TABLE III.
Degree of Hemorrhage in Rabbits Sensitized by Repeated Intracutaneous injections of Heat-killed Pneumococci Type I.

Rabbit No.	No. of injections	Duration of sensitization (days)	Degree of skin-sensitivity to vaccine	Degree of hemorrhage in lesion 24 hr after i.v. injection of 1 cc of pneumococcal broth culture
16	6	6	7-1	None
17	6	6	4-1	"
18	12	20	23-2	"
19	12	20	16-2	+
20	12	20	4-0	None
21	18	34	29.3	"
22	18	34	21-3	±
23	18	34	29-2	±
24	24	48	31-3	+++
25	24	48	28-3	+
26	24	48	18-2	None

by intravenous injections of sufficient amounts of killed or living organisms, a hemorrhagic reaction frequently developed at the site of the intracutaneous injection.

The most intense hemorrhagic reactions were observed in animals with the highest degree of cutaneous sensitization. We did not observe hemorrhagic phenomena in non-sensitized animals treated in a similar manner.

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Blood Pantothenic Acid Values in Multiple Sclerosis.

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Since the discovery and synthesis of pantothenic acid (Williams and Major[1]), many attempts have been made to determine its clinical value. Stanbery, Snell and Spies[2] have shown that in deficiencies of the factors of the vitamin B complex, there is always a decrease in the blood pantothenic acid values. Their normal subjects gave values from 19.0 to 32.0 μg %, with an average of 22.5. The daily varia-

[1] Williams, R. J., and Major, R. T., *Science*, 1940, **91**, 246.

[2] Stanbery, S. R., Snell, E. E., and Spies, T. D., *J. Biol. Chem.*, 1940, **135**, 353.

tion was within 2.0 μg %. In cases of deficiency, such as pellagra, beri beri and aflavinosis, the blood pantothenic acid values were found to be from 50 to 77% of the average normal figure.

Phillips and Engel[3] demonstrated that in pantothenic acid-deficient chicks there were lesions of the spinal cord characterized by degeneration of the myelinated fibers. In longitudinal sections degenerative changes were frequently observed in the axis cylinders of the involved nerve.

In multiple sclerosis pathological changes are found which despite a greater relative degeneration of myelin sheaths as compared to axis cylinders have certain superficial resemblances to the lesions described by Phillips and Engel. This suggested to the first author that a deficiency of pantothenic acid might constitute at least a contributing factor in the development of this disease. Accordingly, analyses for this vitamin were conducted on blood of normal and multiple sclerotic individuals to ascertain whether any differences existed.

The microbiological method of Pennington, Snell and Williams[4] as subsequently modified[2] was used. The normal subjects were hospital and laboratory personnel. The clinical material was obtained from patients admitted to the Neurological Institute, and who were diagnosed as advanced cases of multiple sclerosis. In these cases the disease was from 2 to 25 years' duration and in various stages of remissions and relapses. One case of amyotrophic lateral sclerosis was also studied. All subjects subsisted on normal adequate diets, precautions being taken that foods rich in pantothenic acid such as liver and molasses were excluded.

The blood analyses were run in duplicate. A survey of the results indicated that in our hands the method shows a technical reliability or consistency reflected in values reproducible to within 3.5% of the average figure with a maximal deviation of 9.5%.

In Table I the results of the present study are summarized.

Our normal subjects had blood pantothenic acid values varying from 19.7 to 33.5 μg %; this is in close agreement with the range of values reported by Stanbery, Snell and Spies. The blood values of the multiple sclerotic subjects were also in the normal range. This indicates that pantothenic acid deficiency can not be regarded as having etiologic significance in this disease.

In one case of multiple sclerosis, subject B.S., the dietary history

[3] Phillips, P. H., and Engel, R. W., *J. Nutrition*, 1939, **18**, 227.

[4] Pennington, D., Snell, E. E., and Williams, R. J., *J. Biol. Chem.*, 1940, **135**, 213.

TABLE I.
Blood Pantothenic Acid Values in Normal and Multiple Sclerotic Individuals.

Subject	Clinical status	Blood pantothenic acid level μg%	
H.H.	Normal	19.7	
J.G.	"	29.4	Mean = 28.1
M.W.	"	29.3	Avg deviation
D.M.	"	33.3	= 2.2
H.D.	"	23.5	
H.S.	"	33.6	
I.B.	Multiple Sclerotic	29.6	
B.S.	" "	19.7	Mean = 28.8
E.F.	" "	28.0	Avg deviation
J.P.	" "	33.6	= 3.3
K.K.	" "	32.8	
H.S.	" "	29.0	
S.O.	Amyotrophic lateral sclerosis	32.0	

indicated a low intake of pantothenic acid. Oral administration of increased quantities of pantothenic acid in the form of food rich in this vitamin led to a prompt increase in the blood value approximating the maximal in the normal group. This observation agrees with that reported by Spies and associates[5] and supports their conclusion that pantothenic acid deficiency is associated with a decrease in the blood value.

Summary. Blood pantothenic acid values from six normal subjects varied in the present study over the usually obtained normal range of from 19.7 to 33.6 μg %. These values are ordinarily decreased in cases of pantothenic acid deficiency. Six patients with advanced multiple sclerosis failed to show any such decrease in the concentration of pantothenic acid in the blood indicating that this vitamin is probably not an etiologic factor in this disease.

[5] Spies, T. D., Hightower, D. P., and Hubbard, L. H., *J. A. M. A.*, 1940, **115**, 292.