The respiratory quotient in 1933 was one of the indices pointing to a lack of basal conditions. In addition, the systolic blood in the present series was 126 mm as against an earlier level of 146 mm, while the diastolic pressure was unchanged at 90 mm. The earlier pulse rate was 78; during the present study, 60 was recorded, a value in harmony with other independent measurements during both sets of observations.

Comparison of the observed rate with our usual prediction standards is given in Table III.

TABLE III

RELATIVE DEVIATIONS

Standard	1934 Pred.	1934 Dev.	1933 Pred.	1933 Dev.
		Per cent.		Per cent.
Harris–Benedict[3]	3,277	− 24	3,279	− 9
Boothby[4]–Aub–DuBois[5]	3,130	− 21	3,110	− 5
Average		− 23		− 7

The present figures demonstrate a frank depression of the basal rate to a level consonant with the subject's known pituitary status.

But one point remains for brief consideration. DuBois[6] called attention a number of years ago to the fact that febrile temperatures cause a definite and rather uniform increase in the oxygen exchange, the coefficient being of the order of + 7.2 per cent. per degree Fahrenheit. During the test of 1933, the subject's oral temperature was 98.6°, while in that here reported, the more characteristic level of 96.8° was observed. Allowance for the temperature difference on the above basis would lower the 1933 average to − 22 per cent. Whether his earlier instability produced an augmentation of temperature, as it certainly did of systolic blood pressure and pulse rate, is a question. Oral temperatures are well known to lack a nice precision as indices of the mean body temperature. Whatever the mechanisms involved, there can be no question but that the present measurements are much more nearly representative of the subject's energy exchange and demonstrate an established level of hypofunction.

ALLAN WINTER ROWE

EVANS MEMORIAL
MASSACHUSETTS MEMORIAL HOSPITALS
BOSTON, MASS.

3 Harris and Benedict, *Carn. Inst. Pub.* No. 279, 1919.
4 Boothby and Sandiford, *Jour. Biol. Chem.*, 54: 767, 1922.
5 Aub and DuBois, *Arch. Int. Med.*, 19: 831, 1917.
6 DuBois, *Jour. Am. Med. Ass.*, 77: 352, 1921.

THE DETERMINATION OF CO_2 IN THE ATMOSPHERE OF A CLOSED SYSTEM[1]

IN a recent note[2] Elizabeth M. Smyth described methods of determining the CO_2 content of an atmosphere in a closed system. These methods were based on the estimation of pH in a solution of $NaHCO_3$ plus a suitable indicator.

The thermal conductivity method offers distinct advantages for determinations of CO_2 content in closed systems, since this method is capable of high accuracy, as well as being both rapid and convenient in use, and it is believed that a brief statement of important references on the method will be of interest to workers in many fields of investigation. The fundamental principles involved are well described in various sources.[3] The method has been applied to the determination of CO_2 concentration in greenhouse atmospheres[4] and has also been used for the analysis of expired air.[5] H. A. Daynes has used the thermal conductivity device for the study of respiration in small insects,[6] and determinations of CO_2 in leaf respiration in the dark and assimilation in the light have been made by J. C. Waller.[7] A further development of the method was used in a research on the effect of manurial deficiency on the respiration and assimilation rates in barley.[8] H. A. Daynes has described a simple experiment in which a seed, such as a bean, is allowed to germinate in a small chamber attached to one tube of a thermal conductivity cell. A steady increase in CO_2 in the chamber is noticeable in a few minutes. If the chamber is immersed in ice, the increase practically ceases, but is resumed as the seed warms up after being taken out of the cooling vessel.[9]

Attention is called to the utility of the method because of its numerous advantages. The absolute accuracy can be of the order of ± 0.01 per cent. of CO_2 in concentrations up to 5 per cent. Readings can be

1 Communication from the Research Laboratory, Leeds and Northrup Company, Philadelphia, Pa.
2 SCIENCE, 80: 294, 1934.
3 P. E. Palmer and E. R. Weaver, Technologic Paper of the Bureau of Standards No. 249, 1924; also "Gas Analysis by Measurement of Thermal Conductivity," by H. A. Daynes, Cambridge Press, 1933.
4 C. Z. Rosecrans, *Jl. Optical Soc. and Rev. Sci. Instruments*, 14: 479, 1927.
5 A. K. Noyons, *Arch. Néerland. physical.*, 7: 488, 1933; also P. G. Ledig and R. S. Lyman, *Jour. Clin. Invest.*, 4: 495, 1927; also H. W. Knipping, *Zeits. physikal. Chem.*, 141: 1, 1924.
6 H. A. Daynes, *Proc. Physical Soc.*, 37: 349, 1925.
7 J. C. Waller, *New Phytologist*, 25: 109, 1926; also 28: 291, 1929.
8 F. G. Gregory and F. J. Richards, *Ann. Bot.*, 43: 119, 1929.
9 H. A. Daynes, *Jour. Soc. Chem. Ind.*, 45: 8, 1926.

taken in less than one minute after the apparatus is filled with the gas to be analyzed. The atmosphere analyzed is in no way changed by the process of analysis, and no solutions are required. Continuous indicating or recording of CO_2 concentration is possible in some cases where extreme accuracy is not required. It is possible in such cases to control automatically the CO_2 concentration at any desired value by the use of a thermal conductivity cell together with an electrical recorder-controller of a commonly used variety.

A thermal conductivity apparatus of general laboratory utility can easily be assembled from standard laboratory electrical equipment, following descriptions in various references already cited. A useful apparatus for general use was described by the writer.[10] While designed particularly for the determination of fuel gas/air ratios, it can be used for many thermal conductivity measurements of high accuracy by substituting a high sensitivity reflecting galvanometer for the less sensitive pointer galvanometer.

CRANDALL Z. ROSECRANS

THE AXIS OF THE HUMAN FOOT

PREVIOUS workers on the human foot have held divergent views concerning the position of the axis of the foot. Attempts have been made to compare the human foot with that of even-toed forms, in which the axis lies between the second and third digits, or with the odd-toed types, with the axis coinciding with the third digit. The latest view is that of Morton,[1] which maintains that the functional axis of the foot of the human and of apes differs from that of other mammals in that it lies between the first and second digits.

No doubt the difficulty of determining the axis of a structure as complicated as that of the human foot is responsible for this confusion. The position of the axis of the ungulate foot can be ascertained by sheer morphological observation. With the human foot such observation has led to no definitive solution of the problem.

Fortunately, it is now possible to determine the position of the axis of the human foot by experimental procedure. Recently one of us[2] published a description of a new method by means of which the distribution of pressure in the human foot at any instant can be recorded cinematically as a pattern of dots, the area of the dot varying with the pressure being exerted. For details of the method and samples of the results the original article may be consulted. We have now calibrated the variation in area of dot with variation in pressure. By the method of moments it has been possible by extensive calculation to determine, for the step illustrated in Fig. 2 of the article mentioned, the position of a resultant force having the same effect as the various discrete pressures recorded.

The position of this resultant must lie on the axis of the foot, if the axis, as is usually considered, represents the line of functional symmetry of the foot. It would be more accurate to refer to a plane of symmetry and to say that the resultant lies in the line of intersection of this plane with the horizontal.

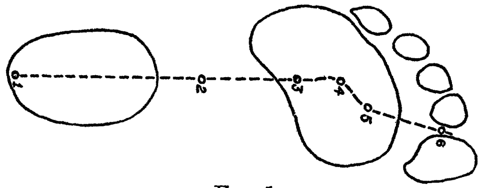

FIG. 1

The accompanying diagram (Fig. 1) illustrates the position of this resultant at successive moments in the course of one step, the path of the resultant being indicated by a dotted line. The position of the axis at any moment can be approximately determined by drawing a tangent to the dotted line through the position of the resultant at the moment under consideration.

Until the step is half completed, the axis passes through the center of the heel and along the medial border of the third metatarsal. As the heel is lifted and the metatarso-phalangeal joints dorsi-flexed, the axis becomes directed definitely inward, at the conclusion of the step lying between the first and second digits. By visualizing the successive positions of the foot in space, it is possible to follow the changes in position of the axial plane.

The position of this functional axis varies with the degree of toeing in or out and may very well vary with the structural condition of the foot. A comparison of the human foot with that of the chimpanzee is nearing completion. A detailed report of our findings will be published as soon as supplementary measurements by another method have been accomplished.

HERBERT ELFTMAN
JOHN T. MANTER

COLUMBIA UNIVERSITY

[10] C. Z. Rosecrans, *Ind. Eng. Chem., Anal. Ed.*, 1: 156, 1929.

[1] D. J. Morton, *Jour. Bone and Joint Surgery*, 6: 56–90, 1924.

[2] H. Elftman, *Anat. Rec.*, 59: 481–491.

BOOKS RECEIVED

Introduction to the Reports from the Carlsberg Foundation's Oceanographical Expedition Round the World 1928–30. Pp. 130. 2 figures, 7 plates. Oxford University Press, London.

JEANS, SIR JAMES. *Through Space and Time.* Pp. xiv + 224. 106 figures. Macmillan. $3.00.