TABLE 1

Toxin	Sulfanilamide	*p*-aminobenzoic acid	Per cent. survival	No. of animals
1 M.L.D.	.....	.....	52	48
2 M.L.D.	.....	.....	8	36
10 M.L.D.	.....	.....	0	38
.....	20 mgm (oral)	.....	95	20
2 M.L.D.	20 mgm (subc.)	.....	46	13
2 M.L.D.	20 mgm (oral)	.....	94	38
10 M.L.D.	20 mgm (oral)	.....	33	30
10 M.L.D.	20 mgm one hour prior to toxin injection plus two doses of 10 mgm each at four hour intervals (oral)	.....	45	20
20 M.L.D.	20 mgm (oral)	.....	0	9
.....	20 mgm (oral)	10 mgm (subc.)	100	11
2 M.L.D.	.....	10 mgm (subc.)	0	5
2 M.L.D.	20 mgm (oral)	10 mgm (subc.)	17	35
2 M.L.D.	Sulfathiazole 20 mgm (oral)	.....	50	20
10 M.L.D.	Sulfathiazole 20 mgm (oral)	.....	0	18
2 M.L.D.	Sulfapyridine 20 mgm (oral)	.....	75	16

1 M.L.D. is designated as the amount of antigenic material required to kill within 24 hours 50% of mice injected intraperitoneally with an aqueous solution of the antigen. By dry weight 1 M.L.D. equals 1.3 mgm of toxic material.

Since sulfanilamide is not in all probability a naturally occurring substance the question arises as to whether the protective effect of sulfanilamide results from increasing the general resistance of the body to the toxin, or whether sulfanilamide or one of the products into which it is converted by the body is utilized more specifically for a detoxication process. The first hypothesis is weakened by the finding of Carpenter and associates who observed that sulfanilamide protected mice against toxins produced by such gram positive organisms as *Staphylococcus aureus* and *Clostridium welchii*, both of which differ markedly in pathogenesis from the toxins of gram-negative organisms, particularly *Salmonella* studied by us and by Levaditi, and the *Neisseria* toxins studied by Carpenter and by Levaditi.

A specific detoxication mechanism for toxic proteins, aside from hydrolysis, has never to our knowledge been proposed. The experiments of Morgan[7] showing that the toxicity of typhoid antigen is not destroyed by its homologous antibody (in contrast to the neutralizing action in other toxin-antitoxin reaction mixtures, *e.g.*, diphtheria and tetanus) may suggest that some other means, presumably non-immunological, within the body is called upon to detoxify this antigen.

This action of sulfanilamide, if it is a detoxication of bacterial toxins, may represent a special instance of the enhancement of the general detoxication of proteins within the body.

[7] H. R. Morgan, *Jour. Immunol.*, 41: 161–80, 1941.

SUMMARY

Sulfanilamide compounds protect mice against multiple lethal doses of purified *Salmonella* endotoxin. This protective action of sulfanilamide is inhibited by *p*-aminobenzoic acid.

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ANTICIPATORY CARDIAC ACCELERATION DURING SLEEP

As a part of a series of studies of sleep motility[1] at the University of Virginia, recordings of the heart rate during sleep were made. The data obtained proved to be of considerable interest and served to indicate the nature of the stimuli causing sleep movements.

Johnson[2] has called attention to the fact that during sleep, when body positions are maintained for fairly long intervals, there is, among other things, an interference of circulation (stasis of the blood and body fluids in parts of the body) and an overheating of the unventilated portions of the skin. These conditions, he suggested, must become sufficiently irritating in time to lead to a change in body position. For convenience this shall be termed the congestion hypothesis.

It is a matter of common knowledge that, as Johnson mentioned, such stimuli become irritating and even painful after some minutes. Further, it has been shown that either restriction of circulation or raising of the skin temperature produces an increase in the heart rate. If these irritating stimuli were the ones causing movement, an increase in the heart rate prior to movement would be expected. According to the same reasoning, a decrease might be shown following movement, as a change in position would relieve the irritating conditions.

This reasoning led to an experiment in which the heart rate was examined in conjunction with motility. In order to rule out the possibility of experimental artifacts interfering with the normal circulation during sleep, the heart rate was determined electrically by means of a cardiotachometer. Each heart beat was recorded on a moving strip of paper along with the movements of the sleeper. A high-speed kinetograph was used to determine precisely the onset and termination of each movement. In this study only the larger movements involving a change in position of the trunk were considered. To obtain the heart rate uncomplicated by factors other than those under consideration, a given movement must be preceded and followed by several minutes of inactivity.

[1] Results of these studies are to be published.

[2] H. M. Johnson, T. J. Swan and G. E. Weigand, *Psychol. Bull.*, 27: 18, 1930.

Records for twelve complete nights' sleep of one subject were analyzed. From these records 83 movements conforming to the preceding criteria were obtained. The average heart rate for each minute of the period beginning 6 minutes before movement and terminating 5 minutes after movement is shown graphically in Fig. 1.

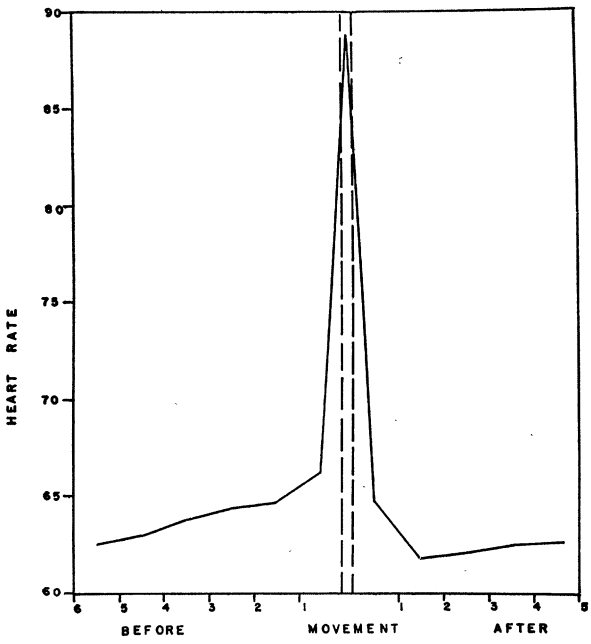

FIG. 1.

A trend of the sort suggested by the congestion hypothesis is apparent. An anticipatory increase in the heart rate is clearly demonstrated. From the curve, the rise appears to begin as much as 6 minutes before movement and the increment becomes greater until movement takes place. A minimum below that of any other period under consideration occurs soon after movement, and from this point there is a slow return to the earlier level. While of no immediate bearing on the congestion hypothesis, the much increased rate during movement is to be noted.

Analysis of the cardiotachometer records in quarter-minute intervals shows the same general trend, and the points of change are fixed more accurately in time. There is a slow rise continuing until one-half minute before movement. This is followed by a much more rapid rise that immediately precedes movement. This suggests that the anticipatory rise may be the resultant of two different functions. Statistical analysis of the data shows that both the anticipatory increase and the subsequent decrease are reliable.

These data are evidence of the correctness of the congestion hypothesis. Further experiments are planned to determine more specifically the nature of the stimulus and the mechanisms involved.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A RAPID METHOD FOR THE DETERMINATION OF NITROGEN IN PLANT TISSUE

IN view of the imminent shortage of critical elements which are necessary in maintaining crop production, it is becoming increasingly important that guess-work be eliminated in so far as possible in determining the actual fertilizer needs of economic plants. The chemical analysis of leaves as a means of determining the nature of nutritional disorders and as a tool in determining the fertilizer requirements of crop plants has received increasing attention in recent years. The investigations of Lagatu and Maume,[1] Thomas,[2] Thomas and Mack[3] and others have placed the theory of leaf analysis or "foliar diagnosis" on a sound basis. This method has not found wide application probably because of the time and expense involved in the chemical procedures usually employed. With these factors in mind, and faced with the necessity of analyzing hundreds of apple leaf samples in connection with nutrition studies, along with specimens of nutritional disorders frequently brought to the laboratory by fruit growers, we found it desirable to devise more rapid methods for the determination of some of the common nutritional elements in plant tissue.

Nitrogen is perhaps the element that is determined most often by agricultural and biological chemists, and practically all analyses are based on the standard time-consuming Kjeldahl method. A rapid acid-digestion procedure was sought which would make it possible to determine not only nitrogen, but also phosphorus, potassium, calcium, magnesium and other elements in the same sample. The use of 30 per cent. hydrogen peroxide in the presence of concentrated sulfuric acid was found to be a remarkably fast and thorough method for digesting relatively small quantities of plant material. The entire digestion takes only about five minutes, and total nitrogen, including nitrates, can be determined in the resulting solution by the standard nesslerization procedure using a photoelectric colorimeter of the test-tube type. The

[1] H. Lagatu and L. Maume, *Ann. Ecole Nat. Agr. Montpellier*, 20: 219–281, 1930.
[2] Walter Thomas, *Plant Physiol.*, 12: 571–600, 1937.
[3] Walter Thomas and Warren B. Mack, *Penn. Agr. Exp. Sta. Bull.* No. 378, 1939.