THE HUMAN EMBRYO'S USE OF ITS SELF

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In all phases of life, from conception to death, the human organism is using its body, in the same sense that F.M. Alexander considered the use in the post-natal period. When the human embryo is about eight weeks old, it has all its major organs and it is moving slowly inside the amniotic fluid. During these early weeks, it is remarkable how the embryo is using its self at each stage to create new organs and structures.

This early period of life is characterized by growth-movements: slow, almost, imperceptible displacements of cells and tissue masses over defined distances in specific times. The growth movements have been determined by the construction of many three-dimensional scale models of actual human embryos of different ages. From a knowledge of growth-movements, one can deduce the responsible biological forces. This approach is described as the biokinetics (movements) or biodynamics (forces) of human development and stems mainly from work done at Göttingen University by the embryologist E. Blechschmidt. It offers different insights into early development compared to the currently popular molecular biological approach.

Biodynamic Embryology

Biodynamic embryology shows that body 'systems' (such as cardiovascular, nervous, musculo-skeletal) do not exist independently of the rest of the body. At any stage of life, it is impossible to define, both anatomically and physiologically, where one 'system' ends and another starts. In the embryo, it is impossible to state when a 'system' first arises. Since the human grows initially by subdivision of one fertilized egg, the organism is always integrated and functioning as a whole at every stage: its behaviour cannot be interpreted by reductionist techniques. This new approach to development is unashamedly wholistic. Since all the organs arise over the first eight weeks after conception, this is the most creative period of an individual's life.

'Outside-Inside' Differentiation

The evidence for this view can he reviewed by tracing the history of early development from fertilization onwards, initially concentrating on the changing form and structure of the whole conceptus (fertilized ovum) and then on the embryo that arises from an internal part of the conceptus. An understanding of growth-movements requires an identification of the sources, sinks and pathways of the flows of nutrients and waste products as a consequence of the metabolic relationship between the conceptus and the mother. Blood vessels always arise where there exist initial fluid and metabolite movements between sources and sinks, and all embryonic blood vessels function, in a biomechanical sense, as restraining structures resistant to the tension created by the growth of nearby organs or sheets of cells. Changes in the external form of the embryo or its organs should not be construed as starting within the organ, or within its cells, and then manifesting themselves externally, but rather these changes should be seen as the manifestation of the reactions of growing cells or organs (cellular ensembles) to stresses imposed from without, e.g., as a reaction to the spatial constraints of metabolic pathways. Thus development is outside-inside differentiation. As opposed to the molecular biological view that differentiations begin with the gene and express themselves externally, the biomechanical view holds that the genes are simply part of those many components of a cell that allow the cell to react to the stimuli coming from without. The genes are a necessary component, but do not represent a driving engine, for differentiation and development.

Biomechanical Forces

Various illustrations [which were shown at the Congress] can be reviewed: a sheet of ectodermal cells may change its curvature as it tries to grow in volume, principally in surface area, against the resistance of the amnion at the perimeter of the sheet. In this case, the changing form of the sheet is not to be sought in its single cells, but rather in the cooperative reactions of the whole ensemble to its external conditions (forces). The development of the human face is another example: the early face arises in the embryo as folds and furrows compressed between an expanding brain and a beating heart (to which the brain is anchored by taut arteries, the so-called aortic arch vessels). These folds are biomechanical flexion folds, seen at sites of all bending throughout our life, and are not ‘gills’: Haeckel's ‘Law’ of 1866 (that ontogeny recapitulates phylogeny) was based on scientific fraud and is now known to be inapplicable to human development.

Growth-movements are the natural precursors for all subsequent functions. For example, through growth-movements, the back of the embryo is seen to be initially extended longitudinally, then flexed, and then re-extended. These slow embryonic movements driven by growth of the nervous system, heart and liver and restrained by blood vessels and boundary structures (e.g., amnion) anticipate the later, faster reciprocal actions of the spine now driven through the action of axial muscles, elastic ligaments, gravity, etc. The former are no less a use of the body than the latter.

Development of Muscles

It can be demonstrated that muscles arise in zones where embryonic cells are first extended by longitudinal stresses and allowed to thicken and multiply in an oblique direction to the extending stress. Cytoplasmic protein filaments align, initially longitudinally, immediately under the cell’s boundary membrane, which bears the external stress. The muscle cell develops to resist the imposed stress and displays its first (isometric) ‘contraction’ or hardening. It can be further demonstrated that muscles which arise through embryonic growth-flexion become the extensors of the child, and muscles which form in growth-extension become flexors, i.e., there is a reversal of muscle function between its use during growth and its final use. On the other hand, tendons and ligaments arise where embryonic cells are extended in one direction and compressed at right angles. These growth-movements of the cell are accompanied by the expression of some of the cell's intracellular proteins which polymerize extracellularly into strong, tension-resistant fibres of collagen.

Growth-Movements of the Arm

The growth-movements of the embryo’s arm are a kind of growth-grasping: as the arm grows it is seen, over weeks, to adduct, flex and pronate. At all times these predominant growth-movements, which are bringing the arm to its natural rest position, are always accompanied by minute growth-movements in a reciprocal or ‘antagonistic’ sense. Thus, growth-flexion will be associated with some growth-extension, growth-pronation with some growth-supination, etc. The newborn child is equipped with all the requirements for powerful, harmonious movement cycles of the arm because the arm has been developing this way for months *in utero*, since the first appearance of the arm fold when the human embryo is only about 4 mm long.

Growth-Movements of the Lung

The principal growth-movements associated with lung development in the embryo are as follows: extension and straightening of the vertebral column, flattening of the upper surface of the liver, descent of the liver with respect to the head, and forward displacement of the heart (diastolic erection). These growth-movements all lead to a continual, pulsating enlargement of the triangular space between heart, liver and spine. Into this ever increasing space, the lung bud grows, mainly by surface growth of its epithelial cells, forming a huge branching tree of tiny tubes with end buds. The very growth of the lung is a growth-inspiration, i.e., an increase of surface area into an enlarging sac, and is the precondition for the function of post-natal inspiration. At any stage of embryonic growth-inspiration, the fluids and waste products from lung cell growth are being conveyed (excreted) through the lung tubes and the embryo’s trachea into the amniotic fluid, in the opposite direction to the growth-movement of inspiration. This fluid movement represents a growth-expiration (it encompasses the so-called glandular phase of lung development). Therefore, as a consequence of the manner in which the lung is growing, embryos and fetuses are breathing watery fluids *in utero* for months before the first breath of air.

Body Functions Based on Growth-Movements

No ‘adult’ function can be understood in terms of the purposes or uses to which we put our anatomy. The science of ‘functional anatomy’ may contain many interesting correlations but incorporates too much teleological thinking to ever offer a natural insight into the workings and use of the human body. The easiest way to interpret an adult use is to study the way the use arises normally in development from conception. At any stage in life, even as an embryo, we use our bodies according to what structures we have available and according to the preceding growth-movements. At any stage our bodies may be trained under, or exposed to, conditions that modify the use – but the basic initial functions are those resulting from normal growth and to these functions we can ascribe no purpose. Whether in cells, or organs, or whole organisms, they are simply reactions to pre-existing conditions. ■

<u>REFERENCE</u>

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<u>BIOGRAPHY</u>

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[published in: **Sydney Congress Papers,**
4th International Alexander Congress,
Sydney, Australia July 1994.
Edited by David Garlick.
Published by DIRECTION, pp. 63–65]