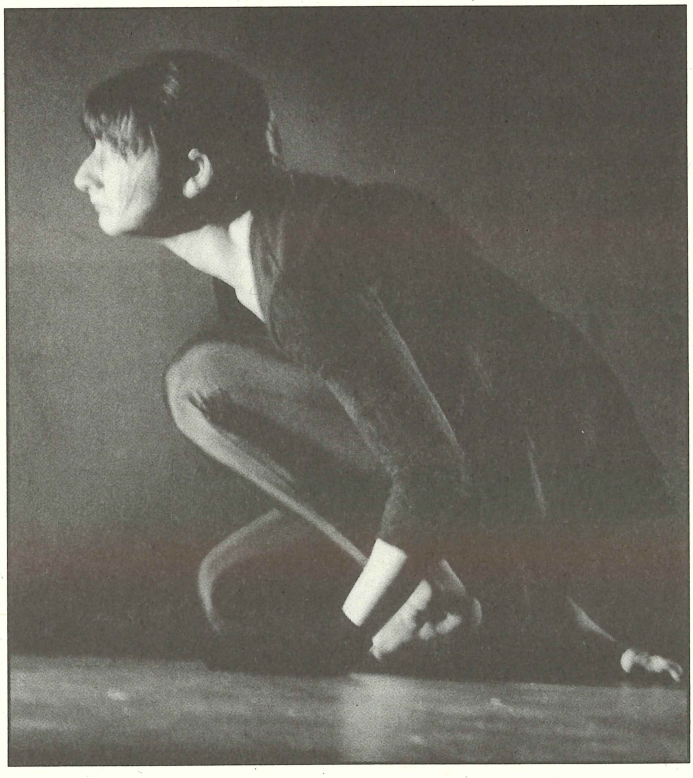
All other arts can wait for the verdict of history if they are rebuffed by the contemporary world - the choreographer not so. To keep faith with himself, he cannot pander to popular taste; he must choose his subject and the means to body it forth from his total convictions about values in art and life.

Doris Humphrey, 1959



CARDIORESPIRATORY PHYSIOLOGICAL TECHNIQUES INVOLVED IN DANCE ACTIVITY

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Dance is a visual music
M. Bejart

The dancer is mainly a body in movement, with a deep instinctive understanding coming from the body.

Despite the long history of the various artistic forms of dance in Europe (classical ballet, contemporary dance, jazz dance, folk dance), it is not until the years 80' that dance has been studied from biomedical perspectives.

Another problem is that professional dancers and amateurs are groups who need selective approaches.

But the biomedical field and more particularly the field of exercise physiology can be applied to dance and the scientifically knowledges asses the limits set to the physical performance capacity.

In this presentation I intend to focus on the various investigation procedures we frequently utilize in our research laboratory to measure the level of the cardiorespiratory parameters during calibrated efforts.

1. Aerobic processes are studied by means of the wellknown "open-circuit" method, which evaluate the oxygen uptake during calibrated efforts on a bicycle, treadmill or rowing ergometer.
   This O2 uptake involved in mitochondrions energetical process is mainly concerned with long duration submaximal exercise but is still interessing to evaluate the maximal aerobic capacity of the dancers, not only to lead the training but also to evaluate the strain during the public performance.

2. Blood lactic acid levels are now recently measured in the lab, as well as on field by means of a new enzymatic technique, which only needs a capillary blood sampling (1).
   Related to O2 uptake, exercise intensity and heart rate, these values are very important to develop the efficiency of the lessons and the physiological cost of the performance.

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3. In order to investigate the anaerobic processes, which are prevalent in dance activity, we have to establish a laboratory procedure depending of the pathway involved in muscular energy production.
   So, to measure the explosive ALACTIC POWER, we ask the subject to realise a full speed maximal effort on a bicycle during 10 seconds (4).
   This test is then completed with a ABALAKOW test which measures the vertical jumping height (6).

4. If we need to explore the ANAEROBIC LACTIC pathway, we utilize the Wingate test previously described on the bicycle but with a 30 seconds duration (2).

5. Besides these classical procedures, we perform various studies based upon the cardiac function.
   By means of a non-invasive method (7), we are able to follow from rest to exhaustion, the cardiac parameters of a dancer.
   This is particularly important as we know that cardiac output depends directly from Stroke Volume and Heart rate.

Let us have a look on the physiological basis of Heart activity! It would help us to understand the importance of stress appearing during the public performance.

Cardiac output is highly dependent of the SV level, if the SV is reduced, the cardiac output required to obtain a defined physical work intensity would be produced by an important Heart rate increase.

On the contrary if the SV is enhanced, the same cardiac output is reached with a relatively reduced Heart rate increase.

Which are the mechanisms sustaining the Heart contraction?

$$E = \int P * dV + \int T * dt$$

The energy production depends of the following 2 terms:

* The first one is the integral of the blood Pression (P) and Stroke Volume (dV), expressing the EXTERNAL CARDIAC WORK.

* The second represents the integral of the Tension (T) time (dT), corresponding to the energy produced to sustain a constant BASIC CONTRACTED STATE of the myocardial fiber.

The second term is much more important than the real cardiac work produced, and is firmly dependent of the blood pression for (T) and of the Heart rate for (dt).

So we can observe, that heart load could be very important even when a low muscular work intensity is required, as soon as blood pression and heart rate are increased.

When do we observe such conditions?

According to the Frank-Starling law, the initial length of the fiber is related to the Venous Return level.

During the Diastolic time, End Diastolic Volume (EDV) remains constant and the control upon the Systolic Volume (SV) is realized during the Systolic time by means of plasmatic catecholamine and thyroxine hormonal secretion which enhance the cardiac contractility (5).

So, if during moderate aerobic exercises, the heart is able to increase 2 or 3 times its cardiac output (CO) without corresponding blood pression increase, as soon as anaerobic processes are involved, we record related hormonal stimulations. Heart contractility is improved but Venous Return and EDV which depends on the aerobic training, are limited and hormones act mainly upon blood pression and heart rate (5).

In dance activity, anaerobic state and exercise strain and stress which occur during public performance are conditions leading to a heavy hormonal secretion responsible of a markedly cardiac energetical cost.
Therefor we can conclude, that without an aerobic training process, dancers have to produce a cardiac load too high versus the level of the muscular efort required in dance activity.

6. Finally, another method to test the muscular power is the isokinetic power measure which is able to evaluate the local level and duration of muscular contraction (mainly the quadriceps).
A computerized Cybex device could give objective informations about these aspects involved in dance performance (3).

Conclusions

Laboratory as well as field studies could give valuable informations concerning training and public performance.

There is an important need to develop an aerobic capacity for dancers, mainly involved in anaerobic processes.

Laboratory and field studies are now able to follow the evolution of the cardiac function during the lessons as well as during their professional public performances.

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