readiness for the assumption of terrestrial life. Two opposite responses are thus given by regions of tissue lying side by side, and superficially indistinguishable. Presumably what thyroxine is doing here and in similar situations is to stimulate or inhibit the production of certain enzyme systems that are involved in growth and maturation[7]. This seems to follow from Tata's finding that the regression of the tadpole tail, which can be evoked by the hormone acting on the isolated tail *in vitro*, is accompanied by increased synthesis of protein[8]. This presumably represents the increased synthesis of certain hydrolytic enzymes that contribute to the regression of the caudal tissues.

Embryonic Differentiation

This does not, of course, explain what is the basis of the adaptation of the target cells, although it can be assumed in general terms that it depends on the ability of their genetic transcription systems to react in ways that have been determined already in earlier stages of development. We are driven back, in other words, to the problems of embryonic differentiation discussed by Goldacre. He had emphasized the significance of feedback control. Recent findings[6,9] indicate that this plays an important part in metamorphosis, mediated in this instance through the blood stream, and involving both negative and positive feedback.

It is known that early in the life of the amphibian tadpole, before the onset of the visible changes of metamorphosis, the pituitary is able to produce thyrotropin, which can stimulate thyroid activity. At this early stage its stimulating effect is minimal. This is supposedly because its output is kept at a low level as a result of the thyrotropin-secreting cells of the pituitary being highly sensitive to negative feedback from the thyroid gland. However, the neurosecretion of the hypothalamus also enters into the regulating system. This secretion reduces the sensitivity of the thyrotropin-secreting cells to thyroxine, but its effect is at first small because the hypothalamus is only poorly differentiated. According to Etkin's analysis, the effect steadily increases because the thyroxine exerts a positive feedback action on the hypothalamus; the effect of this is to increase its output of neurosecretion, so that there is a progressive increase in desensitization of the thyrotropin-secreting cells. This positive feedback action is by its very nature self-accelerating; thus it rapidly builds up the hypothalamic neurosecretory activity to a point at which large quantities of thyrotropin are released, and the thyroid gland is raised to the high level of activity needed to bring about the metamorphic climax.

Feedback Systems

It is not clear whether this positive feedback relationship is peculiar to amphibians, or whether the events of metamorphosis are extreme specializations of processes that occur also in other vertebrates. But the principles of organization revealed in amphibian metamorphosis must be widely applicable. This symposium made clear that at all stages of development, and at all levels of complexity, from the single cell to the advanced metazoan, molecular messengers operating through feedback systems are of paramount importance in developmental and physiological regulation.

1 Goldacre, R. J., and Bean, A. D., *Nature*, **186**, 294 (1960).
2 Goldacre, R. J., *Proc. Second Intern. Congr. Medical Cybernetics, Naples*, 1964 (in the press).
3 Clarke, K. U., and Langley, P. A., *J. Insect. Physiol.*, **9**, 287, 363, 411, 423 (1963).
4 Clarke, K. U., and Gillott, C., *J. Exp. Biol.* (in the press).
5 Thomsen, E., and Møller, I., *Nature*, **183**, 1401 (1959).
6 Etkin, W., in *Physiology of the Amphibia* (edit. by Moore, J. A.), 427 (Academic Press, New York, 1964).
7 Tata, J. R., in *Actions of Hormones on Molecular Processes* (edit. by Litwack, G., and Kritchevsky, D.), 58 (Wiley, New York, 1964).
8 Tata, J. R., *Dev. Biol.*, **13**, 77 (1966).
9 Etkin, W., *Neuroendocrinology*, **1**, 45 (1965).

BOOK REVIEWS

OLYMPIANS OF CHEMISTRY

Nobel Lectures in Chemistry 1901–1921
Including Presentation Speeches and Laureates' Biographies. Pp. xii + 409. (Amsterdam, London and New York: Elsevier Publishing Company, 1966. Published for the Nobel Foundation.) 160*s*.

THIS finely produced book commemorates those chemists who gained the Nobel Prize in the first twenty-one years of the present century. Here indeed are riches for the historian of science! Here is pleasant reading for all who would be reminded of the great men whose names frequented the chemistry text-books of old: Nernst, Emil Fischer, Grignard, Haber, the redoubtable van't Hoff and the rest. The lives and scientific work of eighteen men and one woman are recorded. It is interesting to note that no fewer than nine of these were German; four (counting Madame Curie as French) were French; three (counting Rutherford as British) were British; and one each came from the United States, Sweden and Holland. These figures emphasize in a striking way how devoted and imaginative were Germans during the nineteenth century in all branches of chemistry.

The whole book is in English. The chapter devoted to each prizeman is divided into three parts. First there is the translation of the "presentation" speech, given by a Swedish scientist of renown, recounting carefully and concisely the main discoveries in chemistry that the recipient had made. This is in most cases done well and with the minimum of irrelevance. Then comes the prizeman's lecture, in which one of his great pieces of work is recounted at length. Finally there is a short biographical account of the man, giving dates and places, telling what he was like both in the laboratory and at home. Thus for Emil Fischer, who got the prize in 1902, the presentation speech occupies four pages, his lecture on "syntheses in the purine group and sugars" gets fifteen, and the biography four.

The three British prizemen in the book are Ramsay, Rutherford and Soddy. Ramsay's lecture was, of course, on the rare gases of the atmosphere; Rutherford's was on the chemical nature of the alpha particles from radioactive substances, and Soddy's on the origins of the conception of isotopes. It would be presumed on an occasion like a Nobel prize-giving that the recipient would have done his homework well, and certainly with these three, and, indeed, with most of the others too, this is true. Although these lectures are of chemistry in a bygone day, they still make excellent reading. If one was awarding marks one would, I think, give the highest to Soddy, whose fully documented account of the work on the elements he named isotopes, in which he himself took a hand, is a model of scientific exposition. Several of the organic lectures run this one close.

The reader misses one thing: photographs of the prizewinners. The book has a few photographs and diagrams, but it would have been improved if the reader of today might see or see afresh what these Olympians were like. They were great men. They raised chemistry from an almost pre-natal sleep to a healthy and wonderful adolescence. It is meet in a work like this, which tells us so much about them, that we should be reminded of what they looked like. The excellent paper of the book could take photographs directly, thus avoiding the special insertion of photographs required by some books. And, at the price asked for this handsome and carefully edited volume, this request is not churlish. A. S. RUSSELL