pound but reverses this relation notably in the acetic-glycocoll couple and in the propionic-alanin pair.

3. The agar-protein biocolloid shows notably greater hydration in the amino-acids than in the related organic acids, and greater even than the hydration in distilled water.

4. Equimolecular concentrations of amino-acids produce notably greater swellings of the biocolloids in comparison with related organic acids implying the positive action of factors other than the hydrogen ion concentration.

5. Glycocoll facilitates hydration in all concentrations above .01 M. in both agar and agar-proteins, and also in agar-gelatine, the data of which are not given in this paper. This fact goes far in explanation of the scattered results obtained by various workers in which accelerated growth or increased total growth has been seen to result from the addition of glycocoll to nutrient solutions. Such increases have been attributed to catalytic action by Dakin and others.

6. The amide, asparagin, induces a maximum hydration, greater even than that possible in agar in distilled water, and very high at all concentrations. Similar action was exerted on agar-gelatine and agar-protein plates. The positive action of both glycocoll and asparagin is indicated by the fact that the maximum effect is reached at certain concentrations above the minimum.

The destruction of our supply of phenyl-alanin in transit prevented an examination of the effects of this substance, but it will be possible to extend this work to this and other amides in the next few months.

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The carbon dioxide of injury and of respiration in nervous tissue.

By **A. R. MOORE.**

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It has been shown that injured nervous tissue gives an acid reaction with phenolsulphonephthalein as indicator and that the acid measured by Haas[1] method is carbon dioxide.[2] If the rate

[1] Haas, A. R. C., *Science*, N.S., vol. 44, pp. 105–108, 1916.

[2] Moore, A. R., PROC. SOC. EXP. BIOL. AND MED., vol. 15, pp. 18–19, 1917.

f acid output of a frog's sciatic nerve be measured by taking the time required for the solution to change tint from pH 7.8 to pH 7.4, this rate will be seen to fall after the first or second consecutive readings. If now the nerve be taken out and crushed with a glass rod, the subsequent measurement will show a large increase in

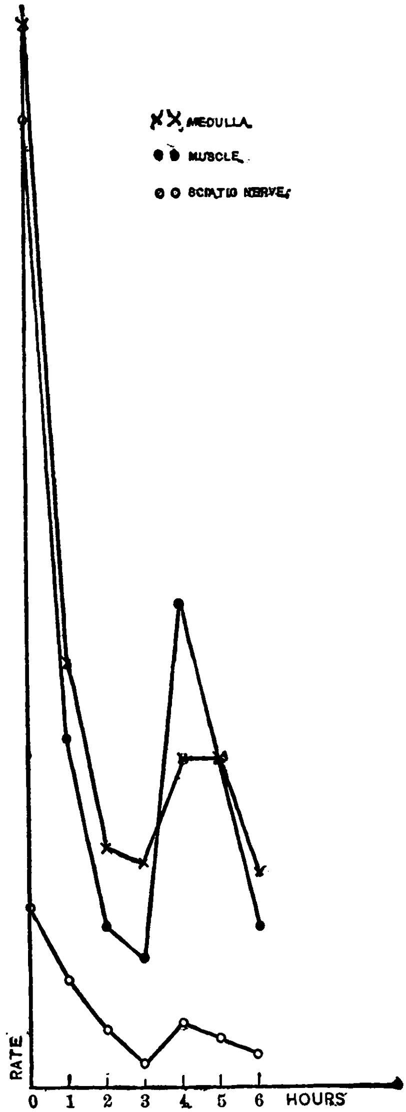

FIG. 1.

rate, which, in turn, after a few readings, falls to the former low rate. The following determinations on a pair of frog sciatic nerves shows this fact.

		Time.		Rate.
Fresh,	first	reading	360 seconds	.28
"	second	"	1440 "	.07
Crushed	first	"	420 "	.24
"	second	"	1740 "	.06

$$\text{Rate} = \frac{100}{\text{Time}}$$

It is apparent that the acid resulting from injury develops only momentarily and is soon washed out by the surrounding neutral Ringer's solution. It therefore seems reasonable to suppose that the carbon dioxide output during the time following is largely that of respiration.

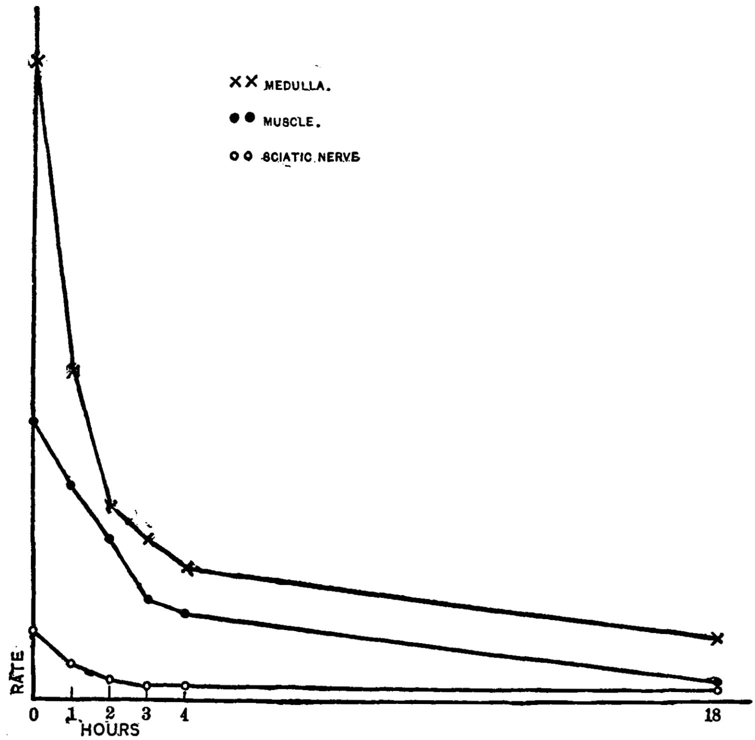

FIG. 2.

With a view to comparing the rates of acid production of central nervous system, muscle and nerve fiber, equal weights of the medulla, the sartorius muscle, and the sciatic nerves of the same individual frog were taken. The Haas measurements were made by putting the tissue to be tested into a small test-tube containing 3 c.c. of Ringer's solution tinted with the indicator and previously rendered pH 7.8 with a drop or two of $n/10$ NaOH to the liter. The tube was closed with a paraffined cork. A bubble of air acted as a stirrer and the preparation was inverted and righted at short intervals until the tint of the solution matched that of a standard tube of solution whose pH = 7.4. Time was taken with a stop watch and the number of seconds required for this amount of change gives an inverse measure of the rate.

$$\text{Rate} = \frac{100}{\text{time in seconds}}.$$

As soon as one reading was taken the tube was emptied of its fluid and refilled from the stock bottle, and another reading taken. As a rule five or six consecutive readings were made. The last two or three were fairly constant; hence their average values are given in the tables and form the basis of the graphs. A set of readings was made each hour and in the interval the tissues remained in their respective tubes each containing 3 c.c. of solution (Table I., Fig. 1) or in beakers each containing 100 c.c. of neutral

TABLE I.

Hour.	Medulla.		Muscle,		Sciatic.		Sciatic / Medulla.	Sciatic / Muscle.
	Time.	Rate.	Time.	Rate.	Time.	Rate.		
0	18	5.5	20	5.0	110	.91	.16	.18
1	45	2.2	55	1.8	180	.55	.25	.30
2	80	1.25	120	.83	360	.28	.22	.34
3	85	1.17	150	.67	900	.11	.09	.16
4	60	1.7	40	2.5	300	.33	Av. = .18	.245
5	60	1.7	60	1.7	400	.25		
6	90	1.1	120	.83	600	.17		

TABLE II.

Hour.	Medulla.		Muscle.		Sciatic.		Sciatic / Medulla.	Sciatic / Muscle.
	Time.	Rate.	Time.	Rate.	Time.	Rate.		
0	30	3.3	70	1.43	270	.37	.11	.26
1	60	1.7	90	1.11	540	.185	.11	.17
2	100	1.0	120	.83	1000	.1	.10	.12
3	120	.83	190	.52	1200	.07	.08	.13
4	145	.69	220	.45	1200	.07	.10	.15
18	300	.33	1000	.10	1620	.06	.18	(.60)
							Av. = .11	.17

Ringer's solution (Table II., Fig. 2). In the small quantities of fluid a strong acid reaction developed during the hour. This led to rigor and opacity of the muscle by the end of the fourth hour. This change was accompanied by a marked increase in the rate of acid output not only in the muscle but in the medulla and in the sciatic nerves. Probably death changes were also occurring in the nervous tissues. Where sufficient solution was present to maintain neutrality, no secondary maximum of acid production developed.

It will be noted from the graphs and tables that a marked fall in rate occurs during the first hour, and that the medulla has a higher rate of acid production than muscle while the sciatic nerve has an extremely low rate. Under appropriately headed columns of the tables are given the ratios of rate of acid output in the sciatic nerves to that of the medulla and to that of the muscle of the same animal. In view of the fact that Mathews[1] states that the respiratory rate of nerve fibers is "higher than that of any other tissue examined," it is interesting to note that under identical conditions of experiment, nerve fibres produce carbon-dioxide at 10–20 per cent. of the rate of the medulla and at 15–30 per cent. of the rate of muscle.

23 (1398)

Volumetric analysis of ion-protein compounds.

By JACQUES LOEB.

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The speaker demonstrates that gelatin at $pH > 4.7$ combines only with cations and at $pH < 4.7$ only with anions, while at the isoelectric point ($pH = 4.7$) it combines with neither anion nor cation.

He shows further that the curves representing the influence of monovalent anions or cations upon the swelling, osmotic pressure and viscosity of gelatin are always approximately parallel with the curves representing the amount of anion or cation found in chemical combination with the gelatin.

[1] Mathews, A. P., "Physiological Chemistry, p. 590, 1915.