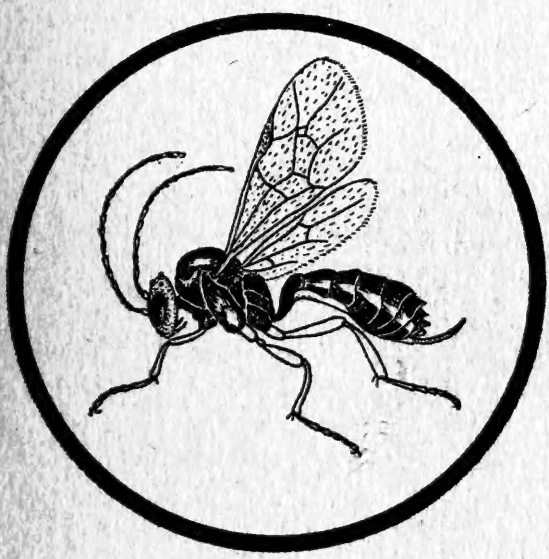
ANNUAL REPORT
1965-1966

MUSEUM OF COMPARATIVE ZOOLOGY



HARVARD UNIVERSITY

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MUSEUM OF COMPARATIVE ZOOLOGY

Campoplex, a parasitic ichneumon wasp

HARVARD UNIVERSITY
CAMBRIDGE, MASS.
1967

MUSEUM OF COMPARATIVE ZOOLOGY

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MUSEUM OF COMPARATIVE ZOOLOGY

REPORT OF THE DIRECTOR

The image of a natural history museum as a warehouse of dead and preserved specimens has been obsolete for generations. Considering the activities of a modern museum, only a totally uninformed person can still hold on to this image. The museum naturalist of today studies the diversity of living nature in all of its aspects. His concern with the understanding of organisms and their environment becomes more important every day as all of us are increasingly concerned with man's environment. Virtually every staff member at the MCZ devotes part of his time to the study of the living animal, be it in the field or in the laboratory. Yet, up to the present, the Museum has been poorly equipped for such studies. It has been our endeavor to acquire new facilities and it gives me great pleasure to report here on recent progress.

Our efforts to acquire for the Museum (and Harvard's entire biological community) a field station within easy driving distance from Cambridge are nearing fulfillment. An almost ideal tract of land, the Estabrook Woods, has been located in Concord, and we now have an option on some 700 acres. The area is only thirty-five minutes by car from the Museum, and there is every reason to expect that the Concord Field Station will become a reality before the end of 1966. Owing to the generosity of the Edward Pickman family, we are also acquiring an abandoned Nike site and attached acreage close to (but not immediately adjacent to) the Estabrook Woods. The Nike site will be converted into the headquarters building for the Station. All of this is being made possible through a concerted fund-raising effort.

The most recent part of the MCZ building is seventy-seven years old, and has become totally inadequate for the tasks of the Museum, both as to space and facilities. Application for a subsidy toward a new wing has been made to the National Science Foundation and funds are also being sought in the Harvard Program for Science. This new facility will provide laboratory space, a headquarters for oceanographic research, for behavior analysis and for comparative studies with living animals, as well as much needed graduate student quarters. The new wing when completed will increase the existing floor area of the Museum by one third.

STAFF

We note here the retirement of Professor Alfred S. Romer after thirty-two years of active association with the Museum where he served in the capacities of Director, Curator of Vertebrate Paleontology, Alexander Agassiz Professor of Vertebrate Paleontology, and Member of the Museum Faculty. Dr. Romer is now vigorously pursuing his research without administrative worries, and we enviously wish him a long and continuously productive life.

Professor Whittington's resignation this summer to assume the post of Woodwardian Professor of Geology at the University of Cambridge was regretfully accepted. In the nearly twenty years that he has been associated with this Museum, he has greatly added to its distinction.

Staff appointments during this year include: Leif Stormer, Visiting Alexander Agassiz Lecturer in Paleontology; Kenton Stuart Wall Campbell, Research Fellow in Invertebrate Paleontology; Eviatar Nevo, Research Fellow in Biology; and Tomislav Munetic, Librarian. Mr. Munetic was appointed to fill the vacancy created by the resignation of Mrs. Jessie Bell MacDonald.

Of awards and honors received by staff members, the following may be singled out for special mention: Professor Simpson received one of the eleven National Medals of

Science for 1965, and the degree of *Doctor honoris causa* from the University of Paris, France. Professor Mayr was awarded the American Ornithologists Union's Brewster Gold Medal.

Staff members continue to be active in many national and international organizations. Some new responsibilities include: Professor Mayr—Chairman, National Science Foundation Advisory Committee on Bio-Medical Sciences, and Chairman, International Biological Program Sub-committee on Systematics and Biogeography; Dr. Mead—Trustee, George Vanderbilt Foundation; Dr. Paynter—Editor, Nuttall Ornithological Club publications. Staff members gave a total of more than forty lectures in the United States, Canada, and Europe.

TEACHING

In other years, we have elaborated on the increasing involvement of the Museum in teaching. This increase has necessitated (where possible) improvements in our facilities, both for student housing and for classrooms. Within our limited space, improvements have been and are being made. We are grateful to the Freshman Seminar Program and to the Office of the Dean of the Faculty of Arts and Sciences for help in underwriting some of the expense.

Almost all staff members either offered or participated in undergraduate and graduate courses. These included:

Freshman Seminar Program (Fell, Turner, Paynter), *Introduction to Research in Biology for Undergraduates* (Fell, Paynter), *Aspects of the Natural Environment* (Kummel), *Introduction to Invertebrate Paleontology* (Whittington), *General Survey of the Invertebrates* (Fell), *Biology of Insects* (Carpenter), *Biology of Vertebrate Animals* (Lyman, Patterson, Mead, Paynter, Williams), *Biology of Amphibians and Reptiles* (Williams), *Stratigraphy* (Whittington), *Stratigraphy and Sedimentation* (Kummel), *Biology for High School Teachers* (Levi), *Methods and Principles of Syste-*

matic Biology (Mayr, J. Lawrence), and *Invertebrate Paleontology* (Kummel).

Graduate research courses were offered by Carpenter, Clench, Darlington, Evans, Fell, Kummel, B. Lawrence, Levi, Lyman, Mayr, Mead, Patterson, Paynter, Romer, Simpson, Turner, Whittington, and Williams.

Hans Reichardt, doing his basic research in the Museum, was awarded the Ph.D. degree. His thesis was entitled, "*A Monographic Revision of the American Planetini* (*Coleoptera, Carabidae*)."

In Dr. Fell's courses in marine biology, numerous opportunities occurred for students to participate in trawling from the vessel *Salvatore,* and thus to gain some practical experience in off-shore collecting methods. About 40 stations were worked in the Boston Harbor region, and several excursions by bus were made to coastal localities in New Hampshire and the Cape Cod area. Students from the mollusk and fish departments joined in these activities, as did a number of students from the Biological Laboratories.

EXPEDITIONS AND TRAVEL

Field research again took students and staff to all corners of the world. Professor Patterson, spending his third summer in East Africa, encountered a wholly new early Pleistocene formation in the vicinity of Kanapoi. The work of his expedition was concentrated in this area with excellent results. A large vertebrate fauna of pre-Olduvai age was collected. An outstanding find was a portion of the humerus (or upper-arm bone) of a hominid. The fossiliferous formation is capped by a basaltic lava. Subsequent to the expedition's return a potassium/argon date of 2.5 plus or minus 0.2 million years has been attained.

Dr. Evans was in Mexico for several months collecting wasps of the family Bethylidae.

Cruise XIII of the *Anton Bruun,* sponsored by the National

Science Foundation, with Dr. Mead as Chief Scientist, was a great success. The Humboldt Current was transected at the latitude of Valparaiso, Chile, and research on the collected material is actively in progress.

Professor Whittington collected from Ordovician rocks along the west coast of Newfoundland, from Port au Port to Cape Anthony. This was his first visit to the northern peninsula and excellent collections were obtained from several localities.

A number of other successful collecting expeditions were undertaken by students and staff to such places as Australia, Argentina, Curacao, Ecuador, New Guinea, Costa Rica, Lesser Antilles, Haiti, Puerto Rico, Turkana Desert in Kenya, and to almost all sections of the United States.

RESEARCH

Many many years ago a lay person was able to follow and understand almost any kind of biological research. This is no longer the case. Most modern investigations deal with very technical questions which are of interest only to a limited group of specialists, even though their solutions often add to our basic fund of knowledge and to our understanding. In this report on staff and student research special attention has been given to results that are of broad interest, but mention is also made of more specialized findings for the friends and colleagues of our staff members who are always interested in these progress reports.

The breadth of research in modern museums always astonishes the non-specialist. Even though straight descriptive taxonomy is still one of the tasks of the modern museum worker, it has more and more become a means to an end. Ever new problems of biology emerge that can not be solved until a sound classification is established. Indeed many of these problems would not even be apparent except for the work of the taxonomist. His diversified interests in behavior, ecology, zoogeography, and evolution not only enrich tax-

onomy itself, but add greatly to the breadth of biology as a whole. The leading museums play a role in this area of which they have every right to be proud.

Taxonomy

Last year's report attempted a survey of the enormous task of the taxonomist and of the strategy he has to adopt in order to perform most efficiently. This year's report will be devoted to actual advances on the research front.

Dr. Clench completed a review of the family Viviparidae for the Treatise on Invertebrate Paleontology and (with Samuel L. H. Fuller) a monographic revision of the genus *Viviparus* in North America. He is undertaking a major series of revisions of Cuban land snails, of which the first installment, a study of the genus *Spiroceramus* in the Urocoptidae, has been completed.

Dr. Darlington continued his work with the New Guinea ground beetles (Carabidae). He completed about six hundred pages of manuscript during the year, getting now very near the end of the descriptive part of the job. There have been many collecting parties in New Guinea in recent years mainly from the Bishop Museum in Honolulu, and the amount of new material received is enormous. "Of the commoner and more obvious Carabidae of New Guinea I now often have to handle two or three hundred specimens of each species, and the labor of sorting, examining, and reporting on all this material is tremendous," says Dr. Darlington. Of the genus *Demetrida*, he was able to study a total of almost 900 specimens from New Guinea, representing what seem to be 57 species, all of them new. For an evolutionist, this is one of the most exciting genera because it is in the midst of an evolutionary explosion, but many other genera of New Guinean Carabidae are almost equally interesting.

Dr. Evans made a most exciting discovery among Peruvian wasps sent to him by E. S. Ross of the California Academy of Sciences. Two wingless female specimens represent the first

known females of the family Plumariidae. This family has long been known from males only (two genera and numerous species, from South America and South Africa) and is of doubtful taxonomic position. The structure of the females suggests that the plumariid group is in many ways intermediate between the superfamilies Bethyloidea and Scolioidea.

The fungus beetles continue to receive the close attention of Dr. John Lawrence. A study of type specimens preserved in various European museums, particularly in London and Paris, has clarified numerous problems, not only of the identity of species, but of generic arrangement. The classification of the genera of Ciidae must be revised completely. For instance, the genus *Ceracis* must be used in an entirely new sense, as shown by the fact that of the forty species to be included in the genus, twenty-one were formerly placed in six different genera (*Cis, Ennearthron, Octotemnus, Xestocis, Xylographus,* and *Scolytocis*). Some of the genera of ciids had been established on the basis of the number of antennal segments. Dr. Lawrence's studies have shown that a reduction in the number of antennal segments from ten to eight has occurred independently in a number of different phyletic lines. A revision of the North American species of *Ceracis,* which he has just completed, includes a key to the species occurring in the United States and Canada, an account of the geographical and ecological distribution of each species, and descriptions of four new taxa. One of the previously recognized species has been shown to consist of two sibling species which prefer different host fungi.

Dr. Lawrence also completed a study of the type specimens and generic concepts in the leaf beetles of the Diabroticites group. This meant an examination of over 900 nominal species, of which he examined at least 95 percent, and permitted not only the working out of synonymies but also the placing of the species in species-groups and genera. A sound basis has thus been established for all future studies of this difficult beetle group.

A careful study of the beetle *Sphindocis denticollis* Fall, particularly of wing venation, larval structure, and genitalia, has revealed that it does not belong to the family Ciidae, to which it has been assigned in the past, nor does it agree with any other currently recognized family. It may be necessary to erect a separate family for this aberrant species which occurs only along the narrow coastal strip of central and northern California where it is associated with a fungus growing on the branches of the Madrono. Perhaps it represents another of the many relict groups occurring in this area. Dr. Lawrence is continuing his study of the ptinid beetles which live with ants, especially the Australian species. He had an opportunity to examine the types of most of the species. The final report will contain a general discussion of the origin of myrmecophily in the Ptinidae, a revision of the genera in the subfamily Ectrephinae, and a key to the Australian species.

Dr. Levi had the satisfaction of completing this year his series of revisions of the comb-footed spiders (Theridiidae). In the course of these studies he worked out the diagnostic characters of 800 species from all parts of the Americas, about half of which were new. No less than 200 species occur north of Mexico and of these 22 percent were new. Yet, much still remains to be done. For instance, the question of the number of species among the poisonous black widow spiders is still unsolved. There are four sympatric species in Argentina, others in the Amazon Basin, and still others at the southernmost tip of the continent. Three sympatric species from Israel differ from each other only minutely in morphology but are well characterized by habits and coloration. Even though these three species are conspicuous and poisonous, they are curiously not mentioned in the Bible, which is otherwise so rich a source of natural history observations from the Holy Land.

A number of taxonomic revisions by staff and graduate students are in progress in the Fish Department. Dr. Mead is working on pelagic Bramidae, Mrs. Dick on South American

Potamotrygonidae (with Dr. Mariano Castex), Dr. Henry B. Bigelow and William C. Schroeder on skates and rays, Mr. Musick on hakes of the genus *Urophycis,* Mr. Nafpaktitis on lantern fishes (*Diaphus*), Mr. McDowall on the New Zealand members of the salmonoid family Galaxiidae, Mr. Menezes on South American characinids and Mr. Graae on some deep sea fishes.

Mrs. Barbara Schevill (with Dr. W. H. Bossert) undertook a multiple character analysis of the skulls of coyotes, wolves, and dogs. A linear discrimination analysis provided a basis for the identification of skulls not obviously distinguishable by size or other diagnostic characters. A first result of this analysis was to show that the original red wolf population of the southern states is only subspecifically distinct from *Canis lupus* of adjacent areas.

Dr. Turner has continued work on a catalogue of the Pholadidae, an important family of rock-borers. An interesting deep sea species of *Xylophaga* was discovered, and work is in progress to shed light on its life history. She is also engaged in writing (with Dr. Kumpol Isarankura) a monograph of the Tonnidae of the Indo-Pacific, a family of large marine gastropods. They are reputed to have long-lived pelagic larvae; this is reflected in the very extensive ranges of most of the species. Why a few species have very restricted ranges is still an unsolved problem. Morphological material is now being collected to permit a study of the internal anatomy.

Morphology and Cytology

The shell of mollusks, used as the principal basis for their classification, offers relatively few distinguishing characters. Now, however, a study of the internal organs is adding a great deal to our understanding of the relationships among the mollusks, and their classification. Dr. Turner is continuing such investigations. She completed (with Dr. Clench) a revision of the genus *Latitia* of the New Guinea Papuininae.

Extensive work is now under way to provide a sounder basis for the classification of the Pholadidae and, indeed, in collaboration with other malacologists, of the classification of the entire phylum Mollusca. Vida Kenk continued her dissections of mytilid mussels and found that the species of the genus *Brachidontes* can be arranged in a number of well-defined species-groups. A study of the anatomy also showed that some of the species have to be transferred to other genera. The more precise delimitation of species-groups permits the use of these bivalves for zoogeographic studies.

W. E. Schevill completed dissection of the head of a sperm whale. An understanding of the anatomy of these whales is important in connection with the study of the reception of underwater sounds.

Dr. Ellis G. MacLeod completed the first part of a study on the cytotaxonomy of the Chrysopidae (Neuroptera). Dr. Guy Bush continued his studies on the chromosomes of tephritid flies. The chromosomes are a character complex which often give revealing information on the relationship of species and on evolutionary pathways, when the evidence from external morphology is insufficient.

Faunistics and Stratigraphy

Although collections from well-defined areas continue to reach the Museum, often as the result of field trips and expeditions organized by the Museum, such materials are normally distributed in the research collections and studied carefully only when a taxonomic revision is undertaken. This approach is, on the whole, far more economical than the complete working out of each assemblage as received. However, quite frequently exceptions are made when collections are received from previously unexplored areas or from particularly exciting localities. Such faunistic reports are sometimes of great importance for subsequent zoogeographic studies and in the case of fossil material the careful analysis of a localized fauna is often very important to facilitate the

dating of the deposit and to establish its relation to other deposits. Faunistic-stratigraphic studies remain an important component of paleontological research.

Dr. Carpenter completed that part of his series on the Permian insects of Oklahoma dealing with the mayflies (Ephemeroptera). One of the interesting aspects of these Oklahoma insects (Mideo beds) is their approximate coexistence with those from Kansas beds (Elmo), also studied by Dr. Carpenter, although the environmental conditions at the two localities were apparently very different. Of particular interest is the presence in the Mideo beds of hundreds of specimens of nymphs, representing diverse stages of development in the life history of these mayflies. Dr. Carpenter also continued his studies of the Carboniferous insects of Commentry, concentrating on the Protorthoptera and Orthoptera.

Dr. Kummel continued his intensive analysis of the world fauna of ammonoids of a single short period in the early Triassic, approximately 225 million years ago. He found that the distributional data indicate that climatic conditions were equitable over a large part of the world and that within the Tethyan belt (roughly comparable to the Alpine-Zagros-Elburz-Himalayan mountain systems) western and eastern Pacific regions had very similar ammonoid populations. The faunas of the circum-Arctic regions are smaller than those of the lower latitudes and contain relatively few endemic genera and species. Dispersal must have been easy at that period and climatic conditions very similar in vast areas of the globe because species that are dominant in the fossil faunas of one locality are found to be equally dominant in the faunas of localities as much as 6,000 miles away. These new methods of research are beginning to give us a much clearer picture of the geographical and ecological situation at this long past geological period than the earlier methods of presenting data.

Dr. Whittington (with Dr. Campbell) completed a report

on Silurian trilobites from Maine. This collection is especially noteworthy because it contains some of the best preserved Silurian trilobites ever found, with a greater number and variety of growth stages of the various species than found in any previously known deposit. The new morphological information which this fauna supplied helped to clarify certain aspects of the phylogeny of Silurian groups. A study of the stratigraphy of western Newfoundland (with Cecil H. Kindle), based on the field work of the preceding summer, permitted Dr. Whittington to show that rocks previously thought to be Ordovician contain a Middle Cambrian fauna of a type not previously known from this region. Allen R. Ormiston finished a study of Devonian trilobites from Arctic Canada, and Frederick C. Shaw worked on the Middle Ordovician trilobites of the Chazy region, New York State. Dr. K. S. W. Campbell of the Australian National University, who was a guest in the Museum from May to December 1965, not only participated in the work on the Maine trilobites, but also completed a monograph on Silurian trilobites from Oklahoma. The additional presence of Professor Stormer in the department gave an unparalleled opportunity for stimulating discussions on trilobite morphology, classification, and phylogeny. Dr. Stormer undertook studies on Ordovician trilobites, particularly the relationship of Norwegian species with those from other parts of the world.

Dr. Clench completed several faunistic studies based on collections made by the Noona Dan expedition of the University Museum of Copenhagen. A collection of mollusks from Rennell Island and another one from Savo, both in the Solomon Islands, were particularly interesting.

Dr. Evans reviewed the bethyloid wasps of Dominica (Lesser Antilles). This small island with its otherwise limited fauna has no less than 19 known species of Bethylidae. A few of these wasps are widely distributed in the neotropics but the majority of species found in inland forests appear to be confined to Dominica or to the Lesser Antilles. This work is

part of the biological survey of Dominica currently undertaken by the Smithsonian Institution.

Dr. Dearborn continued work on Antarctic invertebrates, particularly crinoids; he also investigated some ophiuroid faunas, including one from the Chilean seas. Dr. J. Lawrence completed a report on the ciid fauna of California and advanced his research on the Ciidae of Micronesia. This necessitated examination of a large amount of Indo-Pacific material in European museums. As would be expected, most of the Micronesian species have been derived from the faunas of the Philippines, New Guinea, and the East Indies.

Dr. Simpson completed his revision of the very large mammalian faunas of the three earliest stages (Riochican, Casamayoran, and Mustersan) of the age of mammals (Cenozoic) in South America. Fossils of the latter two of these stages were discovered in Patagonia by Carlos Ameghino and described by his brother Florentino Ameghino in the years 1897 to 1904. The controversial interpretations of the stratigraphy, and of the classification and phylogeny of the mammals offered by the Ameghinos, were widely challenged, but until 1930 no one did anything about them except offer destructive criticism. The questions involved are of utmost importance not only for understanding the geology and paleontology of South America, but also for their crucial bearing on the principles of evolution, systematics, and zoogeography.

In 1930, Dr. Simpson determined to attack these problems, covering the entire range from field observations up to the broadest theoretical implications. Two summers, 1930-31 and 1933-34 were spent in Patagonia under quite primitive and rigorous conditions, making stratigraphic observations and large fossil collections. The winter months of these years were employed in studying the Ameghino and related collections in Buenos Aires and La Plata museums. In 1954-55 further study was made in Buenos Aires and also in Rio de Janeiro of the then recently discovered related Brazilian

fossils. From 1931 onward, many papers have been published on all aspects of this long-range project, from preliminary descriptions of new species to a general treatment of the historical zoogeography of South America. A first part, less than half, of the detailed faunal revision appeared in 1948. The large manuscript sent to the editor in May, 1966, completed that revision and with it the project planned in 1930.

Zoogeography

The history of distribution patterns has intrigued zoologists since long before the days of Darwin. Why do the faunas of certain areas have the particular composition which they have, how are highly isolated areas colonized, what is the relative contribution of ecological and historical factors in determining distribution patterns—these are some of the questions the student of zoogeography has to ask himself.

In his studies of the New Guinea Carabidae, Dr. Darlington added two more cases to the one previously known of mainly Australian genera that have closely related species on high mountains in New Guinea and the Indonesian archipelago. He found the first clear case of "mountain hopping" in the genus *Chydaeus* that has used a series of mountains as stepping stones to get from Asia across the Malay Archipelago to New Guinea. The endemic New Guinea species which occurs above timber line in the Bismarck and Snow Mountains is still rather similar to species in the Himalayas and on mountains in Sumatra, Java, and the Philippines.

Dr. Mayr (with William H. Phelps, Jr.) completed a zoogeographic analysis of the birds found on the isolated tabletop mountains of southern Venezuela. Ninety-six species can be considered typical subtropical elements, twenty-nine of which are endemic. The ninety-six typical species of this upland area represent every stage of endemicity—from endemic genera and species (29) to nonendemic species with endemic subspecies (55), and species without endemic subspecies (12). The fauna is composed primarily of two elements,

altitudinal derivatives of otherwise tropical species (34), and species that reach these mountains by long distance dispersal across the unsuitable tropical lowlands (48). The small number of old endemics indicates that there must be a rapid turnover in the bird fauna of these mountains which must have been in existence for some 30 million years.

Dr. Williams has advanced his taxonomic analysis of the lizard *Anolis* to the point where much of the faunal and evolutionary history of the genus can be reconstructed. The numerous attempts to colonize the Caribbean Islands have had varying success, depending on the ecology of the islands and competitive interactions. His tentative conclusions are: (1) Species that are successful colonizers of distant islands are a specialized group, able to endure the physiological hazards of trans-oceanic rafting. Colonizers are thus physiologically more similar to each other than they are to non-colonizers, they are more likely to be ecologically equivalent, and there is thus a greater probability than on the mainland that a first comer will exclude a later arrival. The composition of the fauna of small islands is thus to some extent a result of the historical accident of the time of arrival. The earliest colonists will pre-empt the previously empty niches and prevent colonization by close relatives or ecologically equivalent colonizers. (2) Extinction is one of the processes which provide empty niches for later colonists. The precise nature of empty niches is not rigidly determined; rather, there is an ecological space which may be subdivided in various ways depending on the historical accident of the sequence of arrivals.

An analysis by Basil Nafpaktitis of the distribution pattern among Atlantic species of the lantern fish *Diaphus* revealed two interesting findings. First, in certain species, in addition to the normal breeding range there is an area where "expatriates" occur; that is, individuals are swept by ocean currents into waters where they can live but not reproduce. Secondly, he found that the distribution pattern in some of

the species could not be explained by the widely held picture of the Gulf Stream and a single clockwise gyre, but it conforms readily to the two-gyre system recently proposed by L. V. Worthington of the Woods Hole Oceanographic Institution.

Several members of the staff have again been very active in reconstructing paleogeographic distribution patterns. The old questions concerning a possible shift of the poles and a drift of the continents are still unsettled and continue to challenge the ingenuity of paleogeographers. Dr. Fell has continued to explore the possibility of using marine invertebrates to discover the pattern of former ocean currents. Study of marine faunas discloses that Africa had already an intimate faunal relationship with Europe in the earliest Paleozoic, and that South America and Australia had dissimilar faunas in the Cambrian-Ordovician, showing no significant relationship to those of Africa. These findings are in conflict with the Gondwanaland hypothesis which postulates a union of the southern continents prior to the mid-Paleozoic. The early Paleozoic faunal affinities of the southern continents prove to be amazingly similar to the present ones, Australia sharing 75 percent of its genera with Eurasia, while South America shows a corresponding relationship to North America. When pelagic forms are analyzed, it is found that they have a different distribution pattern, each southern continent having an affinity with that northern continent lying to the northeast. This pattern can be explained if one postulates the presence at that period of oceanic gyres, inclined at 70° to the present east-west direction. Further investigation disclosed world-girdling arcs of genera forming parallels to a great circle inclined at 70° to the equator, and intersecting it west of Ecuador and south of India. Dr. Fell interprets this to be a former equator and was able by an analogous procedure to locate the equator at other geological periods.

Dr. Fell also investigated growth gradient patterns in Paleozoic and Recent corals and mollusks, and in the Cam-

bro-Ordovician conularians. These have led to a method of determining astronomical data for past periods, using the growth-lines, as first suggested by J. Wells and by Scrutton, but free from dependence upon extrapolation of Recent eclipse data, as hitherto has been necessary. It appears that marine invertebrates must employ an intercalary month system of co-ordinating the solar year with the lunations, when the latter are not integral divisors of the tropical year. This system matches in a remarkable manner that used by the ancient Greeks, a thirteenth month occurring in every third year. By following diurnal rhythms of growth for sequences up to 1200 days he finds a consistent pattern of recurring integrals in former periods, establishing the length of the synodic month (and hence of the sidereal month) for past times. Using these, he investigated the varying distance of the moon from the earth, and the varying force of the lunar tide in past epochs. These results bring many new perspectives into the subject of biological oceanography; it is clear that a first assessment of the data at hand leads to the adoption of a steady state theory of the oceans and continents. A method of triangulating the planet is emerging, enabling distances along specified intercontinental arcs to be calculated, with a measurable probable error dependent upon the length of each generic arc. The results confirm the belief that Gondwanaland cannot have existed, and that all the continents have not moved more than some hundreds of kilometers from their Cambrian positions, i.e., no further than would result from normal movement along transcurrent faults and fracture zones.

Dr. Whittington analyzed the distribution of the Ordovician trilobites and found that there were two major regions at that period, each region having its characteristic fauna. Evolution appears to have proceeded independently in these regions until late Ordovician when there was a mingling of the faunas and a wide dispersal of some of the genera. As an illustration, it might be mentioned that in the earlier Ordovi-

cian (Caradoc) the trilobite fauna of North Wales showed relationship to the Baltic area but not to Scotland.

Ecology

The host specificity of fungus-feeding beetles is being studied by Dr. J. Lawrence. Many of the species of Ciidae have narrow host ranges, preferring a single species of fungus, and occurring less commonly on several others which are similar in color or structure. The fungi seem to fall into a number of distinct groups on the basis of the host preference of insects. For instance, *Polyporus gilvus* and other fungi with brownish fruiting bodies contain a distinct beetle fauna that is not found in fungi of a different color. Other host preference groups appear to be characterized by a particular type of hyphal system. This suggests that pigmentation (biochemical composition) as well as microstructure (toughness and durability) determine feeding preferences. A study (with J. Powell) of the feeding habits of fungus moths in the families Oecophoridae and Tineidae was completed.

In his field work in South America, Dr. Levi made a special effort to accumulate natural history observations that would provide solutions to mysteries concerning older collections. Many species, for instance, had originally been described as green, a rather unusual coloring for spiders, and evanescent in preserved material. He found they are indeed green in life, and color photographs taken in the field have made it possible to establish the identity of many of the older descriptions that were unidentifiable from preserved material. Dr. Turner conducted studies on spawning, larval development, and settlement of wood-boring mollusks, in collaboration with A. C. Johnson of the Clapp Laboratories. It was possible to carry three successful spawnings of *Martesia* through to the settlement stage and to record this in excellent photographs. This has permitted the description of the various embryological stages that had been previously unknown in this group.

Physiology and Biochemistry

Dr. Lyman continued a study of the increased sensitivity of muscles to acetylcholine in hibernating mammals. Cell replacement during hibernation was studied with Dr. S. J. Adelstein. Dr. Lyman secured some hamsters from Turkey which, unlike the Syrian hamster now kept in laboratories, hibernate immediately when exposed to the cold in the fall. Syrian hamsters do not start hibernating until about 54 days after exposure to cold. It is possible that the Turkish hamster is a different species but it is also possible that the ability to hibernate has been selected against, in the Syrian hamsters, since it was introduced into the laboratories in 1932.

Dr. C. R. Taylor, working at the East African Veterinary Research Organization, supported by an NIH grant to the MCZ, is continuing his studies of temperature regulation and water metabolism in African ungulates. The wild eland antelope can live for long periods without water by such physiological tricks as allowing its body temperature to drop at night and become overheated during the day, thus reducing the need for evaporative cooling. These wild ungulates are far better adapted for the East African climate than the introduced European cattle. This work is significant not only for its purely scientific interest, but also because of the importance of wild ungulates as a source of meat for the increasing African population.

George C. Gorman has been studying biochemical characters in West Indian *Anolis*. Different biochemical parameters in the *roquet* group of *Anolis* help to define different levels of taxonomic differentiation from the subspecies to the species group.

In his studies of the chromosomes of West Indian *Anolis*, Mr. Gorman finds both striking agreement with current taxonomic grouping as well as interesting and puzzling discrepancies. He discovered that the *Anolis bimaculatus* group is characterized by chromosomal heteromorphism in males.

Examination of various other iguanids, either closely or distantly related to *Anolis*, shows that most have a set of metacentric macrochromosomes (usually 12) and microchromosomes as do representatives of several diverse lizard families. However, *Polychrus,* a presumed representative of the ancestral stock from which *Anolis* descended, has only acrocentric macrochromosomes. These very interesting studies are being continued.

Dr. Ellis G. MacLeod began an experimental study of the environmental control of the facultative diapause in various chrysopid Neuroptera. It was found that the larval photoperiod determines the presence or absence of diapause in a given group, but that the actual stage in the life cycle at which the diapause intervenes varies from taxon to taxon thus supplying a new set of taxonomic characters for use in classification. So far, species have been found to diapause as mature larvae, pharate pupae, and adults.

Behavior

Dr. Levi and students have been filming and analyzing various behavior sequences in spiders, such as burrowing, courtship displays, and web building. A comparative study of behavior is proving taxonomically very valuable in several families of spiders. Differences in web construction and use of silk seem amenable to analysis, and promise to offer clues on the evolution of this complex and highly developed skill. A crew of nearly 100 spiders, representing three families, are busily at work weaving in his laboratory, unaware that their activities are being recorded and the results fed into a computer.

The colony of South American brown recluse spiders (*Loxosceles*) that once flourished in the basement of the Museum seems to have become extinct. Some individuals, however, were used to establish a captive colony, the study of which is providing life history information that is of con-

Giles W. Mead, Curator of Fishes, with a catch of deep-sea animals aboard the NSF research vessel *Anton Bruun*. Dr. Mead and several students and associates studied the fauna of the Humboldt Current off central Chile during the past year.

Professor Simpson receiving The National Medal of Science from President Johnson.

siderable value because of the potential health hazard presented by this poisonous species.

Lee Miller, working with Dr. Carpenter, has been studying the morphology and functional aspects of a sensory receptor on the forewings of Chrysopidae. He believes that this structure is a tympanal organ which is sensitive to ultra sound, and that members of the Chrysopidae, like certain Lepidoptera, are able to perceive the sounds produced by echo locating bats and then utilize this information to reduce their vulnerability to predation from this source.

John A. Musick (with Dr. Mead) has given special attention to the unique inquiline relationship of the juvenile hake (*Urophycis chuss*) to the sea scallop (*Placopecten magellanicus*). Behavioral observations on young hake actually living within the scallop shell have not heretofore been made, and there are indications that this association is an indispensable stage in the early life history of this fish. W. E. Schevill has gathered considerable material on the sounds of marine mammals, particularly walrus and killer whales.

Evolution

Almost all the research carried out in the Museum has an evolutionary aspect. This is as true for the purely taxonomic research as for that dealing with biogeography, behavior or ecology. Much of the work cited above could have been listed equally well under the heading evolution. Dr. John Lawrence established the first known case of parthenogenesis in the cucujoid beetles (in *Cis fuscipes* Mellié). The evolution of female-producing parthenogenesis (thelytoky) has enabled this species to spread rapidly throughout North America and to colonize successfully several distant islands (Cuba, Madeira, and Hawaii).

Mrs. Barbara Schevill has continued her studies on domestication. Among animal bones recovered by Dr. Sadek-Kooros from an Indian hunting camp (proven to have been in opera-

tion about 12,000 years ago) she found unmistakable evidence of the domestic dog. This is the oldest dated discovery of a domestic animal, and confirms the long held supposition that dogs are in fact the oldest domestic animals. A comparative study of the postcranial skeletons of Recent wild sheep and goats from the Near East has resulted in the discovery that the commonly used characters of the foot bones are not the only ones distinguishing the two species. Diagnostic features are also found on some parts of the long bones as well as on the scapula and the ilium. This is of great interest to the archeologist who studies the culture of human populations in transition from hunting to agriculture.

Dr. Mayr continued his comparative studies on the effect of population structure on the rates of evolution and speciation. His most recent studies indicate that under optimal conditions species status may be reached by a small isolated population at least one thousand times as fast as by a very large gene pool. However, the chance of extinction is inversely correlated with population size in the isolates. The number of facts relevant to such calculations is extremely limited but those that are available are consistent with the stated generalizations. Far more data are needed before the stated hypothesis can be considered as fully substantiated.

Dr. Mayr continued his studies in the theory and philosophy of biology. In a work now in press, he shows that it is inappropriate to apply to biological phenomena (as for instance the biological species) definitions that had been developed for inanimate objects. Most publications issued under the name of philosophy of science are actually philosophies of physics, and omit treatment of the very phenomena and problems which distinguish the organic world from the purely physical world. For instance, there is nothing in the physical world that corresponds to the historical information contained in the genetic program of organisms. There are no systems in the physical world that are anywhere near as complex as organisms. Philosophers of biology are

now making an effort to work out general principles that avoid the pitfalls of the vitalistic and dualistic philosophies of the past. The role of uniqueness, the non-predictive nature of causality, and the programmed purposiveness of organic development and behavior are aspects of life that will provide key issues for a philosophy of life. The replacement of essentialism by the population approach and the selective advantages of ethical behavior in social animals are additional aspects that must find their proper place in a philosophy of biology. Dr. Simpson has actively published in the same area, and he and Dr. Mayr are preparing plans for a conference dealing with these issues.

Dr. Simpson revised his book, *The Meaning of Evolution* (first edition 1949), and wrote a number of essays on varied aspects of evolutionary biology, such as the biological nature of man, zoogeography of the Pacific lands, language, race, and naturalistic ethics. He is becoming increasingly interested in deriving, from the factual data and established principles of evolution, philosophical conclusions and implications for the human condition.

PUBLICATIONS

Publications of finished research includes some 103 titles and 2,342 pages.

Museum publications totalled 1,111 pages and included the "Bulletin" (Volume 133, Nos. 4-11; Volume 134, Nos. 4-9), 23 numbers of "Breviora," 5 MCZ sponsored papers in *Psyche*, and a special publication: *A Survey and Illustrated Catalogue of the Teredinidae* by Ruth D. Turner.

Details of all publications are recorded in the appended bibliography.

COLLECTIONS

An important accession to the fish collection is a 46-inch coelacanth, *Latimeria chalumnae*. Coelacanths were thought

to have been extinct for over 60 million years, but in 1939 were discovered alive in the waters around the Comoro Islands near Madagascar. Professor Henry B. Bigelow's generosity has made possible this valuable acquisition.

The slow process continues of rendering the insect collection safer from museum pests, and more useful to specialists, by transferring specimens to unit trays, and drawers to steel cabinets. Two major projects of the year were as follows:

The collection of European insects, brought together by Hagen and others many years ago and housed in very old, deteriorating drawers and cabinets, has been completely transferred to unit trays and new drawers and cabinets, and each order has been filed in its proper systematic position, i.e., with other material of that order. This material is valuable, despite its age and (in some cases) lack of data, since it includes representatives of the type species of many genera.

A complete reorganization of the Neuroptera, in the old, broad sense, was undertaken (with the help of Dr. and Mrs. Ellis MacLeod). Formerly the termites, bark lice, stone flies, caddis flies, etc., were all filed together under one heading, arranged geographically, and it was exceedingly frustrating to locate anything at all. Now all have been sorted to order and family in the modern classification. Our collections in these "neuropteroid" orders are large and valuable and contain many types of Banks, Hagen, Carpenter, and others.

Preparation of the 1964 African Miocene vertebrate collection from Kenya has been completed. Although badly crushed, it is the most complete material of this age known from Africa.

Preparation has also been completed on one of eight large boxes of fossils collected by Dr. Romer on his expedition to Argentina last year. To date, four new gomphodont cynodonts, two new carnivorous cynodonts, two new thecodonts, and one new dicynodont have been identified.

LIBRARY

The library is expanding into the last possible room available to it, and when renovations are completed, will have considerably more stack area. Modern equipment is being installed, for which we are indebted to the Dean's Office. This will be the most pleasant room in the library.

EXHIBITS AND MUSEUM SHOP

The Museum Shop continues to support our modest program of improving and expanding our educational exhibits. Renovation of the African Room was completed in the late spring and work has begun on a similar refurbishment of the Holarctic Room.

Mrs. Don K. Price has resigned as assistant manager of the Museum Shop. Her enthusiasm and faithful service will be missed.

ACKNOWLEDGMENTS

We extend warm thanks to our many interested friends and associates who have made valuable additions to our collections, have given so generously of their time and have made significant contributions to our resources.

We are particularly indebted to the following:

For valuable additions to our collections:

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ERNST MAYR, *Director*

PUBLICATIONS FOR THE YEAR

1965-1966

BULLETIN

Vol. 133

No. 4. The genera of the Chilocorini (Coleoptera, Coccinellidae). By Edward A. Chapin. 45 pp. 16 figs. 10 September 1965.

No. 5. Comments on some recent changes in the classification of the Ciidae (Coleoptera). By John F. Lawrence. 21 pp. 20 October 1965.

No. 6. The fossil elephant shrews (family Macroscelididae). By Bryan Patterson. 42 pp. 1 pl. 7 figs. 26 November 1965.

No. 7. Panamanian spiders of the genus *Tmarus* (Araneae, Thomisidae). By Arthur M. Chickering. 32 pp. 35 figs. 26 November 1965.

No. 8. The relationships of four small Hispaniolan *Eleutherodactylus* (Leptodactylidae). By Albert Schwartz. 31 pp. 4 figs. 20 January 1966.

No. 9. Two new fishes of the myctophid genus *Diaphus* from the Atlantic Ocean. By Basil Nafpaktitis. 24 pp. 11 figs. 20 January 1966.

No. 10. The *Ameiva* (Lacertilia, Teiidae) of Hispaniola. II. Geographic variation in *Ameiva chrysolaema* Cope. By Albert Schwartz and Ronald F. Klinikowski. 66 pp. 11 figs. 16 March 1966.

No. 11. A new attempt to construct life tables for Kent Island herring gulls. By Raymond A. Paynter, Jr. 40 pp. 3 figs. 18 May 1966.

Vol. 134

No. 4. The species *Bufo granulosus* Spix (Salientia: Bufonidae) and its geographic variation. By José M. Gallardo. 32 pp. 2 figs. 4 maps. 30 September 1965.

No. 5. The mesopelagic fishes collected during Cruise 17 of the R/V Chain, with a method for analyzing faunal transects. By Richard H. Backus, Giles W. Mead, Richard L. Haedrich, and Alfred W. Ebeling. 19 pp. 9 figs. 30 September 1965.

No. 6. New species of *Hemicyclops* (Copepoda, Cyclopoida) from Madagascar. By Arthur G. Humes. 101 pp. 36 pls. 30 November 1965.

No. 7. New oceanic cheilodipterid fishes from the Indian Ocean. By Giles W. Mead and J. E. De Falla. 14 pp. 3 figs. 30 November 1965.

No. 8. Italian wolf spiders of the genus *Pardosa* (Araneae: Lycosidae). By Paolo Tongiorgi. 60 pp. 161 figs. 25 February 1966.

No. 9. Wolf spiders of the *Pardosa monticola* group (Araneae, Lycosidae). By Paolo Tongiorgi. 25 pp. 32 figs. 25 February 1966.

BREVIORA

No. 224. New species of land mollusks with notes on other species from the Solomon Islands. By William J. Clench. 8 pp. 2 pls. 15 July 1965.

No. 225. The Asian species of *Galeritula* Strand (Coleoptera, Carabidae). By Hans Reichardt. 16 pp. 9 figs. 15 July 1965.

No. 226. The larval form of the Heteromi (Pisces). By Giles W. Mead. 5 pp. 1 fig. 15 July 1965.

No. 227. The species of Hispaniolan green anoles (Sauria, Iguanidae). By Ernest E. Williams. 16 pp. 5 figs. 10 September 1965.

No. 228. Relationships among Indo-Australian Zosteropidae (Aves). By Ernst Mayr. 6 pp. 15 September 1965.

No. 229. The genus *Darlingtonia* (Serpentes) in Hispaniola, including a new subspecies from the Dominican Republic. By Albert Schwartz and Richard Thomas. 10 pp. 4 figs. 15 September 1965.

No. 230. Notes on some non-passerine birds from eastern Ecuador. By David W. Norton. 11 pp. 1 fig. 15 September 1965.

No. 231. A new anole (Sauria, Iguanidae) from Puerto Rico. By Ernest E. Williams, Juan A. Rivero and Richard Thomas. 18 pp. 7 figs. 29 October 1965.

No. 232. Hispaniolan giant anoles (Sauria, Iguanidae): new data and a new subspecies. By Ernest E. Williams. 7 pp. 2 figs. 29 October 1965.

No. 233. South American *Anolis* (Sauria, Iguanidae): two new species of the *punctatus* group. By Ernest E. Williams. 15 pp. 3 figs. 29 October 1965.

No. 234. Studies on neotropical Pompilidae (Hymenoptera). I. The genus *Agenioideus* Ashmead in South America. By Howard E. Evans. 7 pp. 4 figs. 29 October 1965.

No. 235. A new salamander of the genus *Chiropterotriton* (Caudata: Plethodontidae) from Mexico. By George B. Rabb. 8 pp. 2 figs. 19 November 1965.

No. 236. Variation in the number of marginal tooth positions in three species of iguanid lizards. By Clayton E. Ray. 15 pp. 5 figs. 10 December 1965.

No. 237. A new species of the ant genus *Dacetinops* from Sarawak. By Robert W. Taylor. 4 pp. 2 figs. 15 December 1965.

No. 238. An evaluation of Jamaican *Dromicus* (Serpentes, Colubridae) with the description of a new species. By Donald W. Buden. 10 pp. 3 figs. 25 February 1966.

No. 239. South American anoles: *Anolis biporcatus* and *Anolis fraseri* (Sauria, Iguanidae) compared. By Ernest E. Williams. 14 pp. 5 figs. 25 February 1966.

No. 240. *Gymnothorax galetae,* a new moray eel from the Atlantic Coast of Panama. By Ira Rubinoff. 4 pp. 1 fig. 25 February 1966.

No. 241. *Avocettinops yanoi,* a new nemichthyid eel from the southern Indian Ocean. By Giles W. Mead and Ira Rubinoff. 6 pp. 1 fig. 25 February 1966.

No. 242. The supposed "sponge spicules" of Merrill, 1895, from the Lower Cretaceous (Albian) of Texas. By William A. S. Sarjeant. 15 pp. 1 pl. 25 February 1966.

No. 243. Quaternary fish fossils from west of Lake Rudolf, Kenya. By Keith Stewart Thomson. 10 pp. 29 April 1966.

No. 244. A new species of *Ashmunella* from west Texas (Mollusca: Pulmonata). By W. J. Clench and W. B. Miller. 6 pp. 3 figs. 29 April 1966.

No. 245. Notes and descriptions of new Urocoptidae from Cuba and Hispaniola (Mollusca: Pulmonata). By William J. Clench. 14 pp. 2 pls. 29 April 1966.

No. 246. *Pseudanthessius procurrens* n. sp., a cyclopoid copepod associated with a cidarid echinoid in Madagascar. By Arthur G. Humes. 14 pp. 29 figs. 3 May 1966.

No. 247. The Chañares (Argentina) Triassic reptile fauna. I. Introduction. By Alfred Sherwood Romer. 14 pp. 3 May 1966.

PSYCHE

VOL. 72

No. 2. New species of Chilocorini (Coleoptera: Coccinellidae). By Edward A. Chapin. Pp. 148-151, 4 figs., June, 1965.

Scolytoidea (Coleoptera) 5: Notes on neotropical Platypodidae, mainly from Central America. By Hans Reichardt. Pp. 159-166, 2 pls., June, 1965.

Picrocryptoides: A new genus of the tribe Mesostenini from southern South America (Hymenoptera, Ichneumonidae). By Charles C. Porter. Pp. 167-174, 1 pl., 1 map, June, 1965.

No. 3. Five new species of the genus *Tmarus* (Araneae, Thomisidae) from the West Indies. By Arthur M. Chickering. Pp. 229-240, figs. 1-15, September, 1965.

No. 4. The types of Proctotrupoidea (Hymenoptera) in the Charles T. Brues collection at the Museum of Comparative Zoology. By Lubomir Masner. Pp. 295-304, December, 1965.

OCCASIONAL PAPERS ON MOLLUSKS

VOL. 2

No. 32. The genus *Viviparus* (Viviparidae) in North America. By W. J. Clench and S. L. H. Fuller. Pp. 385-412, 5 pls., July 9, 1965.

No. 33. Catalogue of the family Pandoridae (Mollusca: Bivalvia). By Kenneth J. Boss. Pp. 413-424, November 8, 1965.

No. 34. Review number and index. By W. J. Clench. Pp. 425-431, November 8, 1965.

Introduction to Volume 2. By W. J. Clench and R. D. Turner. Pp. i-xvi, 3 pls., November 8, 1965.

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