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The American Midland Naturalist: The Life History of a Journal

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ABSTRACT.—The nature of natural history as represented in the *American Midland Naturalist* has changed during its eight decades of publication. Although subject matter became increasingly diverse, the emphasis shifted from taxonomic and distributional studies to ecology. Geographic coverage extended beyond the American midlands, generations of authors came and went and the titles and terminology illustrate the changing face of natural history. Changes in length of articles, sources of funding and questions addressed are evident.

THE NATURE OF NATURAL HISTORY

The terms nature, natural, naturalist, natural philosophy and natural history have long, circuitous histories, and various connotations, extending to Aristotle and likely beyond (Beebe, 1944; Sears, 1944; Hausman, 1975; Lyon and Sloan, 1981). In the classical tradition the nature of something involved its essential or distinguishing characters—in later taxonomic parlance its diagnostic characters. Natural history developed as the recognition and description of objects and phenomena in the material world. Sometimes even unreal objects and phenomena, such as unicorns, griffons and plants producing animal offspring, were incorporated in early volumes of natural history. Less fanciful organisms were often recognized by subsequent generations of naturalists as new species, later to be relegated to synonymy but similarly complicating the work of natural history. Compilations of natural history, such as those of Pliny in the 2nd century A.D. and Buffon in the 18th century A.D., were among the more monumental of many efforts to catalogue the constantly expanding information on natural products of the earth and living organisms. There were 4206 natural history books published in Britain alone between 1495 and 1900 (Freeman, 1980) and 2390 printed in America between 1609 and 1860 (Tucher, 1985). The first "pinnacle" of natural history was Linnaeus in the 18th century (Hull, 1988). History, in the sense of natural history, connotes information or inquiry about the object; and naturalists through most of recorded history were occupied in describing and cataloguing rocks, animals, plants and even fossils, with limited concern for chronological relations. In the 18th century, some naturalists turned to consideration of the history of nature, adding to the description of nature a search for historical understanding of change in the earth and its creatures (Lyon and Sloan, 1981; Browne, 1983; Rehbock, 1983).

According to Lyon and Sloan, this transformation, manifest in Buffon's *Histoire Naturelle, Générale et Particulière,* marked a scientific revolution and provided the root of 19th century

biology, particularly modern evolutionary biology, biogeography and ecology. Browne's apt phrase "the secular ark" reflects the change in the 19th century from natural theology explanations of the earth and its organisms to secular naturalistic interpretations. Rehbock and Lyon and Sloan noted the change in the 19th century from description to a search for natural laws and generalizations which turned traditional natural history, in part, into the science of biology. This was described by Cannon (1978) as "Humboldtian science"—"the accurate, measured study of widespread but interconnected real phenomena in order to find a definite law and a dynamical cause." Cannon, and other historians (Nicolson, 1983), see Alexander von Humboldt as the initiator of a new approach to natural history and a stimulus to many 19th century naturalists, among them Charles Darwin. The search for natural laws, according to Paul Sears (1944), remade the natural historian into a natural philosopher. One element of the difference between 18th and 19th century natural history is seen in Buffon's comment, representing the earlier tradition, that natural history almost always was a subject "too complicated to allow the advantageous application of calculation and measurement" (Lyon and Sloan, 1981) in contrast to Humboldt's insistence on measuring and mathematics as keys to transforming natural history studies into studies of history of nature (Rehbock, 1983). Disagreement about the merits of measurement and calculation for natural history persists to the present in some considerations of natural history and its descendants.

Coleman (1977), in his history of 19th century biology, noted the dramatic rise of experimental biology; but natural history, although sometimes ignored or even decried as mere description, akin to stamp collecting, also flourished (Sears, 1944; Hanley, 1977; Farber, 1982). Natural history collections and surveys of geological strata, fossils, floras and faunas were widespread in the 18th century and proliferated in the 19th and 20th centuries as specialization among biologists increased, new regions of the earth were discovered and examined, often for economic purposes, and as neglected taxa of organisms other than vascular plants, birds, mammals, fishes and conspicuous invertebrates were studied. The immensity and complexity of the subject, noted by Buffon, continues to occupy the attention of many biologists, and recently fears have been expressed that very large numbers of things of interest to natural history will disappear even before they can be recorded. Concern about biological diversity, a key component of natural history, is even expressed in the halls of Congress and in the nonscientific media. The significance of natural history to "modern" biology, which sometimes excludes it, is urged in recent articles (Bartholomew, 1986; Thomson, 1989; Wilson, 1989). All stress the importance of aspects of traditional natural history in posing significant and continuing questions that were not outmoded by the rise of experimental biology in the 19th century or by molecular biology in the 20th century. Bartholomew described the study of organisms as the touchstone of natural history and biology, focussing on organisms in natural conditions often in the framework of diverse specialties of contemporary biology, notably taxonomy, systematics, evolution, biogeography, population biology, comparative physiology, paleontology and ecology. Wilson described systematics as key to the future of biology.

During the 19th century naturalists, in Britain and America, produced myriads of works of natural history about various taxa, geographical regions and habitats; local and regional natural history societies were ubiquitous and naturalist journals of various scientific content and merit were published. Some 20 journals were founded between 1810–1875 that included nature, natural or naturalist in the title. Another 20 were added from 1876–1900. Most were short-lived (Dexter, 1976). Journals of botany, entomology, conchology, ornithology, geology and paleontology were founded catering to more specialized interests. Some natural history journals, then as now, were mixed literary and scientific publications, often appealing to popular, rather than scientific interest in nature, at worst containing what Brown (1921)

described as "childish prattle." Brown described the development of nature writing from "pure aesthetic delight" to "a combination of the aesthetic and the economic, the artistic and real, the scientific and poetic." Naturalists and natural history writing still range over that gamut of motivations and there are worthy, and widely read, successors to such elegant expositors of natural history as Gilbert White, Henry Thoreau, John Muir and John Burroughs. The pursuit of the scientific goal need not, as is sometimes suggested, remove natural history entirely from the realm of the aesthetic but it is not appropriate to conflate all aesthetic or appreciative writing about natural history phenomena with scientific studies thereof. It must, unfortunately, be conceded that few scientific publications on natural history rate high as works of literature. Some journals bearing the name nature or naturalist were and are major scientific publications. *The Naturalist* was published in Britain beginning in 1864 and the *American Naturalist* began publication in 1867, a very different journal from its present descendant sponsored by the American Society of Naturalists, also very different from its 19th century ancestral society. The major journal of the British Association for the Advancement of Science began publishing in 1869 and is still published as *Nature*. Natural history is perpetuated in the names of numerous museums that continue to house the great collections which are the basis of our understanding of biological diversity, a term that has recently caught the fancy of conservationists, politicians and a new breed of environmentalist—deep ecologists. However, in addition to providing the substance, expertise and source of training for natural history, researchers in the natural history museums continue to pursue the significant questions of nature that motivated their founding (Thomson, 1989; Wilson, 1989).

In spite of the sometimes sniffy comments about natural history and naturalists as being simply descriptive and unscientific, natural history was described by Ernst Mayr, in *The Growth of Biological Thought* (1982), as one of the most fertile and original branches of biology that not only filled herbaria, museums and libraries but also provided the cornerstones of biogeography, evolutionary biology, ecology and behavior and essential observations positing questions still addressed by so-called "modern biologists" (Sears, 1944; Bartholomew, 1986; Thomson, 1989; Wilson, 1989). Naturalists have addressed, in various proportions, all the six classes of question recorded in the old saying, "Six honest serving men have I. Their names are who, what and where, when and how and why." Traditional naturalists addressed "what" questions first, demonstrating the existence of and describing the observable attributes of the phenomenon or object of interest. "Where" was the next most frequent question as surveys of biogeographical distribution and habitat characteristics became widespread. "When" was the issue of paleontology, as well as biogeography, and came especially to the fore in the context of evolutionary concerns in the 18th and 19th centuries. "How" was addressed in the concerns of anatomy, morphology and physiology, especially in the context of evolutionary thought. "Who" and "why" questions were less frequently, or at least less profitably, addressed. After the concerns of natural theology were largely omitted from natural history, the major "who" questions were usually, and sometimes acrimoniously, about priority—"who" was first? Priority, real or contrived, often produced fame via eponym. "Why" was sometimes encountered but the answers tended to be somewhat speculative and teleology was a constant hazard. However, "why" questions concerning the goal-directed activities of living organisms are appropriately asked about teleonomic processes (Mayr, 1982).

The New Natural History

Answers to questions posed by natural historians and studied by generations of naturalists, often under a variety of names appropriate to new biological specialties, are still sought in diverse ways. One of the name changes became modestly familiar early in the 20th century.

C. C. Adams (1917) hailed "The new natural history—ecology"; and Charles Elton (1927) described ecology as "scientific natural history." Both men saw ecologists as card-carrying naturalists focussing on organisms in the field but bringing to bear on their studies the "training, methods, facts and ideals of various fields" of 19th century biology and physical sciences (Adams, 1917). The honorable name, naturalist, was less frequently used in academic and other professional, scientific circles in part, no doubt, because jobs for naturalists were scarce and other titles had acquired greater prestige. Naturalist studies were sometimes contrasted unfavorably with the new experimental, laboratory physiology (Coleman, 1977). Naturalist, except for special cases like park naturalist, commonly came to mean the nonspecialist amateur, sometimes in the pejorative sense of "dickie-bird watcher." Nevertheless, the name persisted with various modifiers in a variety of scientific institutions and publications commonly involving taxonomy and systematics, biogeography, evolution, morphology, physiology and ecology in their 20th century guises. The continuing concern of naturalists in the 20th century is understanding organisms in their "natural" habitats, be they field or urban, in their interaction with other organisms and in the context of history in the sense of temporal processes such as succession, dispersal and evolution.

Journals bearing the words nature, naturalist or natural history in their titles were and are a diverse lot. They have been swamped in the multiplication of journals in recent decades and have necessarily changed as the concepts of naturalist and biology changed. In the 50th anniversary issue of the *American Midland Naturalist* in 1958, Theodore Just (1958), its second editor (1935–1947), reviewed the meaning of naturalist and the attributes of a naturalist journal. He noted the debt owed earlier, more versatile naturalists, the influence of specialization imposed by more stringent tests of accuracy and the great increase in the volume of publication in the biological sciences. Just quoted Karl P. Schmidt, a well-known animal ecologist and herpetologist at the University of Chicago, as suggesting a "revolution" imminent in natural history in the 1950s: "Control of observation by repetition and experiment and the inculcation of the basically critical attitude will work as great a revolution in natural history as have genetics and statistics in taxonomy."

Some naturalists, or natural history journals, have adapted to these changes by tacitly concentrating on limited aspects of the whole. The *American Naturalist,* for example, now attempts to integrate ecology and genetics with evolutionary biology, emphasizing "sophisticated methodology and innovative theoretical syntheses." The *Journal of Natural History* specializes in systematics with asides in general biology. The *Great Basin Naturalist* includes diverse studies of organisms of Western North America, retaining its regional focus. The *American Midland Naturalist* asserts that it welcomes articles "reporting original research in any field of biological science," but it receives and publishes manuscripts that represent a limited spectrum of current biology. The *American Midland Naturalist* has been propelled in large part by its naturalist tradition and the nature of the manuscripts it receives, from which the editors, over the years, have winnowed varying kinds and proportions of articles for publication. This article examines the "life history" of the *American Midland Naturalist* as it represents natural history evolving over the 80 years since its founding.

THE AMERICAN MIDLAND NATURALIST: FOUNDING AND EARLY DECADES

Notable among the journals bearing the name naturalist is the *American Midland Naturalist* which first appeared in April 1909 as the *Midland Naturalist.* That name had been preempted by a British journal based on the Midlands of Britain, however, so the qualifier, *American,* was added in the fifth issue of Volume 1. The journal was originally described as, "Devoted to Natural History, Primarily that of the Prairie States." The need for such

a journal naturally was justified by the argument that, "The Middle Western States considered geologically, topographically and climatologically, form a great natural province" (Nieuwland, 1909). Various taxa were characteristic of the region, or even restricted to it, defining a faunal and floristic territory that Nieuwland said was "unoccupied journalistically" and he determined to fill the void. Although the journal was designed for regional natural history studies, the initial, and subsequent, editorial announcements stated that studies of "General Morphology, Ecology, Histology, Physiology, Taxonomy and the History of Botany and Zoology, etc., will at all times be welcome. . . ."

This policy was stated by the founder and first editor of the journal, Rev. Julius A. Nieuwland, C.S.C. (1878–1936). Although known primarily for his work in acetylene chemistry and development of synthetic rubber, Nieuwland had a life-long interest in natural history and botany. This had been fortified by work in botany at Catholic University of America with E. L. Greene (1843–1915). Greene was around the turn of the century a major force in western American plant taxonomy and the premier student of the history of botany (McIntosh, 1983). Nieuwland had taken his Ph.D. in chemistry at Catholic University in 1904 but wished he had worked in botany and was professor of botany at the University of Notre Dame from 1904 to 1918. After 1918 he became professor of organic chemistry, although he continued to teach botany in summer courses (Just, 1936; Crovello, 1978).

Nieuwland had diverse interests in botany and natural history. He was principally interested in taxonomy of vascular plants and assembled a considerable herbarium, largely of midwestern plants. Many of these he collected, others were purchased at 10 cents per specimen or by swapping the equivalent in issues of the *American Midland Naturalist.* Nieuwland also studied morphology of lower plants, particularly algae, and organography of higher plants. By means of a substantial business, making and selling botanical slides, he secured funds for purchase of natural history books. Some of the rare classical publications of the early American naturalists, C. S. Rafinesque and J. E. LeConte, were reprinted and offered for sale in the early volumes of the journal.

The first volumes of the *American Midland Naturalist* included numerous articles on the natural history and taxonomic interests of Nieuwland and his associates in biology at Notre Dame, including E. L. Greene, but the journal never became a house organ. Greene had suggested to Nieuwland that he start the journal but that he should keep him, Greene, out of it because of his reputation as a troublemaker in some botanical circles. Greene did, however, published several articles (10) in the journal before his death in 1915, including one on "Certain Aspects of the Species Question" (Greene, 1910) in which he renewed his long-time criticism of Asa Gray and the famous manual bearing his name. In the first volume of the journal, a book notice appeared concerning the first volume of Greene's history of botany which traced the history of botany from Theophrastus in the 3rd century B.C. to the 16th century A.D. The second volume of Greene's work languished in manuscript until it was finally published in 1983 (Egerton, 1983). Nieuwland joined Greene in his interest in history of botany and his preference for pre-Linnean nomenclature. He wrote in Volume 2, "were the scientists of today better acquainted with the works of the distant past, less time would be lost in discovering things old" (Nieuwland, 1911). Nieuwland published in Volume 1 notes on algal spores, vascular plant names and a floral abnormality. He continued to publish in the journal frequently (74 articles and notes) on traditional topics of natural history, largely vascular plant taxonomy and nomenclature, until 1918 when he turned his attention largely to chemistry. After 1918 he published only four botanical articles until his death in 1936. However, he continued as editor of the *American Midland Naturalist* until Volume 15, 1934.

The traditional natural history tenor of the journal in its early years was evident in many of the titles. These frequently began as "Botanical gleanings of," "Notes on," "The flora" or "The fauna" of, "A new," "Studies of," "Description of" or "Observations on" or, even more inclusively, "The natural history of" or "The biology of." Such articles followed in the tradition of accumulating the raw material of natural history or the answers to "what" and "where" questions—the classical biological survey being a familiar example. Articles on the taxonomy and natural history of higher plants dominated the early volumes supplemented by a rapidly decreasing number of articles about birds and a smaller but stable number of articles about invertebrate animals, particularly clams (Table 1). Many of these early articles were very short notes of casual or anecdotal observations. The more aesthetic or speculative aspects of natural history were addressed in relatively numerous essays, published in the early decades, which then decreased. Poetry, a mainstay of some naturalist publications, was rare. A single excerpt appeared in Volume 10 (p. 174) of a poem by Edward Hitchcock, "The Sandstone Bird," concerning a geologist examining footprints of a fossil bird, that had been written in the heat of debates concerning Genesis and geology in the early 1800s.

Articles in the journal during the editorship of its founder clearly fulfilled his hope of providing a publication outlet for natural history of the American midlands. They ran to lists of species or habitat descriptions from various regions, new species, new locations for old species and comments on nomenclature, a topic of interest to Nieuwland and his mentor, Greene. They were among the leading proponents of unrestricted use of pre-Linnean names, then fighting a rearguard action. This is evident in several articles on botanical nomenclature and many new plant names proposed that do not persist in recent taxonomic literature.

Early articles on birds by Brother Alphonsus Sweet, C.S.C., were traditional notes on observations and lists of birds seen, but some included dates of sightings which suggested an incipient interest in phenology. In Volume 1, Walter L. Hahn (1910) offered "An Analytic Study of Faunal Changes in Indiana" which noted changes in "ecological groups" as some increased and others decreased. Hahn provided maps of introduced insect species representing fast and slow dispersal and offered a summary of reasons for the population changes recorded. Although, like most natural history publications of the era, the article lacked numbers, Hahn was probing the nature of, and reasons for, numerical change in populations and their distribution, a subject to become a classic concern of ecology. Both Nieuwland and Greene referred to ecology of plants in articles in Volume 2. Nieuwland (1911) discussed the difficult problems of phenotypic change caused by environment and attendant taxonomic difficulties. He also lamented that "modern ecology" was learning again the discoveries of previous botanists, such as John Ray, because ecologists were ignorant of the older works. E. L. Greene (1913) noted the cost of a life devoted to natural history. In a joint obituary of two brothers, John and Thomas Howell, Greene commented that one turned from natural history and at his death "left his family in comfortable circumstances." The other stayed with botany and collecting and "died penniless," suggesting an obvious moral.

The subject matter and geographic spread of the journal soon expanded beyond the midlands. Articles appeared on birds of Washington, D.C., and plants of Alabama, Long Island and even Brooklyn. In Volume 8, 1922–1923, Nieuwland added two associate editors, the first of many to serve the journal well. They were geologist-paleontologist Carroll Lane Fenton, first at Michigan then at the University of Chicago, and zoologist N. M. Grier, first at Washington and Jefferson College, and subsequently at Dartmouth College and Elizabethtown College, N.J. In Volume 12, 1930, Francis Wenninger, C.S.C., Nieuwland's colleague at Notre Dame, was added as associate editor for general biology, later switching

to zoology and invertebrate zoology, and W. H. Bucher was added for geology, C. L. Fenton retaining paleontology. Bucher and geology as a special category lasted only one year, however, and geology did not persist as a component of the journal. These advisors both supplied and attracted new types of articles to the journal. Grier published numerous articles on clams and in Volume 8, 1922, an extended survey report on mussels of the upper Mississippi River including extensive data tables, an attribute not previously frequent in the journal's pages. C. L. Fenton, and later Mildred Fenton, introduced a surge of paleontological articles. Animal paleontology of the Miocene and Pliocene was the dominant class of article in Volumes 11 to 20, reaching a peak in Volume 13, 1932, in which 24 of 31 articles published were on fossils of California, New Jersey, Texas, Alabama, Saskatchewan and Utah, areas well beyond the midlands. Animal paleontology and plant paleontology dropped off rapidly after 1938. Paleontology continued as a small but persistent residue until the present, changing from studies of Miocene and Pliocene fossils to Pleistocene animals and pollen studies.

A number of authors recur in the early volumes. Oliver Atkins Farwell published frequent articles (16) on the botany of Michigan, and Benjamin Franklin Bush published extensively (29) on the flora of Missouri and Oklahoma. Farwell (1931) marked the end of an era of pharmacology with an article on the ferns of the Parke, Davis & Co. Herbarium. It would be a surprise to find a recent employee of Parke, Davis who had need to know one fern from another. The versatility of earlier naturalists was represented by Marcus Ward Lyon, Jr. who first published plant lists of the Indiana Dunes, then notes on ground squirrels and badgers anticipating his 1936 opus on mammals of Indiana. Theodore Just, a plant taxonomist, became assistant editor as of Volume 12, issue 6, 1930.

Volume 12 was the last encompassing 2 years per volume and 12 issues per volume. Beginning with Volume 13, 1932, one volume of six issues was produced per year until Volumes 19 and 20 in 1938 when two volumes per year, each with three issues began, dropping permanently to two issues in Volume 50, 1953. Other changes became evident. Articles in early issues were notably short of citations. A few offered a bibliography or cited limited references in footnotes. After Volume 12, 1930–1931, bibliographies, references or literature cited appeared frequently. Articles became notably longer. Early volumes included many brief, 1–2 page notes; most articles were less than 20 pages. After Volume 13, 1932, although most articles were under 20 pages, longer articles became more frequent, often exceeding 50, or even 100 pages. Just (1958) attributed the appearance of these longer articles to the inability of society-owned journals to publish them. It was clear that more extended surveys and more comprehensive studies of diverse taxa representing various disciplines were appearing in the journal (Table 1). The proliferation of societies and specialty journals had yet to come and the *American Midland Naturalist* was an important outlet for articles now diverted into other journals. The journal also increased substantially in size. The first 10 bound volumes, published over 19 years, measure 12 inches of shelf space, the next 10 volumes, published in 11 years, measure 20 inches of shelf space. The first 12 volumes ranged from 200–250 pages; Volume 13, 1932, was nearly 400 pages and after Volume 18, 1937, the journal usually approximated 800–1000 pages per year, sometimes exceeding 1400 pages in the 1940s. There was, obviously, a ready and growing supply of natural history articles.

Volume 14, 1933, was notable for the inclusion of a collection of articles, sponsored by the U.S. Bureau of Biological Survey, on the "Cave Life of Kentucky" which was also reprinted as a separate volume. It anticipated the later symposium on cavernicoles of the United States and North America (Barr, 1960) and numerous other publications on cave life. An early stage of the transition of natural history, as represented in the journal, from

TABLE 1.—Percent of articles published by taxonomic or disciplinary categories in successive groups of 10 volumes

Volumes Years 19-	1–10 09–27	11–20 28–38	21–30 39–43	31–40 44–48	41–50 49–53	51–60 54–58	61–70 59–63	71–80 64–68	81–90 69–73	91–100 74–78	101–110 79–83	111–120 84–88
Taxon												
Vascular plants	54	30	32	34	25	21	18	19	20	24	31	37
Lower plants												
Algae	2	2	2	4	<1	2	2	1	2	<1	1	<1
Fungi	1	<1	3	2	4	2	4	2	1	<1	<1	<1
Bryophytes	<1	1	1	<1	1	3	1	<1	0	<1	<1	0
Insects	<1	<3	11	12	15	9	13	10	10	13	11	19
Other invertebrates	12	40	24	21	24	31	22	20	19	15	11	7
Fish	<1	<1	4	2	5	5	7	4	9	8	10	7
Reptiles and amphibians	<1	3	7	10	10	9	12	13	8	6	6	5
Birds	27	3	4	5	5	4	5	6	5	5	4	4
Mammals	0	11	9	6	7	11	15	22	22	21	18	16
Multiple taxa	<1	3	2	2	3	3	2	2	3	5	5	4
Discipline												
Systematics/taxonomy												
Plant	34	19	21	22	20	16	12	5	3	1	2	1
Animal	6	17	22	22	25	20	20	14	6	5	4	4
Biogeography	1	3	3	2	3	3	7	5	3	4	2	1
Parasitology	0	7	7	7	11	16	5	5	5	2	2	1
Paleontology												
Plant	1	3	6	2	1	1	1	<1	1	1	1	<1
Animal	2	25	4	2	1	2	<1	2	1	1	<1	<1
Ecology												
Plant	2	6	8	8	6	5	7	9	17	19	26	31
Animal	3	5	8	8	8	8	17	17	27	33	33	38

TABLE 1.—Continued

Volumes Years 19-	1–10 09–27	11–20 28–38	21–30 39–43	31–40 44–48	41–50 49–53	51–60 54–58	61–70 59–63	71–80 64–68	81–90 69–73	91–100 74–78	101–110 79–83	111–120 84–88
Physiology												
Plant	0	<1	<1	0	0	0	<1	3	4	3	2	2
Animal	0	<1	<1	<1	<1	2	4	3	4	1	2	1
Behavior	0	0	2	2	5	2	7	10	6	10	9	5
Limnology	0	<1	2	<1	1	2	1	1	3	3	2	1
Anatomy/ morphology	3	5	3	6	8	4	8	9	4	2	1	2
Technique	3	1	1	2	<1	2	1	3	6	3	2	4
Review/essay	5	2	4	4	2	2	<1	<1	<1	1	<1	0
General biology	39	5	8	10	8	15	7	12	8	11	9	6
Total No. of articles	307	376	430	312	328	307	346	419	602	549	538	494

largely taxonomic and biogeographic articles to more ecological articles is seen in Volume 15, 1934, where the names of Lucy Braun, John Potzger and Stanley Cain appear. Braun was to become a major contributor to plant ecology and the first woman president of the Ecological Society of America. Potzger was just getting his feet wet in bogs anticipating a long series (11) of bog and pollen studies in the journal. Cain switched from morphology of Ericales in 1933 to articles marking a distinct change both in the journal, and the discipline of ecology, by introducing a series of sampling and statistical studies of quadrats in various vegetation types and an early analysis of species-area relations. The traditional nonprofessional naturalist persisted in the work of Rev. Peter Hebert, C.S.C., a classics professor of Notre Dame with botanical interests, who collected and studied plants of northern Indiana and southwest Michigan leaving a legacy of carefully prepared specimens added to the Greene-Nieuwland Herbarium of the University of Notre Dame, and a most useful manuscript on the woody plants of the Notre Dame campus.

THE SECOND 25 YEARS

Volume 15, 1934, marked the end of Father Nieuwland's tenure as editor and, fortuitously, the 25th anniversary of the journal. The 15 volumes produced in its first 25 years included some 6000 pages of diverse aspects of natural history as biology, a bit of geology, a great deal of paleontology and even an article on chemistry. The geographic boundaries had stretched beyond the midlands presaging what was to come. By this time the masthead statement of publishing policy had been modified to read "Contributions on general and midland natural history will be gladly received." In a 25th anniversary comment, Father Nieuwland asserted that the scope of the journal's contribution had realized the broader outlook originally intended and, he noted, a new generation of authors was joining a distinguished assemblage of contributors.

Theodore Just became editor with Volume 16, 1935, and three associate editors were added (John Hobart Hoskins, plant morphology and paleobotany; Remington Kellogg, vertebrate paleontology and zoology; and Marcus Ward Lyon, Jr., mammalogy), reflecting the increased diversity of material published. The journal entered its new era with a long article by Paul Weatherwax of Indiana University on the thorny topic of "The Phylogeny of *Zea mays*" which, even in 1935, had an extended literature and was widely discussed for years after. The midlands terrestrial tradition was extended to include a study of the ecology of a California marine estuary by G. E. McGinitie.

Although studies of taxonomy, systematics and distribution of vascular, especially flowering, plants continued as a major subject during Just's editorship, they became a progressively smaller proportion of articles published (Table 1). Paleontology decreased precipitously. Characterizing the content of the journal then and now is difficult. Categorizing traditional studies of natural history is most familiarly done by taxon. As biological disciplines became more defined in the 20th century, certain articles seem more appropriately categorized by discipline than by taxon. Thus the data of Table 1 are categorized either by taxon or discipline on a rather subjective choice of assigning articles to category depending largely on emphasis, often weighting that of the author of the article as suggested in the title or abstract, *e.g.*, behavior, ecology. It was often difficult to determine where an article should be placed. In the taxon section of Table 1 the choice is clear if only one taxon is represented. If, as commonly was the case in later decades, two or more taxa were represented in an article, the choice was often evident from the emphasis of the author. In a number of articles the interest was clearly in several taxa and this is treated as a separate category. Although not evident in the tabulation, work involving interactions between two taxa, especially a plant and an animal, has become more common in recent decades. Disciplinary categories

of Table 1 are, if anything, even more subjective. Work broadly involving systematics, taxonomy, floristics or faunistics is grouped simply because it is commonly done by persons recognized as taxonomists. Biogeography includes references to regional distribution on a relatively large scale; smaller scale or more local distributions are included with ecology. Articles on life history, population, habitat and interspecies interaction, such as feeding and oviposition, were also categorized as plant or animal ecology depending on the author's emphasis. Numerous articles defied clear-cut categorization and were placed in the limbo of a general category. These included reports on biological properties of organisms sometimes described as "the biology of," or "the natural history of," the organism. Parasitology followed the convention of parasitologists by including animal parasites but not taxa of plants which are also parasitic. Since the size of the journal increased over the years, as noted above, and the length of articles also varied greatly, the absolute contribution of any category of study is not given precisely by raw numbers of articles. Nevertheless, some idea of the changing makeup of the journal may be gained from these figures.

As Nieuwland noted in the 25th anniversary issue, a new generation of contributors was appearing in the *American Midland Naturalist* in the 1930s, including many who were to become prominent in American biology but were then early in their careers. Volume 18, 1937, for example, included articles by E. Raymond Hall, Joseph Ewan, Paul C. Standley, Chapman Grant, C. H. Mueller and Aldo Leopold. These notables are scattered among many less well-known authors. It is impossible to record all of the distinguished contributors to the *American Midland Naturalist* in its second quarter century, but certain groups are distinctive. Important figures in the literature on amphibians and reptiles were W. F. Blair, C. E. Burt, F. R. Cagle, R. Conant, H. S. Fitch, F. R. Livesey, S. A. Minton, Jr. and H. M. Smith. Smith's "Amphibians of Kansas" filled 151 pages of Volume 15, 1934, and Roger Conant's "Reptiles of Ohio" took up 200 pages of Volume 20, 1938. The numerous publications of this group in the *American Midland Naturalist* document studies well beyond the midlands ranging to Fitch's studies in California and Oregon. Also in Volume 20, 1938, G. W. Martin, a distinguished mycologist, was added to the editorial staff. Although Martin remained associated with the journal for many years, fungi never represented more than a minor aspect of the journal. E. A. Chapin, an entomologist, was added as an associate editor in Volume 21, 1939, and articles on entomology became more frequent. Studies of insects were well-represented by C. P. Alexander on taxonomy of craneflies, A. C. Cole, Jr. on ants, L. M. Roth on behavior of mosquitoes and C. D. Michener on diverse taxa. Alexander began collecting craneflies in 1906 and his lifetime desire to recognize 10,000 new species of craneflies was advanced by nearly 200 published in the *American Midland Naturalist.* Roth's finding that sound was the basis of sexual attraction in mosquitoes was a landmark study in insect behavior. M. Carpenter provided extended bibliographies of biographies of entomologists.

Studies of invertebrates other than insects were numerous, and notable contributors were F. C. Baker, famous for his studies of Lake Oneida, R. W. Dexter, H. H. Hobbs, Libbie H. Hyman, H. J. Van Cleave and H. Van der Schalie. Among familiar names in mammal studies were Wm. J. Hamilton, Jr., E. R. Hall, M. W. Lyon, Jr. and P. L. Errington. V. B. Scheffler added diversity with studies of marine mammals reaching to the whales and dolphins of Washington State. The entire first issue of Volume 17, 1936 (385 p.), was taken up by Marcus W. Lyon's "Mammals of Indiana." Lyon was in the classical mode of physician-naturalist. He had worked early in life (1898–1900) as assistant curator in the Division of Mammals of the U.S. National Museum. During this interval he completed studies for the M.S. and subsequently the M.D. in 1902. In 1913 he received the Ph.D. In 1919 he joined the staff of the South Bend (Indiana) Clinic as pathologist. In addition to

his busy career in medicine he collected many plant specimens at the Indiana Dunes and elsewhere, and did extensive studies of mammals. Prior to his death in 1942, he had published some 80 articles in zoology, 55 in medicine and four in botany, along with numerous book reviews, technical reports and newspaper articles.

Although plant ecology constituted a relatively small fraction of papers in the journal in this era, in one issue (Volume 16, No. 4, 1935) it represented trends which suggest the diversity of approach, becoming evident in plant ecology. E. L. Braun produced one of the studies of southeastern forests that were to culminate in her magnum opus on deciduous forest in the mode of F. E. Clements' unitary climax formation. H. S. Conard attempted, unsuccessfully, to promote the methods of European phytosociologists for studying associations of plants. He described well over 100 such on a small area of Long Island, New York but, in spite of his and later efforts by others, these ideas were never widely adopted in America. Stanley Cain continued his studies of forests, emphasizing quantitative methods of sampling and analysis which differed sharply from those of Braun and Conard. Cain contributed significantly to the development of quantitative plant ecology in the United States during the 1930s and 1940s, in part in publications in the *American Midland Naturalist.* The flowering of botany and plant ecology at Butler University in Indianapolis, Indiana, was marked by its own *Butler University Botanical Studies,* as well as contributions to the *American Midland Naturalist* by J. E. Potzer, R. C. Friesner and Cain. H. C. Hansen published several articles on plant paleoecology based on studies from Wisconsin to Washington State and W. T. Penfound added studies of autecology and phytosociology. H. J. Oosting and his students, W. D. Billings and J. F. Reed, represented the distinguished plant ecological tradition beginning at Duke University.

Studies of plant taxonomy, systematics and distribution, although less dominant than earlier, continued as a substantial proportion (ca. 20%–25%) of articles published in the second quarter century. F. A. Barkley, A. Cronquist, L. Croizat, L. Constance, N. C. Fassett, G. N. Jones, D. D. Keck, R. McVaugh, H. N. Moldenke, C. H. Muller, H. W. Rickett, B. C. Tharp, L. H. Shinners and E. T. Wherry are names familiar to students of higher plants. Lyman Benson was represented by several studies of *Ranunculus* before he turned his attention to cacti. G. N. Jones contributed several taxonomic articles and his salty "Reply to M. L. Fernald" (Volume 34, 1935), who had the temerity to adversely criticize Jones' Flora of Illinois under the heading "An Incomplete Flora of Illinois," is a nice example of an older polemical style infrequent in the journal. C. H. Muller, in addition to floristic and vegetation studies of the Southwest, is represented by studies of oak taxonomy. Ferns were represented by R. M. Tryon, Jr., bryophytes in the work of W. C. Steere, A. J. Sharp and R. M. Schuster, fungi by H. C. Greene and W. B. Cooke, lichens by J. W. Thompson and algae by G. W. Prescott and L. H. Tiffany. History and bibliography were represented in several articles by J. Ewan, whose name was to become essentially synonymous with botanical aspects of these subjects. A tradition of parasitology became evident in the 1930s continuing as a significant minority of articles in subsequent decades. A major contributor was J. D. Mizelle who later became the third editor (1947–1953) of the *American Midland Naturalist.* R. Rausch, A. C. Chandler and J. F. Mueller, among others, contributed studies of parasites of diverse hosts.

Volume 21, No. 1, 1939, consisted of contributions of a landmark conference—Plant and Animal Communities—edited by Theodore Just, arranged by Stanley Cain and held at the Biological Laboratory at Cold Spring Harbor from 29 August to 3 September 1938. The conference, later described as "an ecological audit," was an attempt to bridge the gaps between American and European ecologists, plant and animal ecologists and aquatic and terrestrial ecologists. Focussing on the complex community concept, the conference included

very diverse views of community. These ranged from an analysis of the plant association as represented in the phytosociology of the school of Braun-Blaunquet to examination of the climax concept of F. E. Clements, and its even more inclusive extension, the biome, to the third version of H. A. Gleason's "individualistic concept" which essentially cast a plague on both these houses of the unit community by denying its existence. Gleason asserted "a precisely logical classification of communities is not possible" (McIntosh, 1975). Ideas of animal community were similarly various, with G. E. McGinitie emphasizing the importance of species' life histories in marine littoral communities and F. E. Eggleton stressing the interrelations of organisms and environment in freshwater communities as complex but "logical and law-abiding." A. E. Emerson outdid even F. E. Clements in asserting the "superorganism" nature of the community, extending it (*sensu* Clements) to its ontogeny (succession) and phylogeny (evolution). The breadth of the conference was evident in papers by T. Park that related experimental population studies to general ecology and by N. Tinbergen considering behavior and social organization among vertebrates. Integration of population ecology and community ecology, however, was more than a decade ahead and effective linking of behavior with community ecology is even more recent.

The conference was an unprecedented, and largely unsuccessful, effort to bring together diverse strands of ecology under the rubric of community. It anticipated a later Cold Spring Harbor Conference that attempted a synthesis of population ecology but largely served to illustrate views of population regulation as divergent as those of community in the 1938 conference. Both are striking examples of the difficulty of achieving consensus on complex concepts. Although it was described "as the first ambitious stock taking of ecology" (Allee, 1939), publication of the conference proceedings in the *American Midland Naturalist* received equivocal reviews. Allee urged that all ecologists should read it and said it should be repeated. He commented that the success of the conference was due in part to the absence of many pioneer ecologists, who would have simply repeated their earlier ideas, and to the presence of younger and more objective ecologists. Allee also noted the absence of references to statistics, a lack more vehemently stated by Elton (1940) under a heading "Scholasticism in ecology." Elton complained about excessive terminology, although Allee said few speakers became overinvolved in terminology. Elton also deplored the absence of data, although the symposium primarily dealt with conceptual problems. Thomas Park (1939), a participant in the conference, put a better face on it. For Park, just getting all those ecological camels into the same tent was enough. Subsequent lack of coordination among ecologists with different interests makes it clear that the conference was, in fact, a landmark in ecology although it failed of its unifying purpose. Its publication was nevertheless a major contribution of the *American Midland Naturalist* to the literature of ecology.

The social history of the times was represented in Volumes 23–26, 1940–1941, when several articles acknowledged support from the Works Project Administration (WPA), one of President Franklin D. Roosevelt's efforts to cope with the depression. Unheralded in Volume 25, 1941, was the first of three articles by R. L. Lindeman on Cedar Creek Bog to appear in the journal. One was based on his Ph.D. thesis. These provided the data for ideas which he and G. E. Hutchinson synthesized, and Lindeman later published in his posthumous article on the trophic-dynamic aspects of ecology which appeared in the journal *Ecology* in spite of the objections of several prominent limnologists (Cook, 1977). The increasing specialization of biology and breadth of coverage of the journal was evident in additional associate editors. In Volume 28, 1942, J. M. Lindsdale and K. P. Schmidt were added as associate editors of ornithology and ichthyology and herpetology, respectively, bringing the total of associate editors to nine. Volume 30, 1943, was dedicated to Father Nieuwland's mentor in natural history, E. L. Greene, to mark the 100th anniversary of his

birth. It also marked the centenary of the University of Notre Dame. K. W. Cooper was added as associate editor for cytology and genetics. Neither became a prominent part of the journal and the associate editorship disappeared in a few years. It reappeared some years later occupied by T. Dobzhansky, but even his distinguished name failed to attract substantial numbers of studies of genetics to the journal.

The midyears of the journal marked a relatively expansive era of publishing as substantial numbers of natural history articles were reprinted separately. A number of articles were essentially monographic in scope and were reprinted as books to make them more generally available. These included *Cave Life of Kentucky* (1933) edited by V. Bailey; *Mammals of Indiana* (1936) by M. W. Lyons; *Reptiles of Ohio* (1938) by R. Conant; *Plant and Animal Communities* (1939), edited by T. Just; *A Manual of the Liverworts of West Virginia* by N. Ammons (1940), and several works on hepatics by R. Schuster (1949, 1959). A symposium on *Speciation and Raciation in Cavernicoles* was edited by T. Barr (1960). These compendia, some representing decades of work by their authors, stand as baseline sources of information for their respective areas, taxa, habitats and concepts. The more leisurely and ambitious style of older natural history was evident in the continuing incidence of long articles in this era. Between Volume 28, 1942, and Volume 57, 1957, although most articles were less than 10 pages, at least 25 articles exceeded 100 pages. The longest published article in the journal was 427 pages on Boreal Hepaticae by R. Schuster in Volume 49, 1953. Since 1960 no article has exceeded 100 published pages, only about 20 have exceeded 50 pages and reprinting of major articles has ceased as costs burgeoned.

A second new facet of natural history publications of the journal was announced in 1944. A series of monographs was begun with the Argisidae of North America by R. A. Cooley and G. M. Kohls, followed in 1945 by the "Flora of Illinois" by G. N. Jones, and in 1946 by the "Mosquitoes of Southeastern U.S." by S. J. Carpenter, W. W. Middlekauf and R. W. Chamberlain. The "Woody Plants of Western National Parks" by V. L. and H. E. Bailey appeared in 1949 and a "Manual of Mosses of Western Pennsylvania" by O. E. Jennings in 1951. The most notable success of this series was Jones' "Flora of Illinois" which reappeared as new editions in Monographs 5 and 7 and continued in several reprintings of the 3rd edition. For four decades it remained the best seller of the Monograph Series due to widespread use in courses of taxonomy and by naturalists generally. The *American Midland Naturalist Monograph Fund* was kept solvent in large part by receipts from Jones' Flora and continues to the present.

In Volume 34, 1945, the traditional subtitle of the *American Midland Naturalist,* declaring it to be devoted primarily to the natural history of the prairie states, as implied by *Midland,* disappeared. It had long been an anachronism as the reach of the journal greatly exceeded that regional limit even by the 1940s. It is striking that even World War II did not result in any reduction of the volume of publication in the *American Midland Naturalist.* In fact, the number of pages published per year increased from 1942–1945. In four prewar years (1938–1941) the mean number of pages published per year was 1484. In the war years (1942–1945), the mean number was 1596 decreasing slightly to 1552 per year after the war (1946–1949). The war was, however, sadly identified in the journal by several articles later published posthumously. In Volume 45, 1951, M. J. Brunwell's study of animals at Fort Leavenworth, Kansas, was published. He had been injured 7 December 1941 at Pearl Harbor and died 14 December. Others were more fortunate. C. O. Mohr survived to publish in Volume 55, 1956, a study of ectoparasites on rats collected during his military service in New Guinea. The end of the war was celebrated in 1946 at the first postwar meeting of the Botanical Society of America by a Symposium on Paleobotanical Taxonomy ranging from algae to flowering plants. The symposium, published in the *American Midland Naturalist*

Volume 36, 1946, addressed the thorny problem of nomenclature of fossil plants and included familiar names such as W. S. Glock, W. C. Steere and O. Tippo. Another product of the war, DDT, appeared in studies of its effects on wildlife in Volume 42, 1950, and on fish food in Volume 50, 1953, early steps on the trail leading, in 1962, to Rachel Carson's dire warning, *Silent Spring*.

Theodore Just was replaced as editor in Volume 38, 1947, by John D. Mizelle, a parasitologist and the first editor of the journal who was not a botanist. The botanical tradition was, however, continued by G. N. Jones as associate editor for plant taxonomy and A. L. Delisle for plant morphology. In Volume 39, 1948, H. M. Raup became the first associate editor for plant ecology which flourished after World War II, both as a discipline and in the pages of the *American Midland Naturalist*. In the immediate postwar years, studies of higher plants, insects, other invertebrates and mammals dominated the journal (Table 1). Also present were publications by R. E. Gordon and J. A. Tihen who were later to become editors of the journal. Many other new authors appeared who were destined to become prominent in coming decades in diverse fields of an increasingly specialized and professionalized biology which, to some, were distinct from the more relaxed traditions of natural history. Among these were: S. I. Auerbach, L. C. Bliss, J. L. Brooks, W. L. Brown, Jr., H. K. Buechner, J. T. Curtis, R. M. Darnell, C. B. Heiser, Jr., H. W. Levi, G. Petrides and G. W. Prescott, to name only a few. Much of the work published in the years following World War II was the product of theses in a period of rapidly expanding enrollments in colleges and universities. Prewar Volumes 23–26, 1940–1941, had only six of 176 articles described as based on theses. In Volumes 50–57, 1953–1958, 39 of 264 articles were based on theses, 23 of these being Ph.D. dissertations. Publications based on theses are still common in the journal and many young biologists practiced their writing skills in the journal aided by reviewers, associate editors and editor.

Some of the rhetorical fire of earlier years flared up in the discussion of the traditional problem of nomenclature in an article on correct scientific names of a genus of invertebrates (Macklin, 1952):

> It seems apparent if an error is made complete enough and carried through with confidence and provided with sufficient psychological distraction, it may be perpetuated through three quarters of a century in time and the more or less thorough scrutiny of a small army of experts. And that even when the error is obvious and easily demonstrable.

The difficulty of establishing new ideas in natural history was evident in an article by A. Wolfson, Volume 53, 1955, urging the acceptance of continental drift to explain the biogeography of the North American bird fauna, an idea whose time was yet to come.

In 1953 the *American Midland Naturalist* faced a financial crisis. The University of Notre Dame, which had supported it generously since its inception, reduced its support and the journal went from bimonthly to quarterly. Dr. Mizelle, the editor, applied for financial support from foundations, securing letters from many distinguished biologists who were contributors to, or associate editors of, the journal. These letters asserted the widespread significance of the journal for diverse fields of biology particularly as an outlet for longer manuscripts. The journal survived the crisis but its size was reduced from the postwar norms of 1250 to 1500 pages per year to 1024 pages per year in 1954. Several of the letters written in support of the journal lamented the tendency of funding agencies to support research but to fail to support publication and dissemination of the scientific information generated. The postwar proliferation of research funding and publication had yet to produce the now ubiquitous page charges and payment of these from grant funds.

A. L. Schipper, a zoologist, became the fourth editor in 1953 and continued to 1957. He

was followed by a brief interregnum when Volume 59, 1958, was edited by a committee, chaired by G. R. Bernard.

BEGINNING THE SECOND HALF CENTURY

R. E. Gordon, a herptologist, became the fifth editor with Volume 60, 1958, continuing to Volume 72, 1964. Volumes 59 and 60 were the 50th anniversary volumes of the *American Midland Naturalist,* appropriately bound in gold covers. Gordon redesigned the traditional cover giving the journal a new look. He also was active in the new Council of Biology Editors, serving on its board of directors. In contrast to his editorial honors he was described as a "pusillanimous editor" by an irate senior biologist for refusing to publish an article containing allegations about another distinguished and deceased biologist. However, the triumphs and trials of an editor are not the subject of this article.

The increasing diversity of biology was evident in Volume 59, which saw the addition of two new associate editors, D. J. Frey for animal ecology and T. L. Jahn for general physiology. In Volume 60, T. Dobzhansky was installed in a revived associate editorship for cytology and genetics. By this time the diverse subject matter of the journal was represented by 15 associate editors. There have since been some changes in the biological disciplines represented by the associate editors, but the number remained about the same to the present. The general publication policy statement of the *American Midland Naturalist* continued the broad intent of its founder, Father Nieuwland, but added specific types of studies as anticipated by Theodore Just and Karl Schmidt in the 25th anniversary issue:

> The *American Midland Naturalist* is a general biological periodical published quarterly by the University of Notre Dame. It welcomes to its pages articles of a descriptive, analytical and experimental nature. Review articles on topics of current interest in the various fields of Biology are also welcome.

An expressed hope to expand its coverage to plant and animal physiology and the appointment of an associate editor for general physiology resulted in slight increases in physiological articles but these never became prominent in the journal as other journals proliferated as preferred outlets.

The most significant part of the anniversary volumes was a 50-year index of Volumes 1 to 60 compiled and edited by G. R. Bernard. The 60 volumes published from 1909 to 1958 included some 40,000 pages of approximately 2000 articles on extremely diverse studies of natural history and its several descendants in the various biological disciplines represented by the increased number of associate editors. The anniversary, and the index, marked something of a watershed in natural history studies as represented by the *American Midland Naturalist.* This is most evident in comparing the 50-year index for the first 60 volumes with the 20-year index for the next 40 volumes (61–100, 1959–1978) published in 1985. The comparison must be interpreted cautiously as the second index includes about 21,000 pages, about half the number of pages of the first. However, since articles in the latter period did not include the long articles frequent in earlier decades, the number of articles (ca. 1700) is only about 13% less. From 1959–1978 (Volumes 61–100) the modal length of published articles was 6–10 pages. Only 14 articles (<1%) exceeded 50 printed pages, and only 67 articles (<4%) exceeded 30 printed pages. Before 1960 the category of Notes and Discussion containing shorter reports, generally 1–5 pages, had been used sparingly. In Volumes 61–70 (1959–1963) the mean number of articles per year in Notes and Discussion was 3.0, in Volumes 71–80 (1964–1968) it was 9.9, in Volumes 81–90 (1969–1973) it was 26.7, in Volumes 91–100 (1974–1978) 22.9. The number diminished to 13.5 in Volumes 101–110 (1979–1983) and to 8.7 in Volumes 111–120 (1983–1988), and has since remained

low, but the trend to short publications in the 1960s–1970s is evident. No established policy limited length of articles and the longest single article in the journal's history was published in this interval. The nature of natural history and the academic scene following World War II apparently dictated shorter, less ambitious studies differing from the earlier decades of the journal. This may be associated with the increase in articles derived from theses and the work of younger authors pressed to publish rather than decades of work by more established authors.

Perhaps most dramatic is the sharp drop in plant and animal taxonomy and systematics, especially in determination of new species and genera (Tables 1, 2, 3). Even in taxa in which significant numbers of new species appeared in the later index, most of it ceased well before the end of the period indexed (1978). Approximately 75% of new taxa appeared in the first 10 years of the 20-year index, less than 4% in the last 5 years. Taxonomic activity in these several taxa did not cease but certainly it shifted to other, more specialized journals and the *American Midland Naturalist* was no longer a major outlet for publishing new taxa. Another index of the taxonomic interests of naturalists is publication of keys to various taxa. The index of Volumes 1–60 included 74 keys to organisms ranging from adult Amphibia to tribes of grasses. The index of Volumes 61–100 also included 74 keys from adult bats to *Ximenesia* species and subspecies, which suggests that the need for basic identification of organisms of diverse taxa, an essential of natural history studies, continued unabated.

The change in emphasis from description of new taxa and studies of taxonomy and distribution is evident in comparing the distribution of articles by taxon and discipline (Table 1). Articles based on vascular plants were numerous in the first 40 volumes, diminished in the next 40 (41 to 80) then increased progressively to the present. In the early decades most of these were on systematics/taxonomy but these diminished to a small fraction, being replaced by articles on ecology of vascular plants. Lower plant taxa were relatively infrequent throughout. Articles on insects are infrequent in the first 20 volumes but increased in subsequent volumes. Invertebrates other than insects is an enormously varied category. It is high in Volumes 11–20 because paleontological studies, then frequent, were largely of invertebrate taxa. Articles on fish have become more numerous in the last two decades although remaining a small fraction. Reptiles and amphibians, either separately or together, are a regular portion of the journal's articles. Birds have not been represented in large numbers of articles, in all likelihood because of numerous ornithological journals familiar as preferred outlets. Mammals have been increasingly represented in the last three decades, in considerable part as articles on animal ecology and behavior replaced studies of animal systematics and taxonomy. Articles concerning technique have increased in recent decades largely as sampling, modeling or statistical methods. The more speculative review or essay common in Volumes 1–40 has largely disappeared with occasional interesting exceptions such as David Barash's "The Ecologist as Zen Master" in Volume 89, 1973.

Animal and plant ecology have become the dominant disciplinary categories of articles in the last two decades with animal behavior prominent but well behind. In the disciplinary tabulation of Table 1, animal ecology, based on whatever taxa of animals, is more apparent than plant ecology. This accords roughly with the general pattern of taxa used in ecological studies, in essentially the same period, shown by Abrahamson *et al.* (1989). These authors had used *Biosis* disciplinary fields for plant and animal taxa. In their tabulation, plant studies constituted about 45% of ecological studies and animal taxa, collectively, the remaining 55%. The total breadth of taxa represented in the *American Midland Naturalist* is not evident in the gross breakdown. Although vascular plants and vertebrate animals dominated, a few articles on bacteria, more on algae and fungi, and numerous publications on zooplankton and other invertebrate organisms are represented in the journal. The trend is

TABLE 2.—New taxa, or new combinations, of animals cited in two cumulative index volumes. New genera in parentheses

	Vols. 1–60 1909–1958	Vols. 61–100 1959–1978
Protozoa	59	2
Porifera	5	1
Coelenterata	34 (4)	1
Platyhelminthes	222 (13)	75 (4)
Aschelminthes	12	0
Acanthocephala	3	6
Nematoda	0	3 (1)
Annelida	13	3
Brachiopoda	67	0
Bryozoa	1	0
Echinodermata	33	0
Mollusca	81 (14)	0
Crustacea	233 (3)	59
Tardigrada	0	1
Trilobita	9	0
Myriopoda	25	0
Arachnoidea	169 (7)	39
Insecta	706 (19)	119 (3)
Pisces	5	3
Amphibia	2	7 (1)
Reptilia	14	4
Mammalia	52 (5)	4

increasingly from the "what" or "where" questions, essentially taxonomy or distribution, of the first decades of the journal to "when," "how" and even "why," questions in the subsequent decades.

Indices are not an infallible guide to content of a journal or book, being influenced by the idiosyncrasies of the indexer and his or her interests. Nevertheless, comparing the cumulative index of the journal for its first 50 years, 1909–1958 (Volumes 1–60), with that for the next 20 years, 1959–1978 (Volumes 61–100), does indicate some of the changes. The subject index of the earlier index was heavily dominated by taxonomic entries including some redundancy with the index of new genera and species. The subject index of the second index does not include generic or specific names, which are segregated in a separate index, although it does provide categories of higher level taxa, *e.g.,* mammals, insects, amphibians. The subject categories of biological disciplines or phenomena show substantial differences in frequency of occurrence between the earlier and later indices (Table 4). An obvious difference is that most increase in frequency in the later index. Some categories appear in both indices (Table 4A), suggesting that the topic at least was recognized by the compilers of each. The 10-fold increase in entries in activity/behavior of animals parallels the large increase in articles on behavior in recent decades. A similarly large increase in ecology and familiar ecological topics, *e.g.,* food, habitat, life history, population, predation, represents the increase in ecological articles. The increase in the category, taxonomy, most likely represents a difference in the concepts of the indexers in that the earlier index segregates nomenclature and designations of new taxa, whereas the later index lumps them under taxonomy. Only one term, flora, appears substantially less frequently in the second index,

TABLE 3.—New taxa, or new combinations, of plants cited in two cumulative index volumes. New genera in parentheses

	Vols. 1–60 1909–1958	Vols. 61–100 1959–1978
Algae	46 (3)	2
Fungi	74	20 (5)
Lichens	4	0
Bryophytes	11 (4)	34
Lycopsida	20	1
Psilopsida	1	0
Sphenopsida	8 (1)	0
Pteropsida	52 (5)	0
Incertae sedis	13 (1)	0
Spermatophyta		
Gymnosperms	7	0
Angiosperms		
Monocotyledons	57	9
Dicotyledons	725 (9)	31 (1)

which also suggests the diminished emphasis on plants and on "where" questions (Table 4B). Some topics did not differ greatly in frequency (Table 4C). Biogeography/distribution increased but not enough to exceed the arbitrary threefold difference selected for the purpose of Table 4. Cave and community continued as substantial topics of interest in the journal along with the plant ecological categories, phytosociology, succession and vegetation.

The indices also differed in terms that appeared in one but not the other (Table 4D, E). Most such were added in the later index, a reflection of increasing disciplinary specialization and introduction of new topics into the concerns of natural history or, in some cases, an increase in jargon. In general, these reflect a trend to "how" questions and the necessity to pursue in greater detail the phenomena of how organisms work in their natural settings. Several new terms in the later index reflect the change in ecology from "what" or "where" questions of phytosociology or distribution to how, *e.g.*, competition, energetics, nutrients, physiology. Attributes of populations and communities were explored under names not familiar to ecologists in the first half-century of the journal, *e.g.*, biomass, diversity, production. The entry of statistics in the later index extended the pioneer use of descriptive statistics by Stanley Cain, Henry Oosting, Dwight Billings and John Reed into more complex numerical approaches. In the period of the later index more than 40% of published articles used descriptive statistics supplemented by tests of significance and other statistical procedures then becoming increasingly familiar in biology. The widespread use of multivariate methods in numerical taxonomy and ecology was evident in the 1970s and, increasingly, in the 1980s. One hazard of the indiscriminate use of these is the substitution in some articles of factor scores, diversity indices or Eigen vectors for data about organisms. At an extreme, one submitted manuscript supplied axis scores for several multivariate methods with barely a mention of the organisms which they presumably represented.

Another change in the journal is evident in frequencies of citations to geographical areas (Table 4F). The initial descriptor of "Prairie States" of the American midlands became inadequate after the first two decades of the journal's history. References to Indiana did not change appreciably and most other midwestern states increased only moderately in the later index. Western states, especially Arizona, California, Colorado, New Mexico and

TABLE 4.—Numbers of citations of selected terms in the subject indices of two cumulative index volumes

	Volumes 1–60 1909–1958	Volumes 61–100 1959–1978
A. Term appearing in both indices, increasing in the later one >3×		
Activity/behavior	32	332
Anatomy/morphology	37	154
Cytology	4	13
Development	4	25
Dispersal	3	20
Ecology	59	420
Evolution	2	21
Food	16	81
Growth	5	54
Habitat	2	69
Life history	6	79
Periodicity	1	34
Photosynthesis(tic)	1	20
Population	19	120
Predation(or)	2	33
Reproduction(ive)	4	106
Taxonomy	30	169
Technique/method	5	74
Temperature	5	39
Variation	9	66
Zone(al, ation)	3	54
B. Term appearing in both indices, decreasing in the later index		
Flora	97	17
C. Term appearing in similar numbers in both indices (not differing by 3×)		
Biogeography/distribution	52	146
Cave	15	17
Community	17	30
Fauna(l)	22	29
Key	74	75
Natural history	11	4
Phytosociology	13	34
Plankton(phyto, zoo)	14	18
Succession	12	31
Vegetation	22	28
D. Terms appearing in the earlier index in substantial numbers, absent from the later index		
Associations	16	0
List	42	0
Myology	10	0
Nomenclature	20	0
E. Terms absent in the earlier index, present in substantial numbers in the later index		
Adaptation	0	21
Benthos	0	15
Biomass	0	13

TABLE 4.—Continued

	Volumes 1-60 1909-1958	Volumes 61-100 1959-1978
Competition	0	17
Diversity	0	20
Energetics	0	16
Nutrients	0	34
Physiology		
Animal	0	32
Plant	0	34
Production	0	38
Statistics	0	11
Systematics	0	64
Theory	0	9
F. Geographical areas		
Alaska	1	16
Arizona	5	31
California	4	61
Canada	3	14
Central America	5	25
Colorado	4	46
Florida	19	37
Illinois	21	75
Indiana	38	38
Mexico	10	23
Michigan	28	54
Minnesota	15	26
Missouri	22	29
New Mexico	3	15
Ohio	12	18
Oklahoma	16	27
Oregon	3	13
South America	0	18
Texas	21	53
Washington	4	11
Wisconsin	7	35

Slash line indicates that the terms are summed

Oregon, increased substantially. This is likely due to proportionally greater activity in natural history in these states in recent decades. The more cosmopolitan reach of the journal was also evident in increased citations of Canada, South and Central America and, infrequently, places as distant as Australia, Bangladesh, Tanzania and New Zealand. These reflect the increased opportunity of American biologists to travel to exotic places and the increased recognition of the journal by natives of distant places.

The lists of authors similarly changed, surprisingly few authors appearing regularly in both indices. In part this was due to a changing of the guard of natural history as earlier prominent figures turned to different journals or retired, and in part to differences in content of the journal. A few names persisted. R. H. Baker, a well-known mammalogist, published

on food habits of armadillo in 1942 and on reptiles and mammals in Mexico in 1967. Dwight Billings, the dean of American physiological ecologists, published on desert shadscale in 1949 and on carbon dioxide flux from tundra soils in 1975. C. H. Muller published on Mexican plants in 1937, southwestern oaks in 1938, on a grass (*Stipa*) in 1977 and on the effect of oaks in 1982. His is probably the longest time-span of any contributor to the journal. Wm. Steere had an article in the journal in 1934 on bryophytes of Chippewa County, Michigan, reaching to bryophytes of Thule in Greenland in 1975. H. H. Hobbs, Jr. started with new crayfishes in 1941 and continued with new ostracods in 1963.

Although a few authors, noted above, appeared in both indices, most were new in the later index as younger generations of naturalist/biologists appeared in the journal. It is easier to single out names from the earlier index because many of these authors had subsequently achieved sufficient distinction so that their contributions to natural history are now well recognized. In the more recent index some names are more familiar than others but for diverse reasons. Thus, it is somewhat invidious to single out individuals on an assumption of scientific contribution. Some are associated with graduate school days, some are former colleagues, some are students or even students of students. There were some continuing traditions evident in the lists of authors. The contributions to physiological plant ecology of W. D. Billings were continued in his own name and that of his students, E. C. Clebsch, H. A. Mooney, L. C. Bliss, K. M. Peterson and B. R. Strain. The work in plant community ecology of J. T. Curtis was perpetuated in the journal by that of his students, R. Brown, G. Cottam, R. McIntosh, M. Partch, F. Stearns, K. Harper, J. R. Bray, O. Loucks, P. B. Whitford and his students' students, F. C. Goff, P. and J. Zedler, A. Auclair, R. Ream, J. MacMahon, R. Anderson, J. Clausen and, no doubt, others I have missed. The power of the skilled exemplar of natural history and biology is evident in these traditions. The stimuli for interest in natural history and careers in science are varied. One of the most significant is the effective and dedicated teacher. A dramatic example of this is that Stanley Cain, Rexford Daubenmire and W. Dwight Billings, all major contributors to American plant ecology, graduated from Shortridge High School in Indianapolis within a few years of each other. Dwight Billings, who apprised me of this striking coincidence, attributed it to many superlative teachers, notably Rousseau McClellan and Elizabeth Rawls. Cain, Daubenmire and Billings were also influenced by R. C. Friesner, of Butler University, who was a key figure in the development of botany at the University. Friesner was also instrumental in converting John Potzger from piano teacher to plant ecologist and leading student of pollen analysis in its early phases in America. Other natural history traditions are apparent in father and son sequences spanning several decades. J. L. George (1949) is succeeded by Luke George (1987). P. B. Whitford (1969) is followed by a joint publication by P. C. Whitford (the younger) and P. B. Whitford (the elder) in 1978. Thomas and Orlando Park were brothers, both distinguished insect ecologists who published in the journal.

Volume 61, 1959, illustrated the new look in technological trends affecting natural history with an article on the effects of radiation on small mammals, and Volume 72, 1964, contained an article on a radioactive tracer in crayfish. The diversity of areas and taxa appearing in the *American Midland Naturalist* was particularly evident in Volume 70, 1963, which included articles on Pacific whales, Panama tortoises, Australian skinks, Mexican vegetation, an Indian plant, Arizona cottontails and Massachusetts algae. Joseph A. Tihen, a student of amphibians and a paleozoologist, became the journal's sixth editor with Volume 73, 1965, continuing to Volume 82, 1969. Tihen shepherded the journal through an era of large increases in manuscripts and costs of publication requiring stringent editorial standards. The developing emphasis on production inherent in the ecosystem approach to ecology was evident in a study of midges in Volume 76, 1966. In Volume 79, 1968, the associate editorship

for genetics and cytology was reinstituted and associate editorships for comparative physiology of animals and mycology added. None of these ever became well-represented in the journal and they subsequently disappeared from its masthead. The devotion of natural historians to their cause was evident in Volume 86, 1971, when a panel of human tasters was assembled to determine the relative palatibility to predators of tadpoles from Costa Rica.

Much of the new diversity in natural history as represented in the *American Midland Naturalist* was manifest in the new terminology, deplored by some as jargon, evident in later issues. As Professor Harold Hill put it, words like "swell" and "so's your old man" represented the depravity afflicting River City. In the *American Midland Naturalist* the suspect terms allozyme variation, caste-based polyethism, resource partitioning, electrophoretic comparison, trophic dynamics, factor analysis, plant apparency, energy flow and nutrient cycling were thought by some to be debasing traditional natural history. Artificial stream design was introduced, as if real streams were not enough. The mix of old and new in natural history was evident in the titles of articles in this era. "Observations on the natural history of," "Distribution of" and "'Contributions to the flora of" were mingled with articles with titles including "Multivariate assessment of," "An alternative model," "Variation in cellulase activity," "Nitrogen turnover" and "Trophic resource allocation." This somewhat schizophrenic tendency confused traditionalists and modernists alike but represents the increased diversity of approaches to natural history. The old was not entirely displaced, just augmented.

Although space and cost have constrained the volume of publication of the journal, the number of manuscripts submitted increased substantially in the last three decades. Manuscripts received approximated 80 per year in the early 1960s which was barely enough to fill the available pages. Manuscripts received doubled by the late 1960s to about 165 per year. The increase continued another 50% through the early 1970s peaking at 279 manuscripts in 1976 then declined to the present (ca. 175). Acceptance rates necessarily decreased over this interval from ca. 80% in the early 1960s to a low of ca. 40% in the early 1980s, increasing to ca. 40–45% in recent years. Increasingly stringent reviewing and editorial standards made for shorter, less expansive articles and some types of natural history studies were diverted to other journals or perhaps were not published at all. Certainly, Karl Schmidt's assertion that a revolution in natural history was evident in repetition, experiment and a more critical attitude was manifest in the published material. An awkward consequence of the increasing flow of manuscripts, in spite of increased rejection rates and stringent restrictions on length was an increasing backlog of manuscripts awaiting publication. Average time from date of receipt to publication rose from 8 months in the early 1960s to 18–19 months in the late 1970s and only gradually decreased through the 1980s to ca. 1 year. Natural history, at least in its published form, travels slowly which is perhaps characteristic as articles of this type have a long half life.

Volumes 80–81, 1968–1969, included 112 articles. Most (77) were of terrestrial habitats, fewer (27) were about aquatic habitats. Relatively few (13) were experimental studies but over half (61) used statistics of various degrees of sophistication. Two-thirds of these (39) used descriptive statistics and standard measurements, such as means and standard deviations; about one-third (19) used a variety of tests of significance, and a few (3) used more involved statistical methods, usually multivariate methods. Theoretical concerns were represented in a minority (5) of the articles, in the tradition of much natural history. A similar survey of Volumes 104–105, 1980–1981, which included 110 articles, showed that more (30) were experimental studies and, again, about half (49) used statistical methods of diverse types.

Subject matter was diverse as suggested above. In Volumes 104–105, 1980–1981, about 15% of articles considered the effects of various familiar environmental factors (soils, water, fire, nutrients, temperature, logging) on growth or distribution of organisms. Classical natural history or life history studies represented a nearly identical proportion. Studies of spatial distribution (location, aggregation, home range, dispersal) constituted about 10% of studies and a similar fraction dealt with properties of reproduction. Diminishing percentages of studies considered behavior, evolution and genetics, niche and competition, diet and feeding, methods, vegetation and succession, predation, island biogeography, energetics, production, populations, allelochemics, parasites and decomposition. Only a few, less than 2%, concerned systematics or taxonomy and an equally small fraction were clearly applied biology involving the effects of pesticides and heavy metals.

The sources of articles published in the *American Midland Naturalist* in this era were as diverse as the subject matter. Most came as in earlier volumes from academic institutions. A survey of Volumes 80–81, 1968–1969, showed that approximately 64% of authors were from state universities, 16% were at small branches of state universities, state colleges or, less commonly, small private colleges, 14% were at private universities, 6% at state or federal institutions or laboratories, none were at private industrial organizations. The same survey of Volumes 104–105, 1980–1981, produced a similar distribution with a slightly higher proportion (75%) from state universities. Nearly one quarter of the articles (23%) included a student as an author and commonly these were products of thesis work.

The 75th anniversary of the journal occurred in 1983, Volumes 109–110. It was anticipated with a bang on 18 May 1980 when Mount St. Helens exploded in Washington State providing an exciting, if somewhat hazardous, opportunity for natural historians. Later in that same year biologists began a flurry of activity to determine the effects of a wide range of damage on living organisms. The first report of this in the *American Midland Naturalist* appeared in Volume 109 describing 2 years of recovery of subalpine vegetation. A Mexican volcano, Paracutin, had provided the opportunity for an earlier study of posteruption vegetation in Volume 69, 1963. It was followed by a later survey reported in Volume 108, 1982. The lag time at Paracutin was 8 years after eruption of the volcano as compared to a few months following the eruption on Mount St. Helens. The opportunism of natural historians was evident in the many studies on Mount St. Helens, several of which subsequently appeared in the *American Midland Naturalist.* The anniversary issue also marked the elimination of the associate editor for genetics and the addition of one for biological statistics reflecting the increased use of statistics in recent years.

An earlier tradition of essay-review articles, which had largely disappeared from the journal, was continued albeit infrequently. In Volume 110, 1983, Catherine Keever wrote a retrospective view after 35 years, of her pioneer studies of old-field succession. The retrospective approach to earlier developments in limnology appeared in Volume 116, 1986, in an article, "Peter and Paul lakes: a liming experiment revisited." This article considered a pioneer whole-lake study by A. D. Hasler in 1951 that, unfortunately, had not been published in the *American Midland Naturalist.* Other traditional problems were considered in Volume 116 in a review of factors limiting the Kirtland's warbler and a study of recovery of chestnut forests following elimination of chestnut by the chestnut blight. Natural history studies seized on this and other natural catastrophes to place increased emphasis on disturbance or, in more refined circles, perturbation, as a major force in natural history, as the confidence of traditional naturalists and ecologists in stability or equilibrium was shaken.

The early tradition of looking for taxa in different places or for new taxa has not become entirely unfruitful. In Volume 99, 1978, a survey was done of the little studied group,

Tardigrada, in Oklahoma. Prior to 1978 none were known from Oklahoma; the study identified 16 species of tardigrades, two new to North America. In Volume 120, 1988, a few handfuls of soil from various places in New Mexico produced 19 species of tardigrades new to the state and one entirely new species. This is in microcosm the dilemma of disappearing biota from the earth before anyone has looked for them and suggests the opportunities still open even in areas well-known scientifically.

Publishing natural history in the last 80 years has become increasingly costly for both author and publisher. The initial subscription price of the *American Midland Naturalist* in 1909 was $1.00, and authors were favored with 100 free reprints (Fig. 1). Subscription costs increased slowly in the first 50 years reaching only $10 in 1955, while the number of free reprints diminished to zero in 1950. Following the 50th anniversary in 1958, the subscription price increased more rapidly reaching $50 by 1988. The ultimate insult to the author, page charges, appeared in 1966 at a modest $9 per page but increased steadily to $35 per page by the early 1980s where they remain—for the moment. The new, or scientific, natural history costs money both to conduct and to publish and the earlier, more relaxed era is gone, likely forever.

The other side of the coin, figuratively, is that both research and publication of natural history studies are at least modestly and partially supported financially. In the early years of the journal, funding was limited. Most studies were supported out of the authors' own resources. Father Nieuwland paid, in part, for the journal in its early years, by making and selling slides. Some studies were supported by federal or state agencies and some by very modest institutional funds. Acknowledgment of financial support was unusual before the early 1950s when relatively large-scale federal funds from National Institutes of Health (NIH), the Office of Naval Research (ONR) and the National Science Foundation (NSF) were at hand. The earliest acknowledgement of NSF support appeared in Volume 57, 1957. In Volumes 64–65, 1960–1961, 20% of published pages were in articles that acknowledged some source of financial support. Financial support for research published in the *American Midland Naturalist* came from diverse U.S. federal and state agencies, universities, private institutions and a few foreign agencies. Between Volumes 84 and 105 (1970–1981) 36% of articles acknowledging support were funded by the National Science Foundation. Six percent were funded by National Institutes of Health, 6% by the Atomic Energy Commission or its successor Department of Energy, 14% of funding from nine other federal agencies. Thus 62% of acknowledged support came from federal agencies. Universities supplied 23%, state and other public institutions, *e.g.,* museums, 7% and private sources 7%. In only one case was private industrial support acknowledged. This comparative frequency of funding source does not give any indication of the dollars involved or the nature of the research support. It is familiar that the National Science Foundation became the major source of financial support for ecology and systematic studies in the 1960s to 1980s.

It is, however, striking that in this interval only 53% of published articles acknowledged financial support. Nearly half of the work published was done with the authors' own funds or whatever minor support was gleaned from departmental sources. Certain types of natural history studies can be accomplished without large amounts of money, but in many instances the possibilities of the work are constrained by lack of funds. Natural history studies have not been notably blessed by congressional largesse as compared with medical or space studies, in spite of recent concerns about biodiversity.

From the selfish point of view of funding the journal, of the 53% of published articles acknowledging financial support a substantial fraction did not pay page charges to support the cost of publication. Thus the considerable burden of publication costs is not carried by

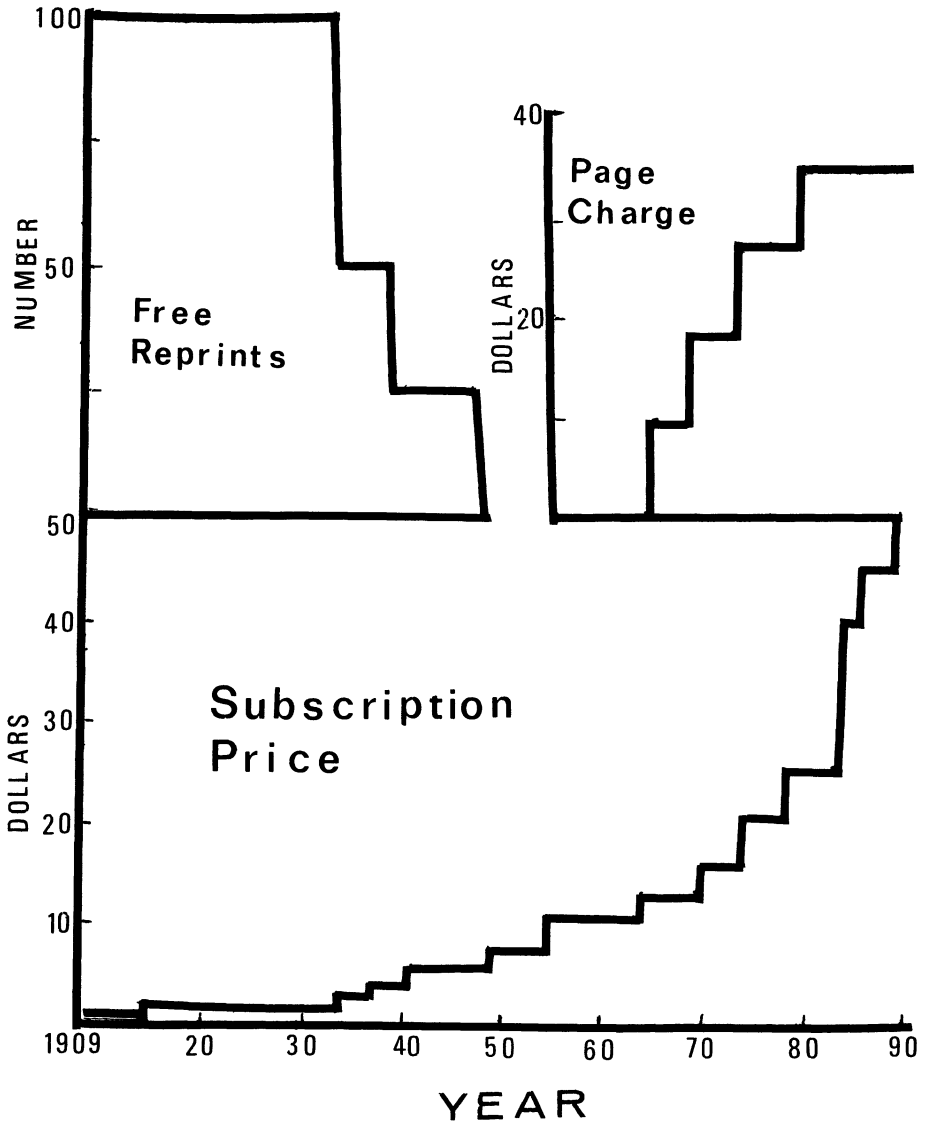

FIG. 1.—Subscription price, free reprints and page charges 1909–1988

the organizations producing the research. Even if the page charge is paid it does not cover the full cost of publication. The balance is derived from subscriptions and the continuing support of the University of Notre Dame for its oldest and best known learned journal.

RETROSPECT AND PROSPECT

In its eight decades of publication the *American Midland Naturalist* has become well-established in the literature of natural history. In an era of increasingly specialized journal publication it remains unusual in, and perhaps suffers from, publishing a wide spectrum

TABLE 5.—Journals in which the *American Midland Naturalist* was cited in 1987

Title	No. of citations	Rank in citing journal
A. Cited 20 or more times		
Ecology	83	14 of 1790
Journal of Mammalogy	74	5 of 1013
Oecologia	63	22 of 2292
Canadian Journal of Zoology	50	37 of 3160
Bulletin Torrey Botanical Club	32	NA
Oikos	31	20 of 1253
American Journal of Botany	28	29 of 1498
Canadian Journal of Botany	28	49 of 2603
Hyrobiologia	28	35 of 2979
Journal of Wildlife Management	25	13 of 1055
Vegetatio	25	9 of 945
Copeia	23	18 of 1171
Animal Behavior	22	37 of 1106
American Naturalist	21	33 of 1347
Herpetologia	20	8 of 468
B. Selected journals representing diverse disciplines that cited it less often but still relatively frequently		
Evolution	16	41 of 1284
Journal of Paleontology	11	38 of 1377
Journal of Parasitology	15	39 of 914
Wilson Bulletin	6	36 of 536
Limnology and Oceanography	6	101 of 939

of biology as evidenced by its 14 associate editors representing as many biological specialties. Its diversity is recognized by high frequency of citation in many and varied scientific journals. The Institute for Scientific Information (ISI) publishes periodic analyses of some 7000 journals based on citation data. The most recent is for 1987. The *American Midland Naturalist* is ranked by ISI along with extremely large general science journals and journals of medicine, biochemistry and various societies. It ranked 1369 of 4023 journals in number of research articles published (101) in 1987, and 868 of 4300 journals in the number of times it was cited. If it were ranked only among its peer journals of biological science, it would be on a quite different scale as most such journals are relatively small. The *American Midland Naturalist* in 1987 was cited 1554 times by 270 journals. It was cited by journals of zoology, botany, freshwater and marine biology, animal behavior, reptiles and amphibians, invertebrates, fish, birds, mammals, evolution and systematics as well as diverse journals of management and applied biology (Table 5).

Reciprocally, the *American Midland Naturalist* cited 2700 articles from 870 journals in 1987. Evidence of the current breadth of interest of its authors is apparent in the large number and wide variety of journals cited. The journals most frequently cited, in order of descending number of articles, were: *Ecology, Oecologia, Journal of Mammalogy, Ecological Monographs, American Naturalist, Evolution, Science, Journal of Ecology, Journal of the American Fisheries Society, Bulletin of the Torrey Botanical Club.*

It is familiar that excellent studies in natural history and its ramifications in systematics, taxonomy, ecology, biogeography, remain useful for extended periods, a trade-off with the highly touted "breakthroughs" which have relatively short half lives. Fifty percent of articles

TABLE 6.—The articles from the *American Midland Naturalist* most frequently cited between 1955–1986 and the year of maximum number of citations

1. Brattstrom, B. H. Body temperature of reptiles. Vol. 73:376–422, 1965.—cited 215 times, max. (17) in 1975.
2. Mohr, C. O. Table of equivalent populations of North American small mammals. Vol. 37:223–249, 1947.—cited 158 times, max. (24) in 1985.
3. Oosting, H. J. An ecological analysis of the plant communities of Piedmont, North Carolina. Vol. 28:1–126, 1942.—cited 133 times, max. (8) in 1975, 77, 83.
4. Roth, L. M. and E. R. Willis. A study of cockroach behavior. Vol. 47:66–129, 1952.—cited 133 times, max. (14) in 1968.
5. Roth, L. M. A study of mosquito behavior. Vol. 40:265–352, 1948.—cited 125 times, max. (20) in 1967.
6. Lloyd, M., J. H. Zarr and J. R. Karr. On the calculation of information theoretical measures of diversity. Vol. 79:257–272, 1968.—cited 115 times, max. (13) in 1976.
7. Cummins, K. W. An evaluation of some techniques for the collection and analysis of benthic samples with special emphasis on lotic waters. Vol. 67:477–504, 1962.—cited 102 times, max. (13) in 1986.
8. Howard, W. E. Innate and environmental dispersal of individual vertebrates. Vol. 63:152–161, 1960.—cited 98 times, max. (8) in 1980, 81, 85, 86.
9. Martin, A. C. The comparative internal morphology of seeds. Vol. 36:513–660, 1946.—cited 94 times, max. (9) in 1971, 83.
10. Nicholson, A. J. The homes and social habits of the wood mouse (*Peromyscus leucopus novelor-acensis*) in southern Michigan. Vol. 25:196–223, 1941.—cited 90 times, max. (9) in 1975.
11. Willson, M. F. and B. J. Rathcke. Adaptive design of the floral display in *Asclepias syriaca* L. Vol. 92:44–57, 1974.—cited 90 times, max. (14) in 1980.

cited in, and from, the *American Midland Naturalist* were over 10 years old. Some articles published in the *American Midland Naturalist* that were most frequently cited from 1955–1986 appeared well before 1955 (Table 6). The average time following publication of these articles to when the maximum number of citations occurred was 21 years and articles published in the 1940s continued to be cited with moderate frequency in the mid-1980s. Frequently cited articles included diverse taxa and subject matter. The most cited article was a study of body temperature of reptiles; the oldest was a study of social habits of small mammals, and the latest to be published was about the adaptation of the floral display of a milkweed plant. The raw number of citations for the most frequently cited articles (90–215) falls at the low end of the range for Citation Classics© of ecology, and the mean number of citations per year (2.9–10.2) is also in the lower range for Citation Classics (McIntosh, 1989). The citation history of these articles shows a substantial lag period, with only a few citations per year in the first years following publication, rising to a peak 6–38 years after publication, and then plateauing or decreasing. It is probable that the increased citations during the 1960s to 1980s of articles published decades earlier is a reflection of the large increase in publication. Nevertheless, some, at least, of the earlier literature has continuing interest in current natural history.

The fate of most natural history articles, like that of scientific publication generally, is to be rarely cited and forgotten. David Hull, in a recent book *Science as a Process* (1988), notes this phenomenon as a characteristic part of science. What makes some articles, like some research groups, disappear with barely a trace is not clear to historians or philosophers of science.

The fate of natural history study is various. Much of it is simply and usefully incorporated into the background lore of natural history and its source is forgotten, a phenomenon termed

"cryptoamnesia" by the sociologist of science, R. Merton (1973). Some is relegated to the limbo of forgotten causes, which was the fate of the early work in the journal advocating unlimited priority for scientific names. There it lies inert unless recovered by historians of science for whom error and lost causes are as much meat for study as success. Many natural history "facts" become irrelevant unless some synthetic or theoretical framework appears that makes a place for them and their authors in the scientific literature. The data from Cedar Bog Lake, published in the *American Midland Naturalist,* Volumes 25–27 (1941–1942), were a substantial part of the basis used by Raymond J. Lindeman in his more famous article bringing together the trophic-dynamic aspects of ecology. Lindeman died before this article was published and made his name familiar to generations of ecologists. In the absence of the synthetic article it is possible that the data of Cedar Bog Lake would have been ignored unless the not unfamiliar phenomenon of multiple discovery in science had led to its use by another author.

An occasional scientific light may flicker intermittently before it finds a favorable atmosphere to sustain it. H. A. Gleason's "individualistic concept" of the community was published three times, the last in the *American Midland Naturalist* in 1939 (McIntosh, 1975). It was substantially ignored until the 1950s when it was rediscovered, widely discussed among plant ecologists and incorporated into most ecology textbooks. Citations of Gleason's previously little-cited articles averaged 4.7/yr in the 1960s, 5.5/yr in the 1970s and 13.5 in the 1980s, reaching a peak of 30 citations in 1987. The citers expanded from plant ecologists to animal community ecologists in the 1970s, in time for Gleason's concept to constrain their ideas about equilibrium community units as it had for plant community ecologists 20 years earlier.

It is not clear that any of these several fates could be predicted for current publications in the *American Midland Naturalist.* If David Hull (1988) is correct about the mechanism of science, the major elements are curiosity, credit and checking. Curiosity has long been the motivation for much natural history study, even of what appears to others to gather worthless data about obscure organisms or unpleasant places. Credit is the second, perhaps less admirable, motivation for scientific study. It is difficult to see why many students of natural history labor as hard as they do on many things when the rewards and kudos are to be gained in other fields or for other activities. Curiosity, or enjoyment, may be the more viable explanation. Nevertheless, credit particularly in the form of priority is sometimes zealously sought by natural scientists. Checking involves scrutiny of work by others, either scientific allies or foes. Inadequate checking, as Hull points out, damages both allies and opponents in the effort to understand nature.

It is clear that much of the detail of natural history has changed in the eight decades of the *American Midland Naturalist.* The primary questions have expanded from "what" and "where" to "how" and even "why." The techniques, equipment and background of knowledge brought to current studies are vastly different from earlier decades. It is not clear that the mechanism has changed all that much. If Hull's mechanism is correct, curiosity is still the major motivation, although in a new age of grantsmanship credit may be a more potent force than earlier. Checking is as crucial as ever and the obligation to provide data, analysis and exposition as clearly as possible to allow effective scrutiny is more marked if only because of the enormous volume of material appearing. The "critical attitude" anticipated by Karl P. Schmidt as the revolutionary force in natural history as imminent in the 1950s must mark the future of the *American Midland Naturalist* and of natural history generally.

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associates in publishing the *American Midland Naturalist* improved both the journal and this manuscript by their thoughtful criticism. These are: Morton S. Fuchs, Arthur W. Ghent, Richard Jensen and Robert K. Rose. Whatever its substantive merits, the manuscript arrived at its present state of legibility only through the unstinting and meticulous efforts of Mrs. Joan Smith. W. D. Billings supplied the information concerning Shortridge High School.

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