Extrarenal azotaemia and extrarenal uraemia are non-specific symptom-complexes which may be produced by a variety of diseases or injuries.

REFERENCES

Beall, D., Bywaters, E. G. L., Belsey, R. H. R., and Miles, J. A. R. (1941) *British Medical Journal*, **1**, 432.
Bywaters, E. G. L. (1942). Ibid., **2**, 643.
—— and Belsey, R. H. R. (1942). *Proc. roy. Soc. Med.*, **35**, 321.
Cooke, W. T., Peeney, A. L. P., Thomas, G., Elkes, J. J., Frazer, A. C., Govan, A. D. T., Barling, S. G., Leather, J. B., Scott Mason, R. P. (1945). *Lancet*, **1**, 487.
Croft, P. B., and Peters, R. A. (1945). Ibid., **1**, 266.
Cuthbertson, D. P. (1936). *Brit. J. Surg.*, **23**, 505.
—— (1942). *Lancet*, **1**, 433.
Darmady, E. M., Siddons, A. H. M., Corson, T. C., Langton, C. D., Vitek, Z., Badenoch, A. W., and Scott, J. C. (1944). Ibid., **2**, 809.
Eggleton, M. G. (1944). Ibid., **2**, 208.
Fishberg, A. M. (1939). *Hypertension and Nephritis*, 4th ed., Lea and Febiger, Philadelphia.
Lucido, J. (1940). *Ann. Surg.*, **111**, 640.
McLetchie, N. G. B. (1943). *J. Path. Bact.*, **55**, 17.
Volhard, F. (1931). "Nieren und ableitende Harnwege," in *Handbuch der innere Med.*, by G. Bergmann and R. Staehelin, **6**, Julius Springer, Berlin.
Young, J. (1942). *British Medical Journal*, **2**, 715.
—— and McMichael, J. (1941). *British Medical Journal*, **2**, 887.
Zondek, S. G. (1944). *Harefuah*, **26**, 103, 125.

PULMONARY EXCHANGE DURING ARTIFICIAL RESPIRATION

BY

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The relative merits of the various methods of artificial respiration have long been a subject of dispute, and each of them still has its advocates. This lack of agreement is doubtless due mainly to the fact that in ordinary circumstances it is impossible to compare the efficiency of the various procedures. In any real emergency skilled personnel and scientific recording apparatus are rarely available. In any event, the prime object must be the resuscitation of the victim; if the method used is successful it is deemed to be a good one, but if the patient dies it is assumed that he was beyond saving.

It is true that the volume of air passing in and out of the lungs in artificial respiration has been recorded, but the value of the conclusions reached is doubtful. For the considerable anatomical differences between man and other mammals make the conclusions reached on the latter largely inapplicable to man. Experiments on man are valueless unless the volunteer is unconscious, toneless, and not breathing. Yandell Henderson (1938) confirms that the tonus of the respiratory muscles of the conscious subject varies so that the respiratory minute volume is kept almost constant, whatever the method used and whatever the rate of the chest movements. A warm cadaver might furnish figures of value, but the means is open to obvious objection, and any experiments carried out after rigor mortis had set in would be useless.

One of our colleagues (E. A. P.) felt that the various methods of artificial respiration could and should be evaluated on a subject depressed to simulate a victim *in extremis*. He asked to be anaesthetized profoundly and brought to respiratory arrest. Artificial respiration now became essential, since almost the only evidence of life was that the heart-beat continued. The various methods of artificial respiration were tried in turn, and the pulmonary exchange recorded on a kymograph.

The subject was a healthy young man of about 10 st. (63.5 kg.). The larynx was anaesthetized with cocaine, after which anaesthesia was induced with pentothal and continued with ether and air from an "Oxford vaporizer." A wide-bore oral endotracheal tube was passed, and the space between it and the trachea occluded with the usual inflated cuff. This ensured that all the air passing in and out of the lungs was measured on a recording spirometer. The apparatus for measuring pulmonary ventilation was in charge of Dr. S. L. Cowan, D.Sc., lately physiologist to this department, and it is hoped that details will be published by him in due course. The kymographic records which we give here are of the better-known methods of artificial respiration, and the ones which we think will be of most general interest. Subsequently the experiments were repeated on another colleague (J. R.), of about 13 st. (82.5 kg.) weight.

The subjects were deeply anaesthetized until the intercostal muscles were paralysed. At this stage slight hyperventilation resulted in respiratory arrest. Various methods of artificial respiration were carried out by the same skilled operator. The respiratory rate was kept uniform at 10 per minute.

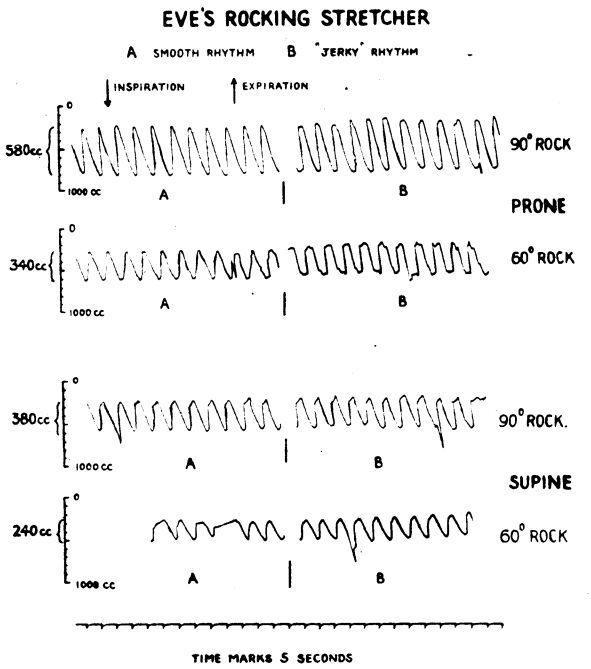

FIG. 1

Fig. 1 shows that Eve's (1943) rocking method produces a larger tidal exchange with the subject on his face than when on his back. The reason for this is not clear. Ventilation of the lungs increases with the angle through which the subject is rocked. Fig. 2 shows the figures resulting from Schäfer's and

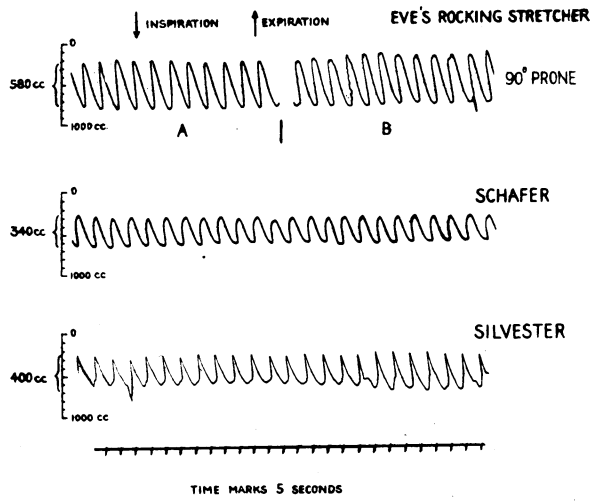

FIG. 2

Silvester's methods compared with those obtained from rocking the prone subject through 90°. In Fig. 3 the figures for inflation of the lungs with oxygen from an Oxford inflator (Macintosh and Pratt, 1939) give an accurate indication of the value of this method. In the "mouth-to-mouth" method the operator blew into the free end of the endotracheal tube. The term "mouth to mouth" is here, therefore, a misnomer, and the figures are

much better than those which would be obtained if actual mouth-to-mouth inflation (Elisha's method ! see 2 Kings, iv, 34) were attempted.

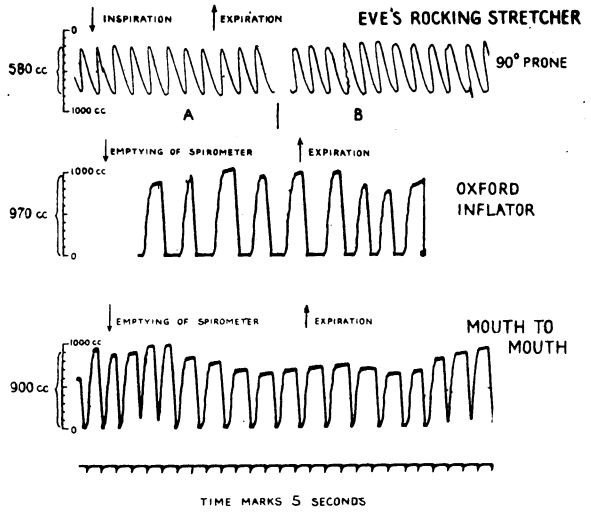

FIG. 3

Discussion

Our figures (see Table) probably show the various methods of artificial respiration at their best. A clear airway was maintained throughout by a wide-bore endotracheal cuff-tube. The subjects were healthy young males, and the operator highly skilled.

Tidal Exchange with Various Methods of Artificial Respiration

Method	Tidal Exchange in ml.	
	E. A. P. (Wt. 10 st.)	J. R. (Wt. 13 st.)
Eve's rocking:		
On back 60°	240	570
On back 90°	380	635
On face 60°	340	725
On face 90°	580	850
Schäfer	340	530
Silvester	400	650
"Mouth-to-mouth" inflation	900	1,030
Oxford inflator	970	1,550

Eve (1943) claims that the venous return to the heart, and therefore the output from the heart, are improved more by his method than by others. The figures we give record only pulmonary ventilation.

We believe that in artificial respiration too much stress has been laid on unimportant outward details and not enough on absolute essentials such as the maintenance of a clear airway. The choice of any particular method appears to us relatively unimportant. If the subject is dead no method will be availing, and, speaking broadly, if a spark of life still exists any method, properly carried out, will probably suffice.

Waters and Bennett (1936) recorded the figures of artificial respiration carried out under deep surgical anaesthesia, and we can agree with their observation that "an apnoeic patient under deep anaesthesia simulates the candidate for resuscitation by artificial respiration."

REFERENCES

Eve, F. C. (1943). *British Medical Journal*, **1**, 535.
Henderson, Yandell (1938). *Adventures in Respiration*, p. 273, Baltimore and London.
Macintosh, R. R., and Pratt, C. L. G. (1939). *Lancet*, **1**, 206.
Waters, R. M., and Bennett, J. H. (1936). *Anesth. & Analges.*, **15**, 151.

The report of a rural life conference held at Newbury at the beginning of the year has been issued under the title *The Science of Relationships* from C.M. House, 6, Salisbury Square, London, E.C.4, price 2s. The object of the discussion was to counteract one-sided development by fostering closer contact between workers in different callings, and to promote a unified programme of action. It was attended by people interested in medicine and nutrition, and among the papers was one by Prof. J. Scott Watson on "Agriculture, Food, and Society," which dealt with nutritional problems.

OBSERVATIONS ON NORMAL BODY TEMPERATURES IN NORTH INDIA

BY

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WITH A STATISTICAL ANALYSIS BY

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The effect of hot climates on normal body temperature has for long been a controversial problem among students of climatic physiology. Castellani (1938) denies that body temperature is affected by journeys to the Tropics or residence there. Sundstroem (1927), and more recently Radsma *et al.* (1938) and Mason (1940), find a higher mean temperature of Europeans in tropical climates. The present data represent some 1,800 temperature records taken during the period March–September, 1945, in North India (Dehra Dun).

Method

In this investigation 21 ordinary clinical thermometers were used. The standard deviation for these corrected to 98.6° F. was 0.12° F.

For resting temperatures, individuals were used who were on normal military duties, had not marched during that day, and had rested for half an hour in the shade. Meals had not been taken for at least one hour. The clothing worn in all cases was khaki drill. Oral temperatures were taken (*a*) under the tongue with the mouth firmly closed, and (*b*) with the thermometer placed as far as possible into the rectum. Where oral and rectal temperatures were done on the same individual these were taken simultaneously, a period of at least three minutes being allowed. All readings were taken in the upright position. Where possible, temperatures were taken in the laboratory, otherwise in the open out of the sun. Individuals were not selected in any way, but no mechanical method of random sampling was used. All British personnel had been in the area for at least four months, and most for one to two years.

The Frequency Distribution of Resting Oral Temperatures

Table I represents the analysis of 9 groups of individuals whose oral temperatures were taken at different times of the day during the monsoon period. The frequency histograms of the groups are shown in Figs. 1 to 9. The wet- and dry-bulb readings were taken at the time of examination. The mean for the whole group of 894 individuals is 98.75° F.; standard deviation, 0.50; and S.E. mean, 0.017. The corresponding figures found by Whiting (1915–17) for 500 criminals in England were: mean, 98.38° F.; S.D., 0.486; S.E. mean, 0.011.

Examination of the skewness figures in Table I shows that some of the samples differ significantly from the normal distribution. There is, however, no evidence of skewness in the total population of temperatures. The fact is that the samples are far from being random samples. There is no evidence from the data that oral temperatures are not normally distributed.

The figures for the standard error of the mean show that the means of some of our samples vary significantly. They also show that the mean temperatures for Serials 1–5 are significantly high compared with the "normal" temperature of 98.4° F. No other meaning should be attached to the standard errors owing to the fact that our samples are not random samples from the total population of temperatures. The low mean of Serial 6 may be explained by the fact that these men were examined just after a heavy shower. This point is discussed later.

Man-to-Man and Diurnal Variation of Resting Temperatures

The first set of data considered here is quoted in full in Table II. It consists of oral and rectal temperatures of 12 normal Indian soldiers taken at five different times during the day on Aug. 8, 1945. The men belonged to one unit, experienced approximately the same external conditions during the day, and were on the same light duty.

Examination of Table II shows that the mean oral temperature for the 12 men rises steadily from 98.79° at 8.30 a.m. to 99.43° at 7.30 p.m., and the means for the individual men vary between 98.58° and 99.66° F. It is clear that the observed variation may not be entirely haphazard but may be partly due to differences