s'expliquer par les théories actuelles, et sont dus simplement à l'exquise sensibilité du cohéreur, ou s'ils ne prouvent pas que les ondes se réfléchissent sur les couches supérieures de l'atmosphère rendues conductrices par leur extrême raréfaction.

"The Measurement of Tissue Fluid in Man. Preliminary Note." By George Oliver, M.D., F.R.C.P. Communicated by Sir Lauder Brunton, F.R.S. Received in revised form May 18,—Read June 11, 1903.

The object of this preliminary note is to indicate a method by which the tissue fluid in man may be measured, thus enabling the observer to ascertain the conditions under which it is effused and disposed of.

In the course of some observations made with the view of eliminating tissue fluid as a cause of variability in the samples of blood obtained for examination, I found that the rolling of a tight rubber ring over the finger from the tip to beyond the interphalangeal joints will, as a rule, considerably raise the percentages of the blood corpuscles, and of the hæmoglobin. I could not arrive at any other conclusion, than that the ring not merely empties the vessels, but likewise clears away any tissue fluid present in the skin and subcutaneous tissues. The needle, in puncturing the capillaries, liberates a certain portion of lymph from the areolar tissue which surrounds them, and this dilutes the blood. When, however, both fluids have been dispersed as much as possible by the compression of the firm rubber ring, a puncture made just before removing the ring yields blood *per se*; for the blood instantly returns to the vessels, whereas an appreciable interval must elapse before the lymph reappears, or is exuded afresh. I, therefore, inferred that the reading of the difference in the percentage of the corpuscles, or of the hæmoglobin, before and after the use of the ring, provides a measure of the tissue-lymph, and makes the study of the circulation of it in man possible.

This simple method having furnished somewhat unexpected results, I naturally accepted them at first with reserve; and, for some time, the data were allowed to accumulate, until at last it was quite apparent that they invariably fell into the same order. Inasmuch as the method did not provide results which were exceptional or erratic, or contradictory and unaccountable, reliability on it became gradually established by the mere repetition of the observations.

A number of observations have been made on normal subjects leading a quiescent life, with comparative rest of the muscles; and on persons subjected to varying degrees of exercise, and to different

temperatures and altitudes. In this note I limit myself, however, to a statement of results obtained in the former class of subjects only.

The numerous observations which this inquiry necessitated on the corpuscles, and on the hæmoglobin, were made by the hæmocytometer tubes, and the hæmoglobinometer, which were described by me before the Physiological Society some few years ago,* and the specific gravity of the blood was determined by Roy's method. The blood-pressures (arterial, capillary, and venous) were read by the hæmodynamometer,† and Hill and Barnard's sphygmometer, and Professor Gärtner's tonometer, were also occasionally used in determining the arterial pressure.

Some of the general conclusions afforded by the observations may be thus epitomised:—

1. The amount of tissue fluid varies at different times in the course of the day; and each variation is of short duration.
2. The ingestion of food produces a rapid flow of lymph into the tissue spaces, which in an hour after the meals acquires its maximum development, and then it slowly subsides, and only ceases to be apparent after the lapse of from 3—4 hours.
3. The digestive curve of variation always follows the same general type; the rise being rapid, the acme short, and the subsidence gradual. The variations were observed to follow this well-defined order in all the healthy subjects so far submitted to observation. The curve of variation is, therefore, rhythmical—the wave abruptly rising to an acme, and then somewhat slowly subsiding.

The following are two examples:—

Example 1.

	Corpuscles per cent.		Diff.	Percentage of lymph.
Before the meal	99‡	(4,950,000 per c.mm.)	200,000	4
(breakfast)	103	(5,150,000 ,,)		
1 hour after ...	91	(4,550,000 ,,)	750,000	15
	106	(5,300,000 ,,)		
2 hours after ...	94	(4,700,000 ,,)	550,000	11
	105	(5,250,000 ,,)		
3 hours after ...	96	(4,800,000 ,,)	400,000	8
	104	(5,200,000 ,,)		
4 hours after ...	98	(4,900,000 ,,)	150,000	3
	101	(5,050,000 ,,)		

* See 'Journal of Physiology,' Cambridge and London, vol. 19, p. xv.

† *Ibid.*, vols. 22, 23.

‡ The figure on the first line represents the percentage of corpuscles before, and the figure on the second line that after, compression of the finger by the rubber ring.

Example 2.

	Corpuscles per cent.		Diff.	Percentage of lymph.
Before the meal (dinner)	99	(4,950,000 per c.mm.)	None	0
	99	(4,950,000 „)		
1 hour after ...	91	(4,550,000 „)	850,000	17
	108	(5,400,000 „)		
2 hours after ...	94	(4,700,000 „)	600,000	12
	106	(5,300,000 „)		
3 hours after ...	104	(5,200,000 „)	None	0
	104	(5,200,000 „)		

4. The amount of lymph is proportionate to the rise of the mean arterial and capillary pressures, and these pressures have been found to follow exactly the same prolonged rhythmical course after the ingestion of food, as does the effusion of lymph.

The following example shows the agreement between the blood-pressures and the amount of lymph :—

	Percentage of lymph.	Mean arterial pressure.
Before the meal	None	100 c.mm. Hg.
½ hour after	10	110 „
1 hour after	16	116 „
1½ hours after	8	108 „
2 hours after..............	5	105 „
3 hours after..............	None	100 „

The method devised for observing the capillary pressure is not quite so delicate for the smaller variations as I could wish, and I am hoping to improve it; but it is sufficiently definite to show that the capillary blood-pressure is raised throughout the digestive circulatory disturbance, and especially so at the acme of it, and falls again at the close of it. When the mean arterial pressure is 100 cmm. Hg. before a meal, as in the above example, the capillary blood-pressure will read, 20 cmm. Hg.; and in an hour after the meal, when the arterial pressure rises to 115 cmm. Hg., or so, the capillary pressure will rise to at least 30 cmm Hg. Though this is a large relative rise, my observations show that it is not less than this, and that it is often more.