the same except that an additional 0.1% asparagin was substituted for the casein hydrolysate. Cultures 2 and 3 were subcultured from the unsupplemented tube of culture 1. Turbidities at the end of the three-day incubation period were measured quantitatively with the thermoelectric turbidimeter described by Williams, *et al.*[5] The galvanometer scale was set to read zero with the uninoculated medium in the cell; a reading of 100 corresponds to complete opacity.

TABLE I

Micrograms supplement per cc. of medium	Turbidities (galvanometer readings) — Subcultures: Culture 1 (1–3 diln.) hydrolyzed casein medium	Culture 2 (1–2 diln.) hydrolyzed casein medium	Culture 3 (undiluted) asparagin medium
Biotin Supplement			
0.000000	15.0	17.0	2.2
.0000133	25.0	19.0	10.2
.0000266	32.0	24.0	29.0
.000053	46.0	34.0	54.0
.00010	60.0	49.0	75.0
.00020	68.0	66.0	88.0
.00066	81.0	67.0	94.0
Liver Concentrate Supplement			
.0133	33.0	28.0	39.0
.0333	52.0	39.0	60.0
.0666	65.0	58.0	79.0
.1332	66.0	66.0	94.0
.2664	67.0	74.0	94.0
.6660	70.0	68.0	96.0

(1) Weizmann, *et al.*, *Biochem. J.*, **31**, 619 (1937).
(2) Brown, Wood and Werkman, *J. Bact.*, **36**, 246 (1938).
(3) McDaniel, Woolley and Peterson, *ibid.*, **37**, 259 (1939).
(4) Kögl and Tonnis, *Z. physiol. Chem.*, **242**, 43 (1936).

The "liver concentrate" was prepared in accordance with work of McDaniel, *et al.*, and was kindly furnished by Dr. Woolley. Biotin proved to be approximately 500 times as active as this concentrate and it is evidently the only substance required in addition to the ordinary nutrients. Hydrolyzed casein evidently contains small amounts of some substance which is in this case physiologically equivalent to biotin. Whether the response which we have obtained is specific for biotin cannot at present be stated. In any event, these results supply further evidence for the great physiological activity of biotin.

We wish to express our thanks to Professor Kögl, who kindly furnished us with the sample of biotin which made this work possible.

(5) Williams, McAlister and Roehm, *J. Biol. Chem.*, **83**, 315 (1929).

DEPARTMENT OF CHEMISTRY ESMOND E. SNELL
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ON THE ABSORPTION SPECTRUM OF HYPERICIN

Sir:

The pigments of *Hypericum perforatum* causing photosensitization in animals are spectroscopically closely related to irradiated oxypenicilliopsin from *Penicilliopsis clavariaeformis* [A. E. Oxford, *Chem. and Ind.*, **57**, 975 (1938); C. Dhéré and V. Castelli, *C. R. Soc. Biol.*, **131**, 669 (1939); C. Dhéré, *ibid.*, **131**, 672 (1939)].

Extracted hypericin was found chromatographically to consist of five components, and we have designated the two most abundant as X and Y. Samples were interchanged with Professor Raistrick, and component Y and irradiated oxypenicilliopsin appear very similar but not identical in chemical behavior. We wish at this juncture to supplement spectroscopic observations by Dhéré and Castelli on these pigments. We have checked their absorption maxima in absolute alcohol within 10 Å. and are in fair agreement as to the intensities.

In Table I we show the effect of solvent composition on the absorption maxima. Values are