rion schoenleinii, Acladium castellani, Candida candida, Endodermophyton indicum, E. tropicale, Endomyces capsulatus, E. dermatitidus, Epidermophyton cruris, E. inguinale, E. rubrum, Glenospora Gammeli, Geotrichum Bachmann, Indiella americana, Microsporon Audouini, M. felineum, M. gypseum, Monosporium apiospermum, Monilia albicans, Oospora humi, Sporotrichum Schenckii, Trichophyton balcaneum, T. crateriforme, T. decalvans, T. granulosum, T. gypseum, T. gypseum-asteroides, T. gypseum-lacticolor, T. interdigitale, T. louisianicum, T. niveum, T. purpureum, T. sulfureum, Willia anomala. Observations were made on growths kept in the cabinets 30 days.

Duplicate tubes containing 10 cc. of mediums used were placed in cabinets at 80 and 97% r.h., 70°F., a.v. 3 ft./min. and 12 ft./min. The original weight of the mediums varied from 9.2 to 9.5 gm. The 38-day weight loss varied from 650 to 900 mg. Mediums at 80% r.h., a.v. 12 ft./min. showed greatest loss in weight and those at 97% r.h., 3 ft./min. least. The second highest weight loss was at 97% r.h., a.v. 3 ft./min.

In conclusion, examination of 30-day growths failed to show difference attributable to difference in humidity. Variation of nutrient gradient and evaporation was not sufficient to influence surface or subsurface tendency of growths.

9517

Dinitrophenol Hyperglycemia. II. Its Prevention by Section of Splanchnic Nerves.*

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In a study of the hyperglycemia produced by 2-4 dinitrophenol (DNP), Hall, Brown and Sahyun[1] suggested that its mechanism might be the stimulation of sympathetic glycogenolytic centers of the brain stem by local cellular anoxemia or acidosis. Wishnovsky, Kane, Schlevin and Byron[2] have criticized this suggestion, on the

* We wish to acknowledge the assistance of Messrs. C. A. Brown, George Fraser, and Julian Edmond during the earlier phases of the work on this problem.

1 Hall, V. E., Brown, C. A., and Sahyun, M., PROC. SOC. EXP. BIOL. AND MED., 1933, **31**, 380.

2 Wishnovsky, M., Kane, A. P., Shlevin, E. L., and Byron, C. S., *Arch. Int. Med.*, 1935, **56**, 374.

grounds that the rise in blood sugar produced by the drug may still be demonstrated after the administration of large quantities of glucose, at a time when, as they state "the tissues are flooded with dextrose and the predominant process in the liver is glycogenesis. There is no need for active glycogenolysis." They were at a loss to explain the observed rise.

In order to determine whether DNP hyperglycemia depends upon impulses arising in the central nervous system and causing hepatic glycogenolysis, we have cut the 3 splanchnic nerves of cats just below the diaphragm on both sides under aseptic conditions. Controls were subjected to the same procedure except that the nerves were not actually cut. After a recovery period of at least 2 weeks, the animals were anesthetized with pentobarbital (37.5 mg. per kg. intraperitoneally), allowed to rest 90 minutes so that the hyperglycemia resulting from the excitement of anesthetization might pass off, a control blood sample drawn by heart puncture and a dose of sodium 2-4 dinitrophenolate solution, adequate to yield 10 mg. per kg. of the acid was injected intramuscularly. Blood samples were drawn 30, 60 and 120 minutes after injection, and the glucose content determined by the method of Folin and Wu.[3]

The results, which appear in Table I, show that, in the controls, DNP at least doubled the blood glucose concentration, the peak usually being reached about 30 minutes after injection. However, in the cats in which the splanchnic nerves had been cut bilaterally, no

TABLE I.
Effect of Section of Splanchnic Nerves on Blood Sugar Response to DNP.

Cat No.	Initial Control mg. %	Post-injection Period 30 min. mg. %	60 min. mg. %	120 min. mg. %	Max. rise mg. %
Controls					
1	91	210	182	128	119
2	94	192	182	164	98
3	99	204	236	192	137
4	96	205	190	174	109
5	98	194	187	163	96
Aver.	96	201	195	164	112
Splanchnic nerves cut					
1	95	90	114	122	27
2	94	96	104	122	28
3	95	90	107	89	12
4	92	95	101	108	16
5	92	85	106	114	22
Aver.	94	91	106	111	21

[3] Folin, O., and Wu, H., *J. Biol. Chem.*, 1920, **41**, 367.

such rise appears. In the first half-hour the blood sugar often falls (presumably due to accelerated glucose uptake by the tissues[4]), but thereafter shows a gradual continuous upward trend which continues throughout the period of observation. Its magnitude is much smaller than that of the rise seen in the controls. Its significance is not clear. It is not due to incomplete section of the splanchnic nerves, for this has been checked at necropsy. Fibers reaching the adrenal medulla by way of branches from the lumbar sympathetic chain may have been responsible.

It is very clear, however, that the rapid early rise in blood sugar produced by DNP depends upon the intactness of the splanchnic nerves. This fact, taken with the demonstration by Magne, Mayer and Plantefol,[5] confirmed by Hall, Field, Sahyun, Cutting, and Tainter,[6] that the blood sugar rise is accompanied by a reduction in liver glycogen content, shows clearly that the DNP hyperglycemia results at least principally from a stimulation by the drug of the sympathetic glycogenolytic mechanisms (including in this term both the direct effect of the sympathetic innervation of the liver and the glycogenolytic influence of whatever epinephrine may be secreted simultaneously). A possible additional factor may be the formation of carbohydrate from other nutrients, including fat, as has been demonstrated by Mirsky and Soskin.[7] Since this conversion was demonstrated to occur in the later phase of DNP action, it is tempting to relate it to the slow rise in blood sugar we have demonstrated in cats in which the splanchnic nerves had been cut.

Relative to the criticism which Wishnovsky and coworkers[2] have made of our concept of the mechanism of DNP hyperglycemia, it should be pointed out that all our animals have been studied in the fasting state. Under these conditions, the occurrence of sympathetically evoked hepatic glycogenolysis has been proved to our satisfaction. Wishnovsky and coworkers were studying patients who had received glucose and in whom active glycogenesis was doubtless proceeding rapidly. Nevertheless, DNP caused a further rise in blood sugar, a result fully to be expected if the drug still produced sympathetic discharge, disturbing the balance between hepatic glycogenesis and glycogenolysis in favor of the latter, so as to retard the

[4] Ashe, W. F., PROC. SOC. EXP. BIOL. AND MED., 1935, **32**, 1062.

[5] Magne, H., Mayer, A., and Plantefol, L., *Ann. Physiol. Physicochim. Biol.*, 1932, **8**, 1.

[6] Hall, V. E., Field, J., Sahyun, M., Cutting, W. C., and Tainter, M. L., *Am. J. Physiol.*, 1933, **106**, 432.

[7] Mirsky, I. A., and Soskin, S., PROC. SOC. EXP. BIOL. AND MED., 1935, **32**, 1273.

rate of glucose uptake from the blood. Their teleological reasoning that glycogenolysis would not occur in the absence of a "need" for it is invalidated by a consideration of the hyperglycemia of asphyxia. Here, as is well known, the blood sugar is increased through the sympathetic glycogenolytic mechanism without there being any more immediate "need" for the glucose than there is following DNP administration. The close similarity of the means of production of the hyperglycemias of asphyxia and of DNP is striking. Although we[1] have shown that DNP evokes its hyperglycemia without producing an asphyxial state of the arterial blood, the possibility remains that the acceleration of the tissue metabolism in the sympathetic centers of the brain stem may result in local anoxia or acidosis and so set up the stimulus which activates the glycogenolytic mechanisms which are responsible for the hyperglycemia produced by the drug.

9518 P

Influence of Insulin on Amino Acid Utilization.*

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During the course of an investigation on the endocrine control of nitrogen metabolism we found that insulin decreases the rate of protein catabolism. Our evidence suggested that this action of insulin may be due, in part, to an increased utilization of amino acids by the muscles. That insulin may have a proteinogenic action, was postulated by Wiechmann[1] and by Janney and Shapiro,[2] but neither group presented evidence to support this concept. On the other hand, Kiech and Luck[3] concluded from their studies on rats that insulin increases the rate of amino acid catabolism and inhibits the compensatory process of protein hydrolysis by which the amino acids are generated. As was subsequently stated by Daniels and Luck,[4] the possibility of an accompanying increase in the peripheral synthesis of protein from blood and tissue amino acids is not incompatible with their experimental findings.

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1 Wiechmann, E., *Deutsch. Arch. Klin. Med.*, 1926, **150**, 186.

2 Janney, N. W., and Shapiro, I., *Arch. Int. Med.*, 1926, **38**, 96.

3 Kiech, V. C., and Luck, J. M., *J. Biol. Chem.*, 1928, **78**, 257.

4 Daniels, A. C., and Luck, J. M., *J. Biol. Chem.*, 1931, **91**, 119.