PALAEONTOLOGY AND THE NEXT HUNDRED YEARS

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Abstract—Issue of the first number of the Journal of the Palaeontological Society of India provides occasion for a look toward the future. The prediction is made that the palaeontological advances of the next century will match those of the past.

One hundred years ago the idea of a progressive succession of life through time was a novelty, and the grand principles of organic evolution were yet to be formulated. The great bulk of the now known species of ancient and modern organisms was still undescribed, and phylogenetic relationships were but dimly comprehended; palaeogeography and palaeoecology were undeveloped; the science of genetics and its implications were unimagined; and palaeobiochemistry was far in the future.

During this past century perhaps a couple of hundred thousand species of fossils have been described, their phylogeny has been deciphered in broad terms, their biogeographic and stratigraphic distribution has been worked out and applied to the discovery of mineral and fuel resources for the comfort and efficiency of mankind, and a beginning has even been made at understanding the palaeoecologic relationships and significance of the fossil biotas. Without the phylogenetic sequences worked out by palaeontologists for horses, elephants, ammonites, and various other groups of animals and plants, the idea of organic evolution would have taken hold much more slowly and might have been impossible to prove. Had our elders among the present group of palaeontologists not stood up to the once prevailing view among geneticists that all evolution was the result of random and nonselective mutation, we would not yet have the modern synthetic theory of evolution whereby genetic mutations are linked and guided into new morphologic streams by the pressures of natural selection.

What can we do to match the great exploits of the past and how shall we go about it? Wherein can the essential continuing operations of fact gathering and synthesis be improved? What qualifications should the current and future crop of palaeontologists cultivate in order that their shades may walk with honor in the presence of those who gather to celebrate the hundredth anniversary of the Journal here being launched?

It may confidently be expected that the reporting of new basic principles and great new factual findings will be the privilege of some of the superior intellects or lucky individuals now among us or yet to be born. Some will contribute new data and ideas on pre-Cambrian life and the origin of life. Others will help to unravel the palaeontology and stratigraphy of the sea floor and to solve the problems of origin and duration of ocean basins and continents. There are also many simple and useful things that need to be done, and that any observer with ordinary opportunities can do to improve and extend the present palaeontological edifice.

Among the simpler things will always be the essential and honorable task of finding and describing new categories of past life and appraising their relationships. There is also room for improvement in the ancient art of systematics and the refinement or even the gross arrangement of supposed phylogenetic sequences. Linnean nomenclature was based on the concept of world populated by completely discrete, specially created units of life which could be characterized by a series of archtypes. This concept has persisted in practice in the tacit assumption that some special value other than name fixing attaches to the type specimen or specimens and that species are nonintergrading in time as well as in space. Only now, and by no means universally, are palaeontological systematists beginning to acknowledge in practice as well as in philosophy that the primary nomenclatorial problem is the consistent designation of segments or intervals of continuously variable streams that branch and occasionally undergo abrupt shifts of velocity and course but which are everywhere interconnected in some way.

The population concept of the species expresses itself in practice in the formulation of specific definitions based on adequate random population samples and tied in name to a single type specimen that is not considered of greater significance that any other specimen except in its function as the name bearer. Without losing sight of the subjective nature of species or being frightened or repelled by the word statistics, let us remember that all data that serve to express similarities and differences are statistical data. Many of these data can be adequately transmitted in simple phrases and sentences, but others can be stated more meaningfully, as well as more briefly, in terms of graphs and standardized numerical expressions. Nothing should be overlooked which might serve to give more precise expression of morphological similarities and differences in continuously sampled evolving lines. This, correlated with palaeobiogeography and palaeoecology, could lead to far clearer understanding of the processes and patterns through which species, genera, and higher categories arise.

Abandonment of unnecessary jargon and legal procedures, greater attention to more effective ways of presenting and summarizing data and conclusions, and rigorous and imaginative thinking habits are essential in the palaeontology of the future if it is to attract superior students to the discipline and make it feasible for them to achieve a reasonably uncluttered command of the essential data in time to use it in creative studies of their own.

Increasingly refined studies in palaeoecology and palaeobiogeography, made possible by accelerated research in modern systematics and ecology will also give us better reconstructions of past conditions and land-sea relations. They may even serve to emphasize the freely acknowledged but frequently disregarded principle that assemblages of fossils, like the physical features of rocks, are subject to facies variations that may have greater resemblance in time-transgressing associations than with contemporaneous assemblages of ecologically distinctive habitats. In this area of study a constant guard must be maintained to differentiate between assemblages of fossils that lived together (life associations) and those that were brought together after death (death assemblages) and to use each with proper regard to its particular significance.

Biostratigraphic correlation has been plagued by two principal sources of misconception, comparable to the effects of the typological or archetypical concept on systematics. Matching of similar biotal intervals or sequences in isolated sections, and correlation on the basis of so-called index fossils of supposedly undeviating range, both provide opportunity for gross mismatching of recurrent faunal facies, homotaxial equivalents of variant age, and time units. Misapplication of the intrinsically valid but sometimes overworked concepts of reworking and downward stratigraphic leaking can produce consistent but dubious results—and consistent error may go undetected in the absence of persistently objective checks. Only careful lateral tracing and study of reasonably well exposed associated strata can show conclusively whether or not fossil assemblages or rocks are transgressing time, or are out of place, and any conclusion based on less should state its limitations. Matching of currently understood terminal ranges of groups of fossils, with due regard to facies variations, the limits of accuracy in identification of materials studied, and the possibility of extended ranges is the proper basis of proximate biostratigraphic correlation— anything less is subject to broad reservations.

The search for more precise placement at both ends of the time scale, and for more accurate means of interregional correlation, has led on the one hand to continued development of isotopic-ratio methods and on the other hand to an emphasis on pelagic and planktonic elements of the biota in correlation. At opposite ends of the organic spectrum are the fossil cetaceans and the planktonic protists—the latter including many Foraminifera, Radiolaria, diatoms, coccoliths, and discoasters. With the new facility of study provided by the phase and electron microscopes, and the growing interest in oceanic stratigraphy, we may confidently expect increasing emphasis on studies of the planktonic micro-organisms, more refined interregional and local correlation, and even the discovery of previously unknown groups of microfossils.

Healthy dissatisfaction with dogmatically stated first principles and curiosity about the great events of organic evolution that preceded the elaboration of multicellular animal life are leading to increased interest in life origins and in palaeobiochemistry. We would now like to know within what limits conclusions based on analogy with similar living forms are biochemically valid, and to learn enough about the distribution of biochemical synthesis in time to warrant an opinion as to whether biochemical evolution is satisfactorily mirrored by the sequence of morphological events. Through collaborative research, calling on the best in all pertinent disciplines, we may yet discover the facts that will permit less highly speculative concepts of the nature and origin of life, of its time and place of origin, and of the events that necessarily intervened between the appearance of the first self-duplicating entity and the origin of a multicellular form of animal life capable of preservation as a fossil.

These are some of the things we may try to do in the next hundred years. None can say what our efforts will yield, but if we do our best and seek the help of allied disciplines to rectify our limitations and provide fruitful new avenues of investigation we may expect great things. With dedication, industry, and constancy of effort toward well-formulated objectives any of us can contribute much of value. It is a rare individual who uses his resources to full capacity, and the inspired and candid man of modest capacity may make a richer contribution to science and civilization than the genius who lacks a goal or a plan for reaching it or who underrates the little victories that make the big ones possible.