THE ACTIVATION OR DE-ACTIVATION OF RECEPTORS FOR THE PURPOSE OF DEVELOPING SOMATIC, AUTONOMIC, AND MENTAL FUNCTIONS: INTRODUCTION. PART I — PHILOSOPHY

BARRY C. STILLMAN, DIP.PHYSIO., M.A.P.A., M.C.S.P.

Physiotherapy School of Victoria.

At the present time there appears to be a growing interest in the work of Miss Rood—Professor and Chairman, Physical Therapy Department, University of Southern California, U.S.A. Her approach deals with the activation or de-activation of receptors for the purpose of developing somatic, autonomic, and mental functions. The work is based upon what is presently known or believed in the field of physiology, and upon a re-evaluation of normal human ontogenesis.

Using the words of Miss Rood (1966): "The following hypothesis is an attempt at a brief total concept of the reactions of the body which might affect the evaluation of patients and the clinical application of therapy." It is not intended that the techniques be described here, but rather, the material which forms the basis for selection and application of the techniques. There is a real risk of applying the various techniques without fully comprehending the broad philosophy of the approach. It is hoped that this paper will obviate this risk, as well as forming a starting point for therapists who are about to embark on a study of Miss Rood's work. Some of this information will also be found relevant to the neurodevelopmental treatment of Dr. Karel and Mrs. Berta Bobath, the proprioceptive neuromuscular facilitation of Dr. Herman Kabat and Margaret Knott, the approach of the late Dr. Temple Fay and of Glen and Robert Doman, and the work of Signe Brunnstrom.

Many disorders, orthopaedic, neurologic, thoracic, and others, were initially considered by physiotherapists in terms of the mechanical dysfunction which resulted from the disorder.

Treatment was correspondingly directed towards correcting the mechanical disturbance, often in an essentially passive manner. This may be termed a centrifugal approach as distinct from the centripetal approach of modern treatment, including that of Miss Rood. Whatever the disorder, Miss Rood's approach is centripetal in that it does affect a change in neurological activity within the central nervous system. Without this change there can be no effect from her approach which, as has been previously stated, deals with the activation or de-activation of receptors for the purpose of developing somatic, autonomic, or mental functions.

Miss Rood's approach to treatment is dependent on the acceptance of two fundamental points:

(i) that receptors may be activated or de-activated during therapy; and
(ii) that such changes in receptor activity can affect motor function (whether somatic or autonomic in nature) and mental function.

It is necessary to recognize that the functional disability in neurological disorders is at least in part due to a physiological discontinuity within the central nervous system, rather than a complete anatomical discontinuity. Where anatomical discontinuity is complete, and this means all neurological pathways concerned with a particular function, then treatment cannot be effective. It is fortunate that all neurological functions are diffusely organized within the central nervous system, so that in clinical practice the integrity of a certain number of reflex pathways concerned with any function under consideration will frequently be retained. It is these reflex pathways which form the substrate for treatment.
The Activation or De-Activation of Receptors

With the partial exception of mental functions, treatment is directed towards securing a motor response through the utilization of receptors and their associated reflex pathways. That such sensori-motor or input-output interaction exists need not be questioned, although the exact nature or effects of many of the proposed inter-connections in this concept of therapy cannot presently be stated.

Although there are many peripheral or local factors which may play a part in determining the nature of a motor response, the basic determinants of any motor response (somatic or autonomic) are the number of active efferent fibres, and the level of activity in these fibres at the time of the response. With regard to somatic functions the fibres in question are the alpha-motoneurones or common motor nerves; in the autonomic system they are the pre-ganglionic sympathetic and para-sympathetic fibres.

In central nervous system disorders there may be an alteration from normal in the number and/or discharge characteristics of somatic or autonomic motor nerves, or of nerve fibres synapsing with these nerves. Whichever be the case, the fundamental objective of any physiotherapy, speech therapy, or occupational therapy approach to the treatment of motor disorders (whether somatic or autonomic) is as follows:

To alter the balance of excitatory or inhibitory influences on efferent (motor) fibres for the purpose of facilitating, initiating, augmenting, depressing, terminating, or preventing motor activity.

This objective Miss Rood aims to achieve through selective activation or de-activation of receptors, and/or through the use of volition on the part of the patient.

With respect to perceptual, intellectual, and allied functions, Miss Rood accepts that these may be influenced by activation or de-activation of receptors, and/or volition on the part of the patient, and that there is an interaction between somatic, autonomic, and mental functions, through which a therapeutic influence on one sphere may be used to affect a change in the others.

A further aspect of philosophy deals with the subject of ontogenesis. The following three sets of hypotheses concerning ontogenesis are an important part of the foundations for Miss Rood's work.

1. Any disorder in the developing child may result in an arrest, retardation, or aberration of normal ontogenesis. Any disorder in an adult may result in a loss, depression, or aberration of one or more functions previously acquired during normal ontogenesis; i.e., a reduction in the maturational age with respect to one or more functions.

This premise recognizes that the development of functional abilities is dependent upon development of related structures, and that in turn, structural disorders will result in a disturbance of the related functions. It is generally true to state that the more complex (mature) functions are those which are most prone to disturbance.

2. The order in which physical or mental functions appear during normal ontogenesis is a desirable sequence for therapy, in that within the normal developmental sequence there is a sound progression of functions from the most simple to the most complex. It may also be stated that in normal development the acquisition of one functional skill sets the scene for the development of the next. In treatment, by directing attention to those functions which the patient has not perfected, improvement in these spheres will serve as foundations for the education or re-education of more advanced functional activities.

3. The principles of normal ontogenesis should, in most instances, be adhered to when attempts are being made to achieve normal or normalized development in a pediatric patient, or redevelopment in an adult patient. The following principles of ontogenesis pertaining particularly to somatic development should all be considered when planning and executing treatment.

(i) Development is a continuous process from conception to maturity.

(ii) Development proceeds in a constant direction —
   Motor:
   According to myotomes (Cervical 1 to Coccygeal 1); i.e.
     Cervico-rostral.
     Cervico-caudal.
     Axio-distal in the limbs.
   Sensory:
     Peri-oral to rostral.
     Peri-oral to caudal.
     Disto-axial in limbs.

(iii) Development lacks a step by step quality — overlapping occurs; e.g. walking is commenced before standing balance is perfected.

(iv) The time of appearance and maturation of motor skills is variable; e.g. walking may commence as early as nine months, or as late as sixteen months.

(v) Each developmental milestone is a total pattern of movement and posture; each total pattern involving interaction between the head and neck, trunk, and limbs, as in picking up an object from the floor in standing.

(vi) Reflex motor activity develops prior to, and is eventually suppressed by willed motor activity; e.g. reflex grasp appears before voluntary grasp, and is lost before voluntary grasp is developed.

(vii) When one skill is being actively learnt, another tends to go into abeyance; e.g. retardation in speech development when a child first starts to walk.

(viii) The absence of a motor skill from the developmental sequence may be considered normal provided that the remaining skills emerge in the correct order; e.g. not all children crawl.

(ix) Motor activity characteristic for man, but which is absent at birth, can only appear when the related structures are fully developed; they require little learning.

(x) Ontogenesis recapitulates phylogenesiss. Phylogenesis refers to the history of our development from the lesser vertebrate animals. The progression of locomotion is —
   Homologous pattern (forelimbs moved, then hindlimbs);
   Homolateral pattern (limbs on one side of the body moved, then on the other);
   Crossed diagonal pattern (opposite forelimb and hindlimb moved together).
   This illustrates the transition from amphibian, via reptilian, to the mammalian eras.

(xi) Muscle actions evolve in a constant sequence. With respect to any segment of the body, the following two sequences of development may be observed —

(a) Unskilled light work: A gross reciprocal muscle action, with movement through a full range. For example, bilateral unskilled reciprocal upper limb movements in the newborn infant.

   Heavy work holding: A contraction of opposing muscle groups, that is, co-contraction, for the purpose of stabilizing a joint. For example, the action of scapulohumeral and cervical muscles in four foot kneeling.

   Heavy work movement: Where one group of muscles are more strongly active in the co-contraction pattern, so that gross movement results. For example, the action of proximal limb musculature during crawling.

   Skilled light work: A fine skilled reciprocal muscle action occurring distally, and requiring proximal heavy work holding. For example, manipulation of small objects in the hand.
(b) Flexion, extension, adduction, abduction, and finally, rotation.

(xi) The most influential factor affecting the nature and rate of functional development is the nature, quality, and quantity of sensory stimulation. All effective functions of the body originate from some stimulus within the internal or external environments: sensory learning forms the stimulus for motor learning.

Miss Rood has considered the development of functions during ontogenesis in terms of what may be called the biological purposes of such functions. See Table I.

### Table I

<table>
<thead>
<tr>
<th>Biological Purpose</th>
<th>Survival — Mobility</th>
<th>Growth — Stability</th>
</tr>
</thead>
<tbody>
<tr>
<td>MECHANISM</td>
<td>Where the organism protects itself from danger, or withdraws from it — the fight or flight mechanism. Later this mechanism subserves more discriminate functions.</td>
<td>Where the organism maintains a controlled sustained interaction with the environment.</td>
</tr>
<tr>
<td>SOMATIC MOTOR SYSTEM</td>
<td>Light work system.</td>
<td>Heavy work system.</td>
</tr>
<tr>
<td>SOMATIC SENSORY SYSTEM</td>
<td>Specific sensory system.</td>
<td>Non-specific sensory system.</td>
</tr>
<tr>
<td>AUTONOMIC SYSTEM</td>
<td>Sympathetic system.</td>
<td>Para-sympathetic system.</td>
</tr>
</tbody>
</table>

In the table it can be seen that both structure and function of the somatic and autonomic systems are considered as being bipartite, although during development they become interdependent. This dichotomy of structure and function has been closely followed through normal development with respect to skeletal functions (the somatic system concerned with somatic functions of the neck, trunk, and extremities), and vital functions (the somatic and autonomic components of the branchiomeric system concerned with respiration, feeding, and speech). It is important in planning therapy not only to know of the kinesiology of various muscles, but also to know how muscles are first activated, and through what stages of control they pass during normal ontogenesis. In this concept of therapy we are concerned rather more with the physiology or biology of the musculoskeletal system than with the kinesiology.

It must be clearly appreciated that the “survival—mobility” and “growth—stability” functions emerge and are integrated in a constant order during normal ontogenesis, and are educated or re-educated in the same order during treatment. As there are specific patterns of stimuli which lead to the development of each individual function, such normal or normalized stimuli should be used to develop the same response in the patient. Whilst treatment may be directed towards one system, it is necessary to keep in mind the likelihood of influence on autonomic or mental functions, or vice versa.

All disorders may be analyzed in terms of the resulting disturbance of the “survival—mobility” and “growth—stability” functions. An example of this method of analysis related to somatic disorders is given in Table II.

One of the highlights of this concept of therapy deals with a hitherto unsolved problem in neuromuscular re-education — that is the patient who is unable, no matter how hard he tries, to perform a required task. This is clearly seen in patients with spasticity who are variably limited to the assumption of postures.
and the performance of voluntary movements which are contained within the boundaries of pathologically exaggerated attitudinal or postural reflexes. Voluntary effort on the part of the patient requires the highest level of neurological function, a level of function which the patient invariably lacks. Such efforts are commonly found to result in abnormal patterns of response, fatigue, and frustration. Within this concept, therapy is initially aimed at producing an automatic yet normal or normalized response by way of reflex mechanisms, and therefore circumventing the patients' lack of voluntary control.

Table II

<table>
<thead>
<tr>
<th>Clinical Pathology</th>
<th>Disordered Function</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atonia-hypotonia: e.g. poliomyelitis, and progressive muscular atrophy.</td>
<td>Absent heavy work. Absent light work.</td>
<td>1. Unskilled light work. 2. Heavy work holding. 3. Heavy work movement. 4. Skilled light work.</td>
</tr>
<tr>
<td>Hypertonia: e.g. spasticity syndromes and Parkinsonian rigidity.</td>
<td>Excess heavy work. Reduced light work.</td>
<td>1. Use available heavy work movement. 2. Skilled light work.</td>
</tr>
<tr>
<td>Dystonia; e.g. ataxia, and choreoathetosis.</td>
<td>Reduced heavy work. Excess light work.</td>
<td>1. Heavy work holding. 2. Heavy work movement. 3. Controlled, skilled light work.</td>
</tr>
</tbody>
</table>

Finally it must be pointed out that Miss Rood's approach to therapy does not ignore, in fact it stresses, the necessity of commencing with a comprehensive assessment, of understanding the nature of the disorder plus its natural history and prognosis, of understanding the patient as an individual with specific needs, and of maintaining a close personal interaction between the therapist and the patient.

Conclusion

Any new approach to therapy will be accompanied by a growth of terminology. This is inevitably associated with problems in semantics. Unfortunately this appears to be very much the case with Miss Rood's concepts of assessment and therapy. The introduction to her work recorded in this paper has, wherever possible, been couched in general terms which, it is hoped, will permit the reader to gain a clear understanding of the concepts. Even excluding the problems of semantics it must be agreed by those who have already faced it, that the study of Miss Rood's work is a difficult task. It is this author's belief and experience that without an adequate statement of introduction explaining the philosophy of the system, much of her work is without meaning.

Although it is recognized that relevant physiology is a most important part of the introduction, it is because of its importance, and to retain clarity, that the author has decided to discuss this in a separate paper.

Selected Bibliography - Ontogenesis


S E L E C T E D B I B L I O G R A P H Y — R O O D


A u s t. J. Physiother., XIV, 3, September, 1968


Rood, M. S. (1967). Use of sensory receptors for motor and other reactions. Lecture-demonstration delivered at 8th Medical and Educational Conference, Australian Cerebral Palsy Association, 8-12th May, Melbourne. (Unpublished.)


Stillman, B. C. (1967). A synopsis on concepts dealing with use of receptors in therapy. (Unpublished.)
