contribute to understanding tectonic features of the earth's crust. $1,500.

H. E. Wood, 2nd, University of Newark, as chairman of a committee of the Society of Vertebrate Paleontology, will select copy for and supervise preparation of a series of colored plates representing important type localities or significant described sections to accompany a paper on the Continental Tertiary of the Rocky Mountains and High Plains. The project will provide a test of the value of colored plates as a tool for the use of stratigraphers. $1,000.

Paleontology—$1,135.

Claude W. Hibbard, University of Kansas, will collect Pliocene and Pleistocene vertebrate fossils from unconsolidated gravels in Clark County, southwestern Kansas, in extension of six seasons of field work in adjacent counties. The gravels of fossiliferous beds are put through screens of proper size to recover small fragments and teeth. The work to date has produced four new High Plains Pliocene and Pleistocene vertebrate fossils, descriptions of which have been published. $450.

M. K. Elias, State Geological Survey of Nebraska, will spend six weeks in central Colorado collecting the Walchia flora from lower Pennsylvanian rocks. Walchia was formerly regarded as a Permian plant, and the beds that Elias will study are the oldest conifer-bearing beds known. $325.

Robert G. Chaffee, Academy of Natural Sciences, Philadelphia, will set up an inter-museum card catalogue of vertebrate paleontolgical specimens of North America. $360.

Geophysics—$4,700.

N. B. Keevil, Department of Physics, University of Toronto, will study the distribution of radiogenic heat in North American granitic rocks. Radioactivity measurements are made, and a rapid method of requisite accuracy is being developed from previous work upon 1,000 rocks. Representative specimens will be obtained from geological surveys, universities, museums and mining companies. The project will provide a reliable average value for the rate of production of radioactive heat in North American granitic rocks and determine the extent of regional geothermal anomalies on this continent. $2,500.

G. P. Woollard, Princeton, New Jersey, will continue his investigation of the subsurface geological conditions along the eastern seaboard by a magnetic and gravitational survey. The survey to date has extended from New England to Washington and will now be extended to Florida. Reports on the transcontinental survey in 1940 and the more detailed examination along the northeastern seaboard in 1941 are in hand for early publication. $2,200.

Economic Geology—$400.

John S. Brown, Balmat, New York, will study the relation of porosity to ore deposition in the metamorphosed Grenville limestone of St. Lawrence County, New York. Porosities of diamond drill cores have been determined, and Dr. Brown will now carry out a thin-section study of the same cores to determine the size of openings. A preliminary report has been published in Technical Paper 1194, American Institute of Mining and Metallurgical Engineers, "Factors of Composition and Porosity in Lead-Zinc Replacements of Metamorphosed Limestone." $400.

Glacial Geology—$140.

Chauncey D. Holmes, University of Missouri, will make a detailed study of glacial transport and progressive changes in the shape of tillstones of known origin in west-central New York. The region is especially favorable for the study because the glacial ice moved at right angles to the strike of lithologically distinctive formations. The study was begun in 1937, and two papers have been published, one in the *American Journal of Science* and one in the *Bulletin of The Geological Society of America.* $140.

SPECIAL ARTICLES

THE "SULFANILAMIDE EFFECT" OF SUBSTANCES DEVOID OF SULFO GROUPS

SULFANILAMIDE and its derivatives reduce *in vitro* the speed of bacterial growth; complete bacteriostasis is attained as the maximal effect.[1] The effect of sulfanilamides is inhibited by p-aminobenzoic acid.[2] The efficiency of sulfanilamides is explained by their structural similarity to p-aminobenzoic acid; they displace this "essential metabolite"[3] or "growth factor"[4,5] from its enzyme's surface. The competition of essential metabolites of the carbonic acid type with analogous sulfonic acid compounds has been demonstrated by McIlwain, applying nicotinic acid amide ⇆ pyridin-3-sulfonic acid amide[6] and α-amino acids ⇆ α-amino sulfonic acids,[7] further by Kuhn, Wieland and Möller[8] with pantothenic acid ⇆ sulfopantothenic acid. The following two observations demonstrate that analogous substances devoid of sulfo groups are also able to displace p-aminobenzoic acid.

(1) THE ANTIBACTERIAL EFFECT OF P-AMINOBENZAMIDE AND ITS INHIBITION BY P-AMINOBENZOIC ACID

Material for inoculation: 24 hours culture of *B. coli*

[1] J. Hirsch, in press.
[2] D. D. Woods, *Brit. Jour. Exp. Path.*, 21: 74, 1940.
[3] P. Fildes, *Lancet*, 1: 955, 1940.
[4] S. D. Rubbo and J. M. Gillespie, *Nature*, 146: 838, 1940.
[5] R. Kuhn and K. Schwarz, *Ber. Deuts. Chem. Ges.*, 74: 1617, 1941.
[6] H. McIlwain, *Brit. Jour. Exp. Path.*, 21: 136, 1940.
[7] H. McIlwain, *ibid.*, 22: 148, 1941.
[8] R. Kuhn, Th. Wieland and E. F. Möller, *Ber. Deuts. Chem. Ges.*, 74: 1605, 1941.

TABLE 1

Test-tube No.		1	2	3	4	5	6	7
Inoculation per 5 ml		1	$\frac{1}{10}$	$\frac{1}{10}^2$	$\frac{1}{10}^3$	$\frac{1}{10}^4$	$\frac{1}{10}^5$	$\frac{1}{10}^6$ drop
		Growth after 43 hours at 37° C						
a	Control	+	+	+	+	+	+	–
b	p–Aminobenzamide 1.10^{-3}M	+	+	–	–	–	–	–
b′	p–Aminobenzamide 1.10^{-3}M + p–Aminobenzoic acid 1.10^{-4}M	+	+	+	+	+	+	+
c	Sulfanilamide 1.10^{-3}M	+	–	–	–	–	–	–
c′	Sulfanilamide 1.10^{-3}M + p–Aminobenzoic acid 1.10^{-4}M	+	+	+	+	+	+	–

on a synthetic medium for staphylococci.[9] Medium: 10.53 per cent. of ammonium chloride, 0.3 per cent. of glucose, 0.5 per cent. of sodium sulfate, 0.01 per cent. of magnesium chloride, phosphate buffer (M/15) pH 7.2; each 5 ml.

The bacteriostatic effect of p-aminobenzamide is almost as strong as that of equimolecular quantities of sulfanilamide; both effects are suppressed by p-aminobenzoic acid.

(2) The Antibacterial Effect of p-Aminophenylarsinic Acid (Atoxyl) and Its Inhibition by p-Aminobenzoic Acid

Atoxyl reduces the speed of bacterial growth, but no complete bacteriostasis is attained. The speed of bacterial growth in aerobic cultures has been determined by continuous measurement of the oxygen consumption in Warburg vessels.[10]

Material for inoculation: 13 hours culture of *B. coli* on a synthetic medium;[9] one drop per 30 ml was inoculated in the same medium.

TABLE 2

Culture No.	I	II	III	IV	V	VI
Addition	–	–	Atoxyl 1.10^{-4}M		Atoxyl 1.10^{-4}M + p–Aminobenzoic acid 1.10^{-4}M	
Hours after inoculation	mm^3 Oxygen consumption per ml in 30 minutes					
3 00	4	4	2	3	6	4
3 30	11	9	7	7	13	11
4 00	23	20	13	13	28	26
4 30	51	40	20	20	49	46
5 02	91	70	30	28	76	75
5 34	126	115	37	38	103	99

p-Aminophenylarsinic acid (atoxyl) acts in the same way but decidedly weaker than sulfanilamide and p-aminobenzamide. This corresponds to the lesser antibacterial efficiency of free sulfanilic acid.

Among the derivatives of p-aminobenzamide possibly a further new group of substances with chemotherapeutic effects towards bacterial infections might be found. Other substances, too, devoid of sulfo groups, but structurally related to p-aminobenzoic acid, should be tested with regard to their chemotherapeutic effects.

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[9] P. Fildes and G. M. Richardson, *Brit. Jour. Exp. Path.*, 18: 292, 1937.

[10] J. Hirsch, *Enzymologia*, 4: 94, 1937.

ENZYME ACTION

Just as the adsorptive capacity of finely ground activated charcoal for methylene blue is decreased by narcotics, so it appears that the activity of enzymes is reduced similarly by the same narcotics.

In plant physiology there is an experiment whose object is adsorption and whose procedure involves the mixing of finely ground activated charcoal with an aqueous solution of methylene blue. Under the correct proportion which varies with the concentration of methylene blue and the adsorptive potency of the finely ground activated charcoal, the filtrate is clear and devoid of methylene blue. The conclusion is that the methylene blue has been adsorbed by the finely ground activated charcoal. The experiment also directs the students to add ethyl alcohol to the residue, whereupon the filtrate becomes deep blue and the conclusion is that alcohol decreases the adsorptive capacity of the charcoal particles.

The students in plant physiology at the University of South Dakota performed this experiment in January, 1942, shortly after the meetings of the American Association for the Advancement of Science in Dallas, and when the prize-winning paper was still fresh in my mind. As most of you may recall, the prize was awarded to Johnson, Brown and Marsland for the paper entitled "The Mechanism of Temperature and Hydrostatic Pressure Reversal of Narcosis in Luminous Bacteria."[1] The research involved the action of narcotics on luciferase, the enzyme which is responsible for luminescence in luminous bacteria. The investigators found that narcotics readily reduce the intensity of luminescence, clearly indicating a decrease in enzymatic activity.

[1] Frank H. Johnson, Dugald E. S. Brown and Douglas A. Marsland, *Anat. Rec.*, 81: 4, Supplement, page 33, 1941.