childhood, if the individual has been favored by fortune, he exercises and develops more or less extensively the primitive instincts and modes of the race in a free out-door life, and the result is so much mind-stuff to be dissolved and transformed with more or less coercion and under more or less constraint into a mind of the twentieth-century type. The period during which a young man is receiving his scientific and professional training is indeed analogous in many respects to the period of complete reorganization of bodily structure, and in the other we have a reorganization no less complete of mental structure; in the one the reorganization is wholly dependent upon and determined by internal energies, but in the other the reorganization is largely dependent upon and determined by external constraint.

It is a remarkable thing this changing of men into bees and butterflies! and the operation is indeed severe. But perhaps the most remarkable thing about it is that it is elective in particular, but apparently in our day a dire necessity in general, somewhat like the curious transformation of the axolotl, which lives always and reproduces his kind as a tadpole unless a stress of dry weather annihilates his watery world when he lops off his tasseled gills, develops a pair of lungs and embarks on a new mode of life on land.

A severe operation! And usually for the individual a change, like that of the axolotl, from a fluid world to a rigid one! I remember as a boy a sharp contest in my own mind between an extremely vivid sense of things physical and the constraining function of precise ideas. This contest is perennial, but it is not by any means a one-sided contest between mere crudity and refinement, for refinement ignores many things. Indeed precise ideas not only help to form our sense of the world in which we live, but they tend to inhibit sense as well, and a world in which their rule is unchallenged becomes indeed a dry and rigid world.

Every student should realize two things in connection with his science study; the first is that the study of the physical sciences is exacting beyond all compromise, involving as it does a degree of coercion and constraint which it is beyond the power of any teacher greatly to mitigate; and the second is that the completest science stands abashed before the infinitely complicated and fluid array of phenomena of the material world, except only in the assurance which its method gives. And both of these things are obscured by books like "Scientific Ideas of To-day," books that know nothing of exacting constraint nor ever stand abashed. The attempt to set forth in an easily plausible style the conceptual structure of modern physical science is one of the most troublesome perversions with which one has to deal in the attempt to contribute towards the solution of what is to be perhaps the greatest problem of the twentieth century, namely, the making available to all men of the simpler phases of the logical structure of the sciences in order to give to all men some measure of that clear insight into nature which contributes so greatly to the ordering of one's daily life.

W. S. FRANKLIN

LEHIGH UNIVERSITY

Normentafel zur Entwicklungsgeschichte des Menschen. By FRANZ KEIBEL and CURT ELZE. 4to, 314 pp., 6 pls., and numerous text figs. Jena, Gustav Fischer. 1908.

This eighth volume in Professor Keibel's series of "Normentafeln" is much larger than any of its predecessors, thus reflecting the special interest which mankind takes in human embryology. Like the earlier numbers it consists essentially of a tabular description of embryos, with plates showing their external form, and a classified bibliography. The titles of papers relating to human embryology occupy 150 quarto pages, and yet, of the publications dealing with malformations, only the more comprehensive have been included. The bibliography is so thorough and useful that it renders this "Normentafel" indispensable to every student of vertebrate embryology. The plates are excellent, and show embryos from 1.17 to 24 mm. in length, seen in several positions. The text figures include numerous single sections, and several partial reconstructions of the embryos described. A

complete series of graphic reconstructions would seem to justify the great amount of labor which it requires, and, at the reviewer's suggestion, Mr. R. E. Scammon is preparing such a series for the "Normentafel" of *Squalus acanthias*. In the Harvard Laboratory some progress has been made toward such a series for the pig. This plan has been partly carried out in the "Normentafel" for man, thus adding materially to its value. The text figures accompany the brief descriptions of the various embryos, which precede the tables.

In addition to the descriptions, tables, plates and bibliography, there are three general discussions of great interest. The first (pp. 7–14) is a critical account of the youngest known human embryos. There has been something hardly scientific in the attempt to obtain the "youngest yet known"—in the description of specimens "excessivement jeune," and in monographs on fragments and pathological debris. Keibel's review shows that the two pages written by von Spee, included in Peters's monograph of 143 pages dealing with a single specimen, is at present the most illuminating account of the youngest human embryo. A reconstruction of this specimen, made by Keibel, is described briefly. From the study of Peters's, von Spee's and Keibel's youngest specimens it is inferred that the cavities of the human amnion, yolk-sac and extra-embryonic cœlom arise as clefts in solid masses of cells; their development is illustrated in a series of diagrams. An amniotic duct, such as is indicated in Eternod's familiar model, is not found in the younger specimens, and in these there is no neurenteric canal.

The second general chapter (pp. 80–89) includes a comparison of human embryos with those of apes and *Tarsius*. It is found that the youngest stages of man and the apes are very similar, but that they differ materially from *Tarsius* at a corresponding stage. Although the human embryo is very much like that of an orang, "a glance is sufficient to distinguish it from any other well-known form." In this chapter it is stated that the bend in the back of human embryos, such as is seen in the reproductions of the His models found in most laboratories, is abnormal.

The third section (pp. 152–162) is a comparative embryological study of various structures, based upon the preceding numbers of the "Normentafeln." Thus it is stated that the allantois in man and the apes develops very early, before segments have formed. In *Tarsius* also it arises before there are any segments, but later than in man and the apes. It first appears in pigs of four to five pairs of segments, in rabbits of about eleven pairs and in chicks of more than twenty pairs. Similar comparisons are made for the lungs, pancreas, thyreoid gland, etc. A foundation is thus laid for future work in comparative embryology which shall be more accurate and detailed than anything yet realized.

It may be noted that in two human specimens, a fifth pair of pharyngeal pouches was identified, in one case reaching the ectoderm. Fox's recent studies of the pig, cat and rabbit have failed to show a fifth pouch, but Tandler declares that its presence in man is not a morphological speculation—it is an established fact. This question is clearly one which requires further study. In fact the great value of this "Normentafel" is the stimulus and aid which it affords to further research. The need of early human embryos is emphasized. The omission of any account of the muscular and lymphatic systems is conspicuous. But the great progress which has been recently made in human embryology has been compactly recorded. The work is of the utmost practical value, and in a recent discriminating review it has been described as a "masterpiece of scientific effort." It is the only comprehensive account of strictly human embryology which is now available.

Frederic T. Lewis

SPECIAL ARTICLES

NOTICE OF TWO NEW HORIZONS FOR MARINE FOSSILS IN WESTERN PENNSYLVANIA

Since the time of the second geological survey of Pennsylvania it has been generally accepted that there are three horizons at which marine fossils may be found in the Conemaugh series of western Pennsylvania. The oldest of these is the Brush Creek limestone, about