ical interaction between the apparatus and the water samples. All the joints between the pump and the accessories were sweated shut, thus giving a continuous metallic surface. The accessories consisted of a tee, a pet cock, a gate valve, a 1-inch pipe and a piece of block tin tubing. One limb of the tee, the opening of which may be used for priming purposes, is stopped with a removable plug. After priming, the plug is tightly screwed in. A second limb was attached to the outflow opening of the pump, while the third limb with the gate valve in it served as the main outflow of water from the tee. The pet cock was sweated into the side of the third limb and the piece of block tin tubing, 12 inches long, was soldered on to the delivery end of the pet cock.

The intake end of the pump was attached to a hose reel by means of a 1-inch pipe and a ground brass swivel joint, which enables the operator to conveniently pay out as much hose as is needed and then by means of a wrench to readily make this joint leak-proof. The hose measured 1 inch inside diameter. It is necessary that all parts of the pump and its attachment to the hose should be leak-proof or serious errors will arise due to the sucking in of air.

In order to make the final preparations for the collecting of both kinds of samples at the same depth and time, the tonometer apparatus, assembled and adjusted as described above, was firmly wired to the hose alongside of its intake end. The end of the hose was weighted with 60 pounds of lead so that the hose would extend downward as nearly vertically as possible. The hose with lead and tonometer apparatus firmly wired to it at the intake end as described were then lowered to the desired depth, the operator paying out the cord with which the tonometer stopcock may be opened.

Both sets of apparatus are now ready for the collection of the sample. In the case of the tonometer the cord upon being drawn tight will open the upper stopcock and allow the water to enter, since the mercury held in the tonometer sinks in order to adjust its level to that in the leveling bulb, which is at a considerably lower level. A release of the tension on the string after 5 minutes allows the stopcock to be closed again by the spring and the sample is tightly enclosed in the tonometer.

In the case of the pump and hose apparatus, after priming and screwing in the priming plug, the pet cock connected with the block tin tube is closed, the gate valve is opened and the water pumped up until sufficient has flowed out to yield a sample which has its origin from 25 meters. The gate valve is then closed, the pet cock opened and a sample of water is delivered either under oil in a sample bottle or preferably into a tonometer such as the one used in the tonometer apparatus but without the rubber tubing, mercury and leveling bulb.

Samples of this sort, taken by the two methods, were then analyzed, within a short time, in the laboratory, using the manometric Van Slyke apparatus. The samples can be transferred to the Van Slyke apparatus without loss of gas if the usual methods in the operation of the apparatus are followed.

A comparison of the results obtained in an analysis of two samples collected by the methods outlined above are given in Table 1.

TABLE 1

	Total CO_2 p.p.m.	O_2 p.p.m.	N_2 p.p.m.
Pump	50.5	9.1	17.8
Tonometer	51.7	8.1	17.1

It will be noted that the difference in each case is about 1 part per million. Even this difference might have been due in part to the use of oil for the pump samples. Another pump sample gave closely similar results. Earlier work, however, in which less care was taken in making the pump and hose leak-proof gave a greater discrepancy in results. It is evident, however, that when the pump and hose are properly put together and properly handled the values obtained for the gases in the water samples taken will be sufficiently accurate for physiological purposes.

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METHIONINE AS AN IMPURITY IN NATURAL LEUCINE PREPARATIONS

IN recent experiments dealing with the effects of various amino-acids in the growth of the diphtheria bacillus, differences have been found in the action of l-leucine preparations. It was recalled that in the early work on methionine considerable sulfur, probably as methionine, was always present in the crude "leucine fraction" of material obtained by concentrating protein hydrolysates. Two instances were also in mind of the occurrence of readily measurable amounts of sulfur in specially purified l-leucine, one of these, at least, prepared by the ester method.

Commercial l-leucine from three different manufacturers, two American and one German, were therefore examined. The two former gave strong qualitative tests for sulfur, and likewise a fairly heavy precipitate with $HgCl_2$. The latter gave only a weakly positive test for sulfur and very slight opalescence with $HgCl_2$. Quantitative sulfur determinations by Na_2O_2 fusion were as follows:

Specimen A 0.4000g gave 0.0471g $BaSO_4$ = 7.5 per cent. methionine
Specimen B 0.4018g gave 0.0573g $BaSO_4$ = 9.2 per cent. methionine
Specimen C 0.4000g gave 0.0179g $BaSO_4$ = 2.7 per cent. methionine

These three specimens were further examined as to their effect on the growth of a strain of diphtheria bacillus which requires methionine for optimal development. A control solution,[1] containing all the ingredients for growth except methionine, was prepared and additions to equal amounts were made as indicated in the table. The solutions were made up to a volume of 10 cc, adjusted to pH 7.6, and sterilized. Total nitrogens, taken as a comparative measure of the amount of growth, were made on the centrifuged and washed diphtheria bacilli growing at 35° in 60 hours on these media. The results are shown in the last column of Table I.

TABLE I

	Media			Mg N in bacterial growth
1	Control + l-leucine	A	10 mg	0.83
2	" + "	B	10 mg	1.44
3	" + "	C	10 mg	0.48
4	" + dl "	(synthetic)	10 mg	0.30
5	" + dl methionine		1.0 mg	1.80
6	"			0.35

It is therefore evident that methionine in considerable amounts may be present in commercial leucine preparations and that failure to recognize this fact may lead to complications where such material is used in biological experiment.

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SPECIAL ARTICLES

ELECTRICAL POTENTIALS FROM THE INTACT HUMAN BRAIN[1]

DR. HANS BERGER, of Jena, has published a series of papers in which he reports that changes in electrical potential which are correlated with human brain activity may be magnified and recorded by the use of a suitable vacuum-tube amplifying system and an oscillograph.[2] These potential changes are obtained from needle or surface electrodes placed on different points of the head. His most typical electrode arrangement is one in which needle electrodes are inserted through the skin to the periosteum, one in the back of the head to the right of the median plane and the other high on the forehead to the left of the median plane. He reports, however, that electrodes placed on the surface of the skin give results comparable to those secured by the use of needle electrodes. He holds that the records secured by the use of this general technique show, among other phenomena, two characteristic forms of rhythmic electrical oscillations. The waves of greatest magnitude he calls alpha waves. Smaller oscillations which are sometimes observed alone and sometimes as superimposed upon the alpha waves he calls beta waves. The alpha waves occur with varying frequency in normal adults, but about 10 cycles per second may be taken as a typical value. These waves may show a potential of as much as 100 to 200 microvolts when needle electrodes are used. The beta waves have a frequency of about 25 cycles per second and have a magnitude much less than that of typical alpha waves.

Berger has carried out control experiments intended to demonstrate that the electrical phenomena which he is studying are functions of brain activity and not of some other organic process. Simultaneous electroencephalograms (as he calls the records of the electrical phenomena which he considers to be correlated with brain activity) and electrocardiograms have been taken. These records demonstrate the fact that there is no direct relationship between the so-called brain waves and the pulse. Moreover, even a momentary arrest of both breathing and heart beat had no marked effect on the brain potentials. In the course of human brain surgery it has been possible for him to place electrodes directly on the brain through trephine openings. The records so taken are similar to those secured by the use of the surface electrodes. Prawdicz Neminski[3] has secured similar action potentials from electrodes on the brain of dogs, that is, waves of large magnitude at a frequency of 10 to 15 per second and smaller waves 20 to 32 per second. Adrian and Mathews[4] have recently observed similar phenomena originating in the cortex of the rabbit.

Dr. Berger has shown in these experiments that the alpha waves diminish in magnitude under certain types of anesthesia, during an epileptic seizure and, it may seem at first sight paradoxically, when the

[1] The control solution is fully described in an article now in press (*Jour. Bact.*).

[1] This research has been made possible by a grant from the Rockefeller Foundation.

[2] H. Berger, *Arch. f. Psychiat.*, 87: 527, 1929; 94: 16, 1931; 97: 6, 1932; 98: 231, 1933; 99: 555, 1933; 100: 301, 1933.

[3] P. Neminski, *Pflüg. Arch. f. d. ges. Physiol.*, 209: 362, 1925.

[4] E. D. Adrian and B. H. C. Mathews, *Jour. Physiol.*, 81: 440, 1934.