Editorial

Neuroendocrinology: Its past, present, and future

Neuroendocrinology has gained recognition as a field of research in its own right only in recent years. Yet, like other scientific disciplines it did not suddenly materialize from nowhere. At one time or another astute observers have drawn conclusions, now recognized as valid, for which no frame of reference existed to make them meaningful to their contemporaries. In retrospect, we re-evaluate their significance and thus reconstruct a historical record from the vantage point of the present. Thus, for example, the behavioral changes following removal of the gonads, practiced from remote antiquity in humans as well as in animals, were not only recognized but were, in fact, the aim of the procedure. Yet, the causal relationships were not investigated until 1849 when BERTHOLD compared the behavior of castrated roosters with that of animals with reimplanted testes and concluded that a testicular secretion acted on the nervous system *via* the circulating blood. At the time his observation did not stimulate further investigation; it was not until 1912 that attention was paid to the effects of internal secretions of the gonads on the nervous system as a result of the widely publicized experiments of STEINACH. Since then this particular field has been extensively explored with many problems remaining, however, still unresolved.

Also at an early date, it was demonstrated (HAIGHTON, 1796) that ovulation in the rabbit is triggered by the stimulus of copulation, and the suggestion was already then put forward that a chemical mechanism was responsible for ovulation, a concept which has received extensive study in recent years and, in its essence, been found correct.

Interrelationships between the central nervous system and another endocrine tissue, namely the adrenal cortex, were explored early, even if they were at the time not understood. MORGAGNI (1733) seems to have been the first to note the absence of the adrenal cortex in an-encephali, a finding confirmed by SÖMMERING (1792), MECKEL (1802) and many investigators since. A connection between the thyroid gland and intellectual development was already recognized by PARACELSUS,

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although the first clinical description in the modern sense had to wait until the middle of the 19th century (CURLING, 1850).

The areas in which the origins of contemporary neuroendocrine investigations may be traced to remote times concern mostly man and his domesticated animals and thus constitute only a part of neuroendo-crinology. The complex aspects of comparative neuroendocrinology have only recently been successfully explored. For example, in 1917 KOPEC isolated the head region of the moth *Lymantria dispar* from the rest of the body with the result that only the part containing the central nervous system pupated, but not the portion caudal to the ligature. He concluded that the brain released a substance into the blood which is necessary for pupation. At about the same time SPEIDEL (1919) described 'gland-like' neurons in the spinal cord of skates.

The close relationship between these two observations became apparent much later when it was recognized that the central nervous system of both invertebrates and vertebrates acts in part as an organ of internal secretion which synthesizes, stores, and releases hormones of vital importance to the organism. In the same way current concepts concerning the role of pheromones or of the effects of hormones on the nervous system, neural pathways for the photic stimulation of gonadal activity, and the nature of the trophic function of nerves, have only recently been formulated. It becomes increasingly evident that the capacity of the central nervous system to produce and release hormones as well as to respond to endocrine secretions of various kinds, constitutes part of the basic endowment of the earliest and most primitive types of neural organization and remains an essential attribute of the central nervous system throughout its evolution. It is by reason of this universality of the fundamental neuroendocrine mechanisms that its investigation derives its methods, concepts and subjects from a wide range of specialities and must include representatives of many different species.

Our awareness of the existence of neuroendocrinology as a new discipline brings with it an atmosphere somewhat like that following the discovery of mineral resources in a hitherto quiet valley. Suddenly the few old-time residents find themselves in the midst of an excited crowd which erects more or less permanent structures and digs numerous holes into the mountain side, some hitting metal-bearing veins, others getting nowhere. Pursuing the simile, we may well ask ourselves at this juncture, what we are digging for, what potential resources are lying under the surface, what problems we are facing in

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our efforts to find productive deposits and how long they are going to last. Should we anticipate the development of a permanent community or are we constructing a future ghost town? Is it, to return to neuroendocrinology, wise to found a journal, to write textbooks, to designate departments, at a time when the available data are still so contradictory and general concepts seem still so vague?

The answer is yes. The future of neuroendocrinology looks bright, even awesome, as one contemplates the magnitude of the task ahead. There are 21 animal phyla each consisting of anywhere from a few to up to a million species. Our present, still extremely limited experience, indicates that each and every species has its own combination of neuroendocrine mechanisms. To venture a very crude guess, some common denominators may become evident after about 10% of the known species in each phylum have been adequately explored. The task is one of staggering magnitude. At present each species that has become moderately well known has required the efforts of a lifetime of at least one, usually of many investigators.

One species, namely man, is particularly troublesome. There can be little question that clinical neuroendocrinology is bound to be of the utmost importance, and there is also no doubt that the concepts derived from studies in general and comparative neuroendocrinology apply to man. However, the peculiar human way of life both interferes with and exaggerates various aspects of neuroendocrine functions to the extent that contradictory phenomena occur from individual to individual.

Under these circumstances this journal cannot hope to gather in its pages all that is being published in the field of neuroendocrinology. Many investigators will want to continue communicating their findings in journals of their professional specialities, whether it be neuro-surgery, psychiatry, entomology,

endocrinology, microscopic anatomy, or pisciculture. However, such diversity of interests, techniques, and subject matter is precisely the reason for the need of an organ in which the many threads can be gathered to be woven into a patterned matrix. It is with the unifying concepts and the common denominators of neuroendocrinology that papers published in this journal should be concerned in interpreting the specific data that will be recorded in its pages. These concepts are only beginning to emerge and they, rather than early records of unrelated observations, signify the beginning of neuroendocrinology as a science.

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