# PROFILES OF NATIONAL LEVEL OARSMEN

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## Introduction

The ability to gauge the features necessary for peak performance in any specific athletic event is a constant problem facing the coach and physical educator. It was with this problem in mind that investigators in the Department of Physical Education at the University of Western Australia decided to test national level rowers on the occasion of the annual King's Cup regatta.

Assessments of independent parameters thought to be important in the sport of rowing were made of the competitors and profiles were then constructed of each state crew in relation to the national average. These profiles were prepared to provide an immediate visual picture of the strengths and weaknesses of the crews relative to their placing in the regatta.

## Procedures

Forty-eight oarsmen consisting of eight representatives from each of six states acted as subjects in the study. They were tested at the Human Physical Performance Laboratory in the Department of Physical Education at the University of Western Australia, three days prior to competing in the annual regatta. The subjects could therefore be considered to be at the peak of their training programme.

Due to the short period of time between the testing date and the actual competition, the coaches did not wish the crews to undergo any tests requiring severe exertion. Thus rowing ergometer and strength measures, which have been found to be useful guides to crew performance (Hay, 1968; Longley, 1967; Railton, 1967) had to be omitted. However, an Åstrand submaximal bicycle ergometer test was permitted so that an oxygen uptake evaluation could be extrapolated.

Haemoglobin levels were determined by the cynmethaemoglobin method using a Beckman D.B. Spectrophotometer. Various anthropometric measures were made after the techniques described by Montagu (1960) and Stewart (1952). In addition to age, height and weight, the measures taken were bi-acromial and hip widths; forearm, arm, leg, thigh, lower and upper extremity lengths; hip, chest and waist girths; and body surface area. From several of the segmental portions, the Crural Index (Davenport, 1933),

$$\frac{100 \times \text{Tibial Ht.}}{\text{Thigh}}$$

the Brachial Index (Stewart, 1952)

$$\frac{100 \times \text{Radius.}}{\text{Humerus}}$$

and Cotton's Index of Build (Cotton, 1964)

$$\frac{\text{Ht (ins)}}{22 \times \text{Wt (lbs)}}$$

were calculated. Subtricep, subscapular and lateral abdominal skinfold thicknesses were measured with Harpenden skinfold calipers. The method used was that outlined by Keys and Brozek (1953).

After blood pressure had been taken, a brachial pulse wave was recorded on a Cameron Heartometer. From these traces the systolic and diastolic amplitudes, diastolic surge and the area under the curve were calculated.

ECG limb leads were attached to the subjects who were in a supine lying position. The R wave amplitudes, T wave amplitudes, heart rates and rest to work ratios were obtained from these traces. The rest phase was measured from the end of the T wave to the end of the QRS complex, while the work phase extended from the end of the S wave to the end of the T wave.

By means of a Vitalograph the vital capacity and forced expiratory volume for one second (F.E.V.$_1$) were recorded.

## Analysis of the Data

After all the raw scores had been tabulated, a mean and standard deviation were calculated for the total forty-eight oarsmen. This was considered to be the Australian mean and standard deviation.

Linearly transformed T scores were computed in order to graph profiles of each state crew. These were then placed on the profile sheet for each parameter measured relative to the Australian mean and in groups according to the finishing positions in the 2,000 metre race. Thus the national average corresponds to a T score of fifty and the individual states are graphed about this line.

Figures 1 — 14 have been divided so that each set of measures which were recorded has two profiles. The figures corresponding to the odd numbers represent the crews which finished first, second and third in the final race. These crews were Victoria, South Australia and New South Wales respectively. The even numbered figures comprise those crews finishing fourth, fifth and sixth, which were Tasmania, Western Australia and Queensland respectively. It should be noted that a canvas separated the first two crews, with the third crew a half length behind the winning boat. Tasmania, in fourth place, was only three quarters of a length behind the first crew, while Western Australia and Queensland finished two lengths and three and one half lengths behind Victoria respectively.

Profiles depicting the status of each of the crews in relation to the national average and to each other are revealed in Figures 1 — 14.

FIG. 1 BODY DIMENSION MEASURES

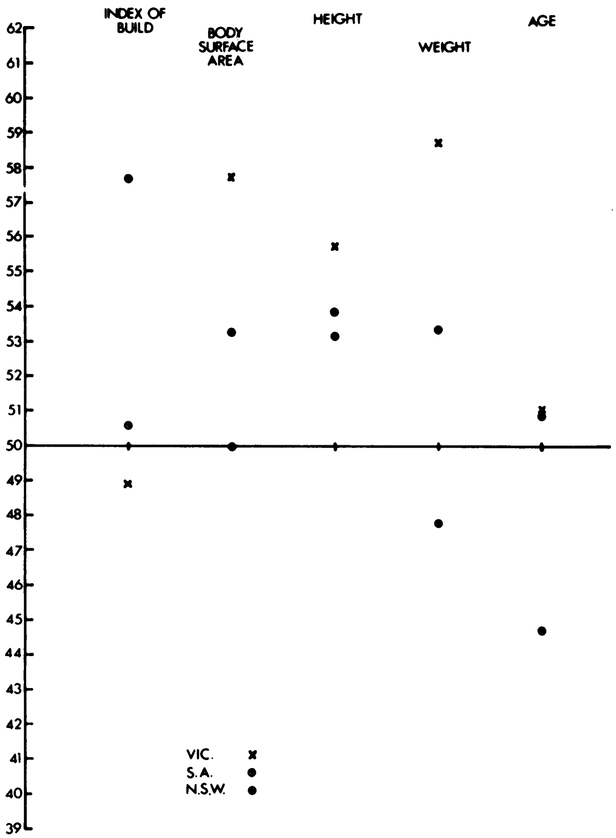
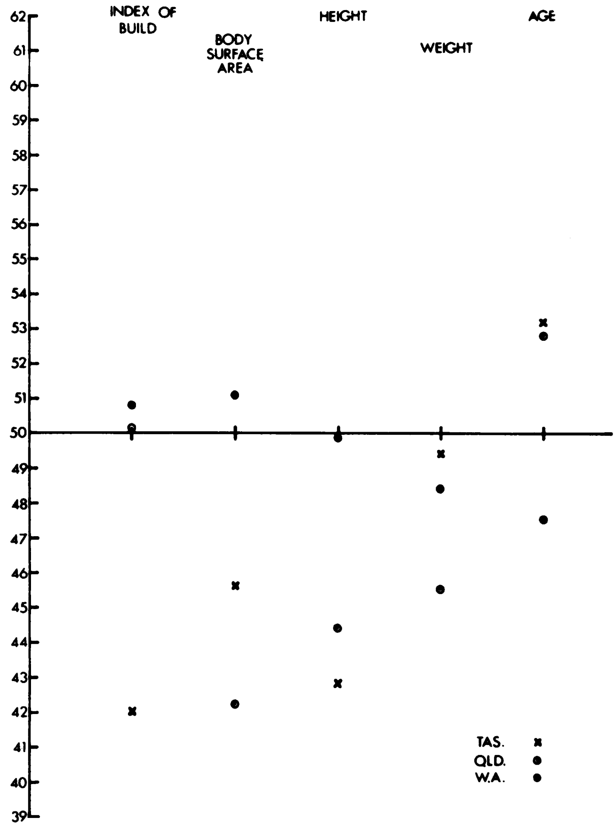



FIG. 2 BODY DIMENSION MEASURES




## Discussion

An observation of Figures 1 and 2 reveal the body dimension profiles of height, weight, age, index of build and body surface area. Investigations by Pawlaczyk (1966), Lewis (1969), Hirate (1966) and Hay (1968) indicated that height is important to success in rowing and that if considered in relation to weight (which is the index of build) should also be useful in predicting varying levels of rowing amongst oarsmen. From Figures 1 and 2 it appears evident that the top three crews in this study were superior to the lower three crews on the body dimension measures.

A review of the literature concerning rowing provided little insight into the value of width and girth measures in helping to identify rowing ability, although Lewis (1969) found bi-acromial and bi-iliac widths greater in Olympic oarsmen when they were compared to district level oarsmen. Figures 3 and 4 provide little information to help clarify the value of width and girth measures, as all six crews recorded a variety of results. Bi-acromial width was the only parameter where the top three crews generally scored higher than the lower three.

FIG. 3 WIDTH AND GIRTH MEASURES

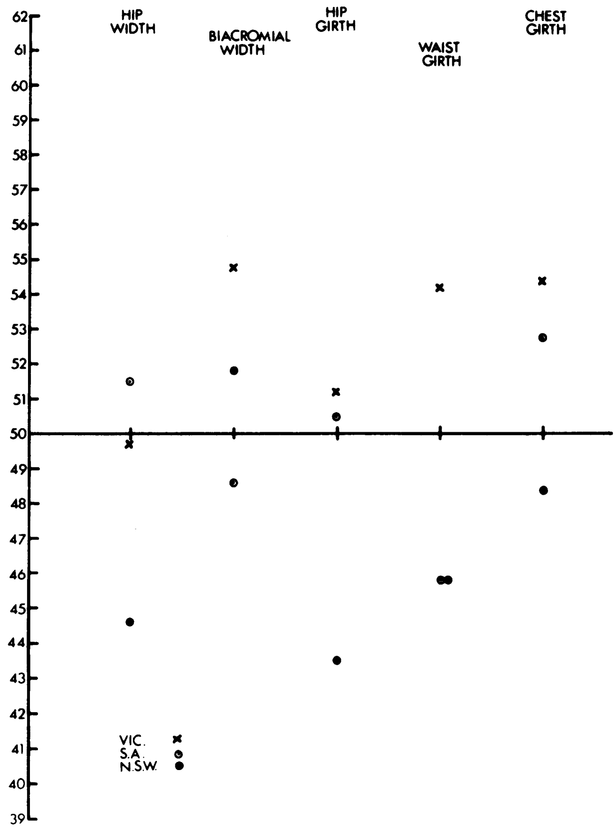
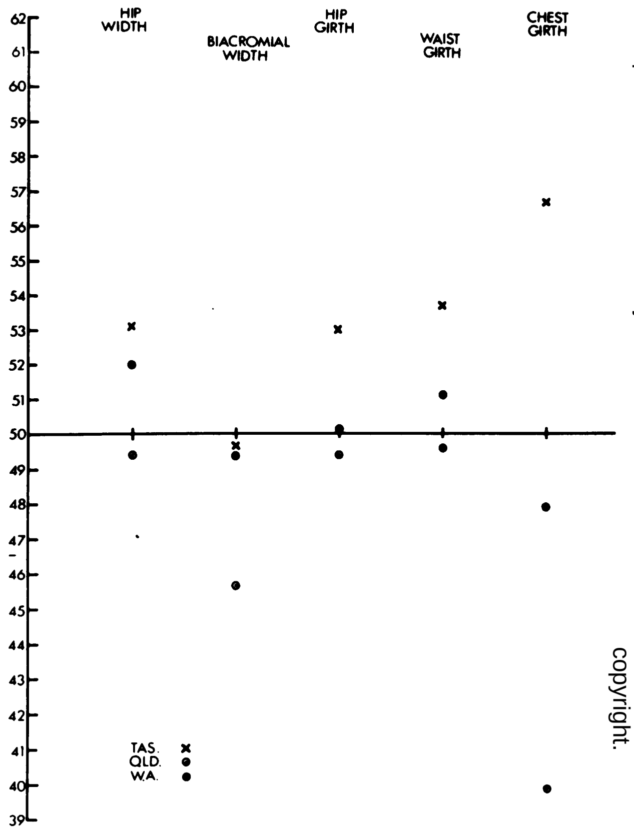



FIG. 4 WIDTH AND GIRTH MEASURES




Figures 5 and 6 are profiles on limb segment measures and indices. The normal pattern of limb movement in Man demands fixation of proximal joints before distal joints can be activated. The movement of a whole limb develops centrifugally to produce acceleration, the powerful, slow-moving limb root muscles overcoming inertia, while the weaker distal muscles contract rapidly to maintain acceleration (Williams, 1967). Biomechanically then, all other things being equal, the crews with longer lever lengths should be superior to those with shorter lengths. On viewing Figures 5 and 6 it can be seen that the lever lengths of the top three crews were in most cases longer than those of the three crews finishing in fourth, fifth and sixth place.

Selected physiological measures were profiled in Figures 7 and 8. An individual's capacity for prolonged strenuous activity is dependent upon the supply of oxygen to the working muscles and is termed maximal oxygen uptake (Åstrand and Rhyming, 1954) An Åstrand submaximal bicycle ergometer test permitted oxygen uptake values to be extrapolated and a significant correlation has been found to exist between maximal oxygen uptake and the ergometer test by Åstrand, (Rodahl and Issekutz, 1962). An examination of Figures 7 and 8 reveals the Victorian, South Australian and New South Wales crews to be clearly superior to the other three crews on the scores for the numbers of litres of oxygen per minute and millilitres of oxygen per kilogram of body weight that could be taken up. Yamakawa (1966) found a correlation of 0.713 between vital capacity and race performance. In this study the vital capacity and F.E.V.$_1$ results follow this pattern, with the top three crews again recording higher results than those of the lower three.

There has been considerable disagreement in the literature (Cureton, 1947) as to normal values and changes which may be expected in maximum systolic and minimum diastolic blood pressures in sportsmen engaged in hard training. Although lowered concentrations of haemoglobin in the blood have indicated stress, no literature was found regarding the ability of haemoglobin to be used as a predictor of performance with state level athletes. Figures 7 and 8 show that no pattern of scores is apparent with either blood pressure or haemoglobin levels. The extremely high result recorded by the Tasmanian crew who

FIG. 5 LIMB SEGMENT MEASURES AND INDICES

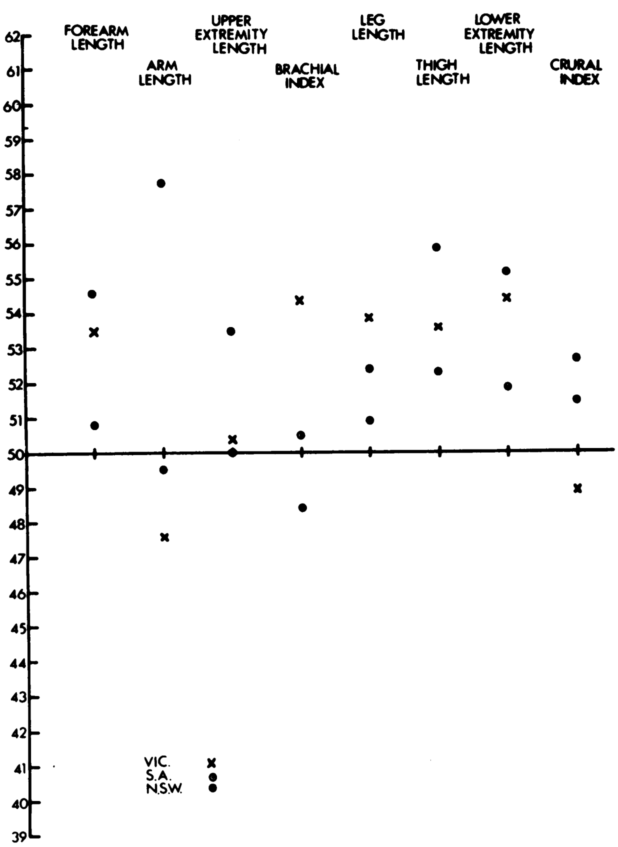
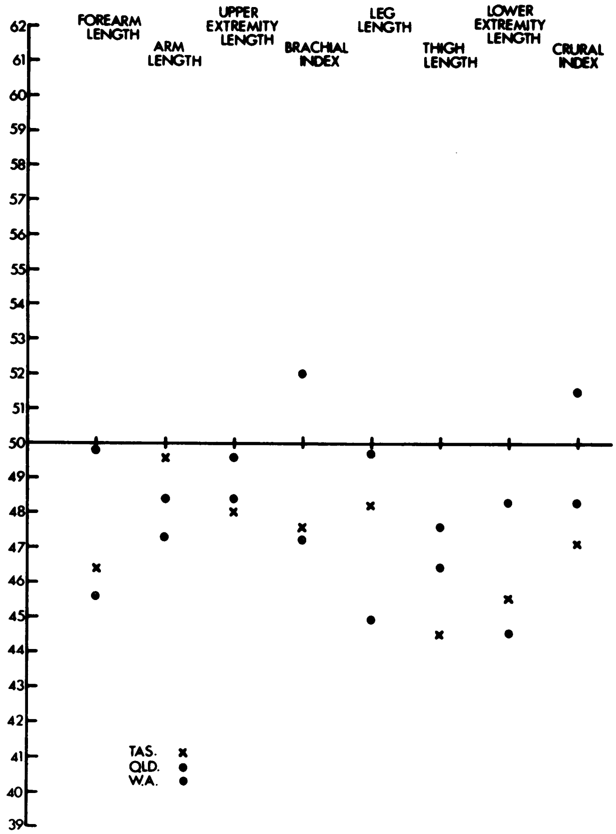



FIG. 6 LIMB SEGMENT MEASURES AND INDICES




finished fourth should be noted, although no specific reason can be offered for the high readings.

Sedentary E.C.G. measures are reported in Figures 9 and 10. Russo and Bloomfield (1970) found highly trained American university swimmers to be significantly higher in all E.C.G. measures when compared to normal university students. Little investigation has been made into the use of the E.C.G. as a differentiator at high levels of physical fitness and an examination of work carried out by Carlile and Carlile (1959), Cureton (1947) and Plas (1963) in this area provided conflicting results. The diverse pattern of results observed in Figures 9 and 10 does not assist with clarification of the matter.

The physiological parameters taken from a brachial pulse wave are reported in Figures 11 and 12. Cureton (1947, 1951) and Russo and Bloomfield (1970) have indicated that the Cameron Heartometer could be used to differentiate groups with a high physical work capacity from other groups with low capacities. Blanksby et al (1972) examined national level oarsmen and found that although the brachial pulse wave measures of systolic amplitude, diastolic amplitude and area under the curve all correlated significantly with each other, none of the measures correlated significantly with the Åstrand test of aerobic power which was used as the criterion measure for fitness. Observations of profiles in Figures 11 and 12 show a clear trend which is the reverse of that which would be expected from the race results. In this instance the three lower crews recorded consistently higher scores than the top three crews.

Figures 13 and 14 represent the subtricep, subscapular and lateral abdominal skinfold measures. Although the Tasmanian crew recorded the lowest fat measures at the sites tested, no other meaningful pattern of results is evident. A project by Lewis (1969) on New Zealand oarsmen revealed that club rowers had a greater total skinfold fat measurement than did national level oarsmen. By adding the individual subtricep, subscapular and lateral abdominal fat fold scores, Lewis (1969) formulated total fat scores for national level and club level oarsmen. The mean for the club level total fat score was 34.4 mm, while the national level oarsmen recorded a mean of 22.60 mm. In the present study the mean total score was 22.01, which is almost identical to the

FIG. 7 SELECTED PHYSIOLOGICAL MEASURES

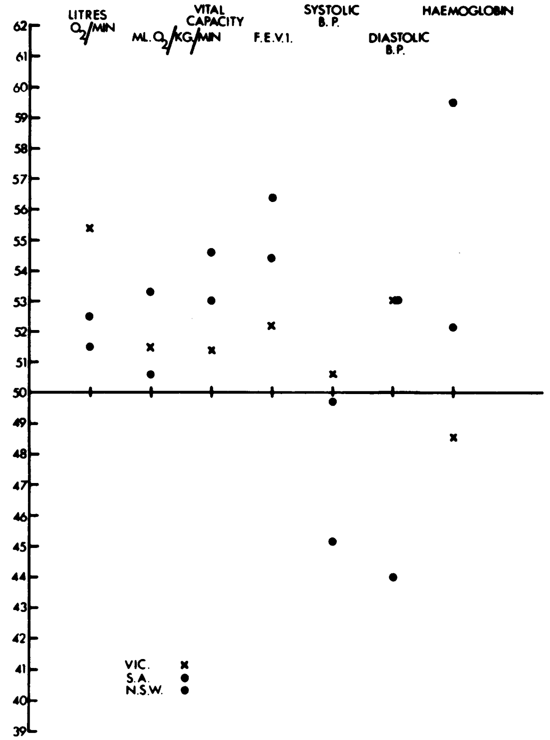



FIG. 8 SELECTED PHYSIOLOGICAL MEASURES

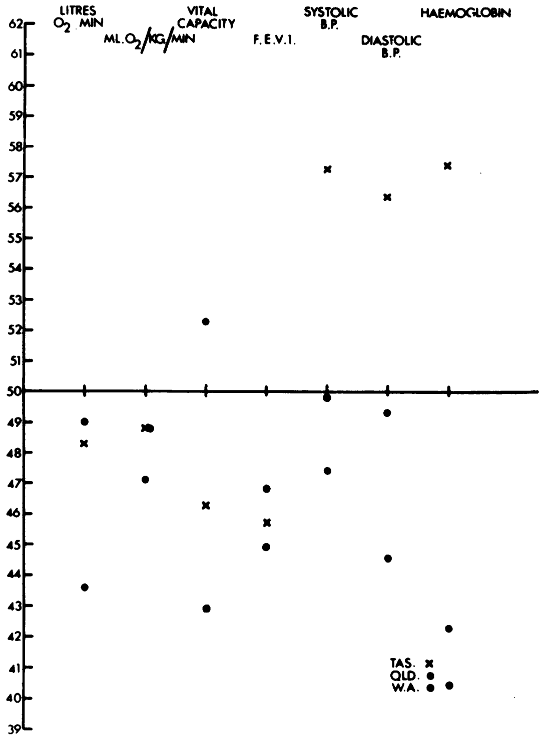



FIG. 9 ELECTROCARDIOGRAM MEASURES

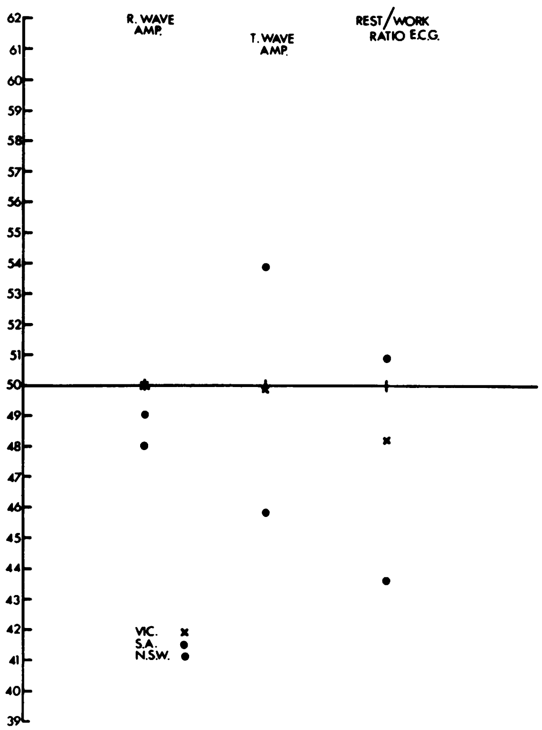



FIG. 10 ELECTROCARDIOGRAM MEASURES

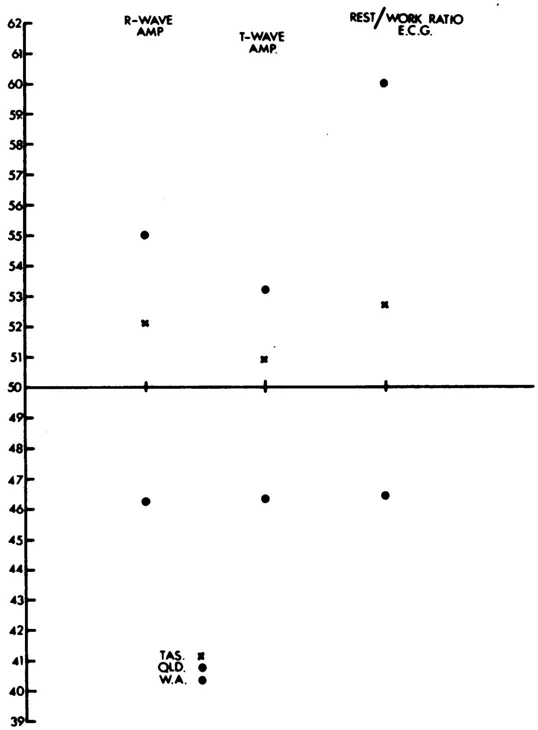


FIG. 11 BRACHIAL PULSE WAVE MEASURES

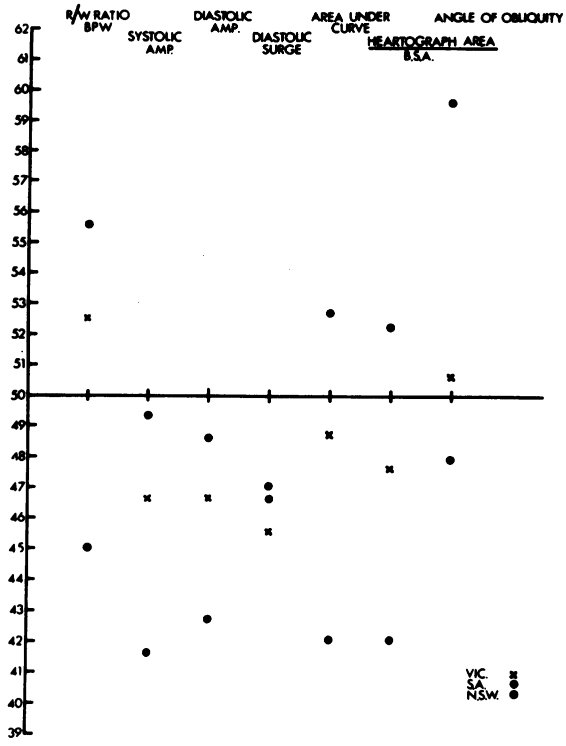
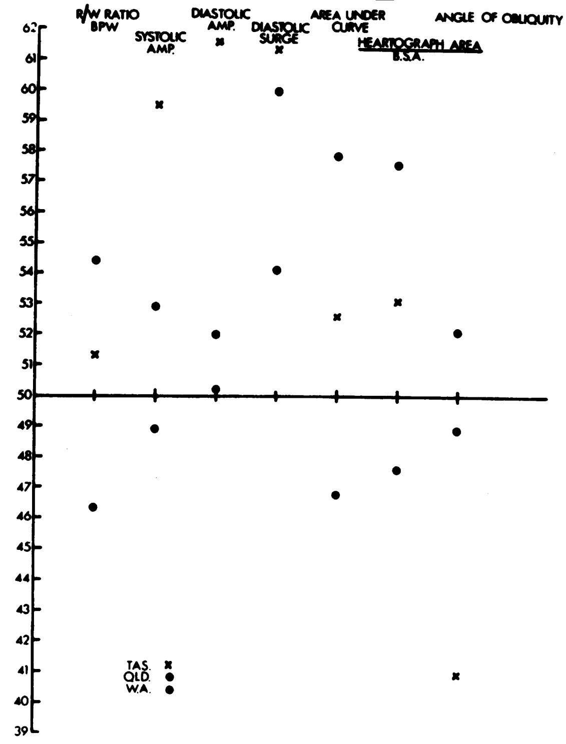



FIG. 12 BRACHIAL PULSE WAVE MEASURES




findings of Lewis when measuring the national oarsmen in New Zealand.

## Conclusion

After examining the profiles in the present paper one can only state that the factors in rowing ability are of a multiple and complex nature. It would appear therefore that comprehensive longitudinal observations need to be made over several crews of varying ability ranges, in order to more clearly delineate and assess those features which are vital to superior performance in the sport of rowing.

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