

## GLOSSARY

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**Aggregation:** May refer both to assemblies that “come together” and to assemblies that “stay together” due to internal division of labor, but only the obligation to stay together is a diagnostic feature of a grade transition, or MTE. The compositional units of aggregations that come together remain largely or completely homogenous, and as Huxley put it “nothing homogeneous can be an individual” (p. 7). The implication is that coming together enhances individuality rather little, and thus precludes the possibility of evolving into organismal wholes of higher-level unity (pp. 7–8).

**Bacteria:** Technological limitations prevented Huxley from differentiating between prokaryotic and eukaryotic unicellular organisms. Nevertheless, he was aware that bacteria have short generation times (pp. 25–26), are able to fix nitrogen (p. 129n5), possess “granules” that perform hereditary and assimilatory functions in the absence of a nucleus (p. 45), are asexual (p. 54), decay organic matter (p. 95), and likely bear a strong resemblance to the very first cells (pp. 43–44, 129).

**Closure:** A process whereby a boundary is created between organism and environment. Closure promotes environmental independence and enables natural selection to create an internal division of labor within organisms (p. 39). Huxley borrowed this concept from the philosopher Bergson, who infamously advocated the unscientific notion of *élan vital*. Accordingly, some have incorrectly accused Huxley of being a crypto-vitalist, even though he explicitly states that Bergson’s vitalism is controversial (pp. xlv, 45) and can promote naïve inferences (p. 128n7). In Huxley’s hands, closure is fully consistent with neo-Darwinism and the scientific method in general.

**Colony:** An aggregate of cells or multicellular units without internal division of labor, not a true organism. Forming a colony is necessary for achieving a higher level of individuality, but it is not sufficient because irreversible transitions require an internal germ–soma division of labor to evolve (pp. 75–76, 81, 89).

**Community:** A colony where cells or multicellular organisms stay together and have evolved irreversible division of labor. “Community” and “family” are synonyms as they were for Darwin. The parts of a community work for the whole and cannot survive independently (p. 28). Examples include ant colonies (p. 108) and cell colonies such as *Volvax*, which exhibit both germ–soma and within-soma differentiation (p. 80). This term is unrelated to ecological communities. Huxley realized that ecosystem-level communities are not closed, and thus lack individuality in any meaningful sense (p. 95). Note the difference between historical and modern uses of the terms “colony” (no division of labor implied then, division of labor assumed now) and “community” (obligate division of labor as part of secondarily extended family ontogeny implied then, now used only for ecological assemblies that have succession of participating species and individuals, but lack any form of organismal ontogeny).

**Hierarchy:** Grades of individuality are hierarchical in that grade 3 individuals (e.g., an ant colony) are composed of former grade 2 parts (multicellular animals), which in turn are composed of former grade 1 individuals (cells). Huxley uses the term “aggregate differentiation” (p. 48) to describe the hierarchical nestedness of systems that stay together and come to exhibit advanced internal division of labor. He identifies three hierarchical levels as originating by this process: molecules forming aggregates to become closed grade 1 cells, cells forming aggregates to become closed grade 2 multicellular organisms, and aggregates of what he calls “persons” aggregating to become closed grade 3 organisms (pp. 103–104).

**Human condition:** Huxley aims to minimize anthropomorphic bias in his analysis and, accordingly, the human condition is only explored tangentially. Huxley notes that our societies have the potential to advance in organizational complexity, but remain at a low level of individuality due to wasteful operating procedures.

The closure achieved by human cultural and political institutions remains incomplete and porous (pp. 108–109). Accordingly, Huxley seems to indicate that human societies are aggregations of grade 2 persons in the main body of the text. However, he appears to contradict this claim in Appendix A, where human society is listed as a higher organizational level. This tension, and its connection to Huxley's emphasis on the need for promoting harmony in human societies (p. 118), would shape his later career, but hardly affected *The Individual in the Animal Kingdom*.<sup>1</sup>

**Individual:** A closed organic system that is differentiated from its external environment, exhibits self-maintenance, and has an internal division of labor between heterogeneous parts that promote survival of the larger whole by enhancing its performance. Individuals also have adaptive features (pp. 11–12) and possess reproductive capabilities (pp. 20–21). Injury to component parts generally decreases their viability (pp. 36–37, 63). Cooperation of internal parts requires no coercion (p. 70), and the organismal whole is irreversibly more than the sum of the parts (p. 70).

**Organism:** Closely related to “biological individual” insofar as grades of individuality constitute discrete types of organismality. However, these terms are not strictly co-extensive. Individuality functions as a continuous variable, in the sense that more individuality correlates with quantitative increases in independence and heterogeneity of parts (pp. 8–9). In contrast, organismal grades are discrete, and include: unicellular (grade 1) and obligately multicellular organisms (grade 2), as well as individually or “person”-differentiated colonies (grade 3) (pp. 47, 91, 105, 117). Transitions between these grades are synonymous with MTEs.

**Power of choice:** An organism's naturally selected ability to actively influence its fate by gaining independence of the environment. Although specialization to narrow niches can reduce these powers (p. 100), they tend to increase over time within lineages and particularly across hierarchical grades (figure F.2). The modern term “agency” (in the sense of naturally selected behavior) is a close synonym (pp. 4, 116–117).

**Protoplasm:** The complete contents of a cell, consisting of at least three complementary substances: an outer layer (absorption/

protection), chromatin (assimilation/nucleus), and cytoplasm (catabolism) (pp. 44–45). Although sometimes regarded as internally homogenous by others of his era, Huxley was aware that protist cells are, in fact, internally heterogenous (pp. 13, 36–37, 67, 113). Protoplasm is described as self-regulating (p. 13), which implies that the individual wholes of all grades inform and define the functionality of their parts (pp. 73–74).

**Race:** A population of organisms, or sometimes the species as a whole (pp. 13–14). Occasionally used interchangeably with “individual” (p. 15) to indicate that species can be viewed as temporally continuous generations of the same basic type of protoplasm that predictably develops into a specific kind of organism.

**Species:** A set or type of organism that are able to reproduce fertile offspring. Generally used in a modern sense, but Huxley occasionally speaks of species when referring to biological kinds, e.g., of protoplasm (p. 43).

**Teleology:** Huxley accepts a naturalized form of goal directedness (*sensu* modern “teleonomy”) that can be understood as an organism’s adaptive drive to complete tasks (work) that promote survival and reproduction (p. 14). He suggests that understanding adaptation (pp. 43–44, 100) requires an integrated approach that appeals to naturalized teleology, materialism, comparative phylogenetic analyses (pp. 25–26, 38, 64, 117–118), and ontogenetic developmental studies (p. 28). This methodology was later formalized by Niko Tinbergen.<sup>2</sup>

#### NOTES

1. Krishna R. Dronamraju, *If I Am to Be Remembered: The Life and Work of Julian Huxley with Selected Correspondence* (Singapore: World Scientific, 1993).

2. N. Tinbergen, “On Aims and Methods of Ethology,” *Zeitschrift für Tierpsychologie* 20 (1963): 410–433.